CONTENTS.

PART I.


2 ART. II.—Earthenware of Florida. Collections of Clarence B. Moore. By W. H. Holmes .................................................. 105

PART II.


PART III.


PART IV.

5 ART. V.—Crania from the Mounds of the St. Johns River, Florida: a study made in connection with Crania from other parts of North America. By Harrison Allen, M. D. (Plates XLIX-LXX). .................................................. 367

6 ART. VI.—Certain River Mounds of Duval County, Florida. By Clarence B. Moore .................................................. 448

7 ART. VII.—Two Sand Mounds on Murphy Island, Florida. By Clarence B. Moore .................................................. 503

8 ART. VIII.—Certain Sand Mounds of the Ocklawaha River, Florida. By Clarence B. Moore. (Plates LXXI-LXXXVI and Frontispiece) .................................................. 518

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April 4, 1884.
CERTAIN SAND MOUNDS OF THE ST. JOHN’S RIVER, FLORIDA.

By Clarence B. Moore.

Preface to Part I.

This first part of the report on the sand mounds of the St. John’s River, Florida, consists of scarcely more than an amplification of field notes which have been given with considerable minuteness, since Florida is almost an unknown land to the archaeologist.

Thanks are tendered to Professor Cope, to Professor Holmes, to Andrew E. Douglass, Esq., and to Professor Haynes, for valuable references and information; also to Dr. M. G. Miller for continuous aid in the field and in the preparation of this report.

Philadelphia, July, 1893.

PART I.

The sand mounds of the St. John’s River, Florida, have not until recently met with systematic investigation.

The late Professor Jeffries Wyman, while exploring shell heaps of the river between Palatka and Lake Harney, confined himself, so far as the sand mounds were concerned, to superficial examinations.¹

¹ "Freshwater Shell Mounds of the St. John’s River, Florida." Footnote page 47.
The late Dr. Frederick D. Lente, in the March and April, 1877, issues of the "Semi-Tropical," a magazine published at Jacksonville, Florida, contributed an article entitled "The Mounds of Florida." This paper was subsequently printed in pamphlet form. The author frankly admits that in no case did he succeed in reaching the base of any mound, his explorations being limited to a visit with a party of ladies to the mound on Dunn's Creek, and to excavations in one of the two mounds on Murphy Island. In neither case did his researches take him over ten miles from home.

Beyond the cases cited, virtually no work has heretofore been done upon the sand mounds of the river. In the Annual Report of the Bureau of Ethnology, 1883–84, page xxi, we read that in explorations recently made in Florida on behalf of the Bureau, the results were almost wholly negative, except so far as they tended to show that in Florida the mounds were chiefly domiciliary, and that but few were built for burial purposes. The portions of the state where these researches were made are not specified. It is quite evident, however, that the territory bordering the St. John's was not included.

Occasional tourists have from time to time made superficial examinations, while the native "cracker" skimming the surface, has gathered at times a harvest of beads or intrusive implements of metal.

The sand mounds of the St. John's, then, in respect to original burials, were found by us as left by their dusky builders.

In the present report the mounds south of Palatka alone will be considered.

The sand mounds of the river, while having a general resemblance, vary so in detail that an accurate classification is impossible. Many are crowded with human remains, while in others considerable excavations along the base failed to reveal an indication of use for purposes of sepulture. Numerous mounds are variously stratified with sand of different shades, from the surrounding territory, with shell, with "muck" and with sand mingled with hematite in powder. Others again are composed of one homogeneous material. Some have a sprinkling of shell; in others not a single Ampullaria or Paludina can be found. It is probable that certain mounds were used as look-out stations, and possibly all in later times served for domiciliary purposes. In height and extent also there is a wide divergence. The great mound at Tick Island has an altitude of over 17 feet, while the famous Mt. Royal, with a circumference of 555 feet, is in area approached by no mound on the river. On the other hand, small sand mounds not exceeding three feet in height, are by no means uncommon. Almost without exception the shape is a truncated cone, the summit plateau in some showing an area doubtless more extensive than the original through the effects of the elements.

Even the form of burial varies. Intrusive interments are in anatomical order as are bodies originally buried in certain mounds; while in others, the long bones, denuded of flesh previous to burial, lie in a bundle with the cranial; and again, both forms of interment are met with side by side and evidently contemporary. Still
another form of burial is that of disconnected bones where no effort has been made to keep in association the various portions of the skeleton. The "chieftain" mounds cited by the late Colonel Jones are not met with on the river, nor are bodies ever found in a sitting position.

It is our intention briefly to describe the sand mounds of the St. John's as we have found them, prefacing the account with the assurance that at no time has work been done save in our presence; that all notes were taken on the spot and rewritten while the memory was fresh, and that special care has been exercised at all times carefully to measure depths and to distinguish the intrusive from the original burial. To guard against confusion, all objects were labeled upon discovery, while to various portions of the skeleton tablets of celluloid were attached, with which subsequent treatment with heated glue could not interfere.

In nearly every case, the specimens described or figured are now in the possession of the Academy of Natural Sciences of Philadelphia.

Sand Mounds of the St. John's River, Florida, considered in Part I of this Report.

Dunn's Creek.  
Murphy Island (2).  
Norwalk Landing.  
Mt. Royal (2).  
Hitchen's Creek.  
Blue Creek.  
In Pine Woods near Blue Creek.  
Volusia (5).  
Bluffton (2).  
Opposite Bluffton.  
Tick Island.  
De Leon Springs.  
Thursby Mound.  
Hunton Island (2).

Stark's Grove, Lake Beresford.  
Fort Florida (2).  
Northern end Lake Monroe.  
Ginn's Grove (2).  
Thornhill Lake (2).  
Black Hammock.  
Cook's Ferry.  
Mansfield's.  
Raulerson's.  
Persimmon Mound.  
Indian Fields.  
Long Bluff.  
Mulberry Mound.  
Fort Taylor.

In the accompanying map no attempt is made to represent distances by water. So tortuous is the river that a rough estimate alone as to distance can be made by those following the course of the stream.

Dunn's Creek, Putnam County.

On Dunn's Creek, about three miles from its point of union with the St. John's, some nine miles south of Palatka, on the right hand side going down, is Horse Landing which, however, must not be confounded with a place of the same name on the St. John's River, a few miles further south. Hidden by woods, perhaps one

16 Antiquities of the Southern Indians," page 183.
hundred yards north of the creek, was a mound of sand having a height of 10 feet and a circumference of 210 feet. Its form was the usual truncated cone. Upon it grew five forest trees. Its proximity to Palatka made it for years the objective point for picnic parties which had excavated in a desultory way, but a systematic investigation was never attempted.

The mound was visited by us November, 1892, and a portion carefully explored. In April, 1893, it was again visited with a party of twenty men, and leveled to the ground. The surface of the mound was composed of a layer of sand to which a pinkish color had been given by admixture of pulverized hematite. This layer had a maximum thickness of about four feet, being considerably thinner on the summit plateau, doubtless through action of the elements. Beneath was fine yellowish sand, in places as dry as flour; while lower, somewhat coarser and moister sand continued to the base which was marked by a layer of pure white sand about four inches in thickness; beneath was the yellow sand of the surrounding territory.

Burials.

Bodies were all in anatomical order, though in certain cases were found portions of skeletons through which previous visitors had dug. Human remains were confined exclusively to the pink sand layer, never exceeding a depth of three feet from the surface.

With the exception of one calvaria, no human remains were preserved, owing to their crushed and decayed condition, though all resources employed upon such occasions were at hand, including shellac and heated solutions of glue.

And here it may be well to remark that the condition of bones depends less upon their age than upon their surroundings. It is fallacious to adduce partial or entire decay of human remains as a proof of advanced antiquity, since the Duni's Creek skeletons, interred with implements of European origin, must be assigned to a post-Columbian period. On the other hand, human remains found in the shell heaps and in sand mounds having an intermingling of shell, though certainly as old and doubtless in some cases of much greater antiquity, through association with shell and the consequent infiltration of lime salts, are in fairly good condition.

Two feet below the surface was a skull associated with a few vertebrae but with no other bones. Close by lay a bit of hematite with two fragments of pottery and two beads of shell. In addition were what seemed to be two brass or copper buttons, spherical in shape and evidently of European origin, since one still had a metal loop apparently soldered on. Their use as earrings is possible. One lay in actual contact with the skull and had imparted a greenish tinge to a part of the temporal bone. The calvaria was saved and was of the brachycephalic variety found almost without exception in the sand mounds. One foot from the surface and three feet east of the skull just described, surrounded by sand deeply tinged with red iron ore, were two tibiae, two femurs and a pelvis. A former investigator had dug through the ribs.
Map of St John's River, between Matanzas Point and Lake Washington.
Three feet from the surface and three feet distant from the other remains was a skeleton in anatomical order. The body lay upon its back, the thighs flexed on the abdomen. The hands were folded upon the chest and on them lay a drinking cup wrought from Fulgar perversum by the removal of the inner whorls and the columella. Drinking cups of this character were still in use when the French landed in Florida. They are not common in the sand mounds of the river, and save in one case have been found only superficially in the shell heaps. Through the bottom of this shell cup a hole had been purposely knocked. Vessels, whether of shell or of clay, deposited with the dead in the river mounds, almost universally show perforation. Of this custom we shall have more to say when describing the low sand mounds near Volusia.

In various parts of the mound, especially on the summit plateau, burials were comparatively numerous, though an estimate as to number would be misleading, owing to the amount of surface investigation indulged in by excursionists from Palatka.

**IMPLEMENTS, ORNAMENTS, WEAPONS, ETC.**

Twenty-two-and-a-half feet from the southern margin of the base of the mound, and three-and-a-half feet from the surface, in the pink sand, were found an iron axe of curious pattern and what seemed to be a cold chisel, both greatly corroded. In immediate association with these implements was an ornament of metal, one inch in length, considerably discolored, perforated for suspension (Fig. 1). Through fear of injury to the specimen, no analysis has been made, but experts of the U. S. Mint, relying on acid tests considered final by them, have pronounced the metal silver, and have ventured the opinion that it is of unusual purity.

No bones were found in association with these articles of metal.

Beneath the roots of a large hickory, 10 feet west of the other implements, 24 feet from the margin of the base and 3 feet from the surface, were found in association a polished hatchet of stone; a circular fragment of glass, rudely chipped and considerably worn, possibly fashioned from the base of a bottle; an unworked pebble; two shell beads; a cold chisel of iron, 8 inches in length, and an axe of iron of the same pattern as the one previously described. No human remains were in immediate association.

Thirty feet from the margin of the base and 6 feet from the surface, in the yellow sand, was a pin formed from the columella of a marine shell, 4.75 inches in length. In the annual report of the Bureau of Ethnology, 1880-81, plate XXX, fig. 2, a counterpart of this pin is illustrated. A similar pin was found in another portion of the mound. Both were unassociated.

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1 American Naturalist, Aug. 1883, p. 717.
2 Figured in the account of the Thurlby Mound.
Scattered through the pink sand layer, none being found below, were eleven polished implements, commonly known as "celts," none exceeding 5½ inches in length. Of these, six, now at the Peabody Museum, Cambridge, were determined by Professor Wolf as being four of diabase, one of porphyrite, one probably of a quartzose slate. Of the remaining five, four are of the usual traps, the fifth syenitic gneiss. The surfaces are somewhat decomposed, rendering an absolute identification impossible without injury to the specimens.

Not over two of these polished hatchets were found in association with human remains. The frequent isolation of such deposits has been noticed by us in the river mounds and commented upon by Mr. Douglass in respect to the mounds of the east coast. In this connection a cache has been suggested, but as we have frequently found isolated polished implements at depths varying from 15 feet to within a few inches of the surface, we are inclined to believe the deposit to have been made out of respect to the dead generally, as we hang garlands on monuments.

On the summit plateau, near the surface, was found a leaf-shaped implement of chert, chipped, 3½ inches in length, much worn as from continued handling.

In all, fifteen arrow and lance points were met with. They were confined to no particular layer, but were distributed from the base to the surface. Of these points eleven were of chert, one of hornstone, one of chalcedony and two of chert breccia. One slender point was possibly a drill or fish spear. The type is not uncommon on the surface but is seldom met with in the mounds of the river. On the eastern slope, 5½ feet from the surface, not far distant from the base, six arrow and lance heads were found in immediate association, the largest being 4½ inches in length, the smallest 1½ inches. With one exception, namely at Mt. Royal, we have never before found so great a number of stone points together in a river mound.

One arrow head of chert, unassociated, was smooth, with edges completely rounded by artificial means.

A small arrow head of chert was discovered carefully stowed away within a Fulgar carica.

Five feet from the surface on the northeastern slope was a slab of banded slate 7½ inches long, 3½ inches wide, with a thickness varying from 2 to 7 of an inch. It was imperforate and gave evidence of use as a hone for cutting-tools.

At the base and near the center of the mound with an arrow head of chert was a flake, four inches long by 1½ inch in breadth. With them lay a rude implement of chert bordering on hornstone, showing cleavage on one side, and upon the other traces of workmanship.

At various points, always with human remains, were six drinking cups, wrought from Fulgar perversum, all, with one exception, showing intentional perforation of the bottom. Throughout the pink sand layer were scattered numerous beads of shell, some as much as one inch in length; while two beads of stea-
tite, with lateral flattening 1·5 inches and 9 of an inch in length, respectively, were
met with.

A small bead of blue glass was found in the pink sand layer.

Other relics were implement of shell fashioned from the axis of a Fasciolaria; a copper hawk-bell, found superficially, covered with patine, still containing the little ball which yielded a jingling sound when shaken. These hawk-bells, used in falconry, were highly prized by the Indians who obtained them by barter from the whites.

POTTERY.

Many fragments of pots, denoting vessels unusually large for the sand mounds, were met with in Dunn's Creek mound. From surface to base were sherds, varying from the coiled pottery of coarse material to the most compact and finest pottery of the mounds. Certain fragments from the base were colored a bright carmine, and ornamented with rims projecting laterally, over an inch in breadth. Other fragmentary portions of vessels had a graceful treatment of curves, a style of ornamentation usually wanting in the river mounds (Plate II, figs. 1 and 2). Other sherds showed interesting patterns (Plate II, figs. 3 and 4). Near the surface, the usual stamped pottery was abundant. Neither in this mound nor in other river mounds do we recall seeing an admixture of crushed shells with the clay.

Owing to the great quantity of roots in the Dunn's Creek mound, often rendering fruitless the most careful digging, we were so unfortunate as to lose several pots by breakage. Besides a number of small bowls, undecorated, with the usual hole knocked through the bottom, two bowls were found in association in the northeastern slope of the mound three feet from the surface, in the neighborhood of the base. Both were perforated in the usual manner. One with a height of 3·5 inches and a maximum diameter of 4·75 inches, had the aperture contracted to a diameter of 3·75 inches. The margin of the aperture was scalloped. Seven feet from the surface, near the base, was a beautiful vase of unique design, imperforate, with oval base, 4·25 inches in height with a maximum diameter through the body of 2·5 inches. The upper diameter, including the laterally projecting rim, was 4·75 inches (Plate III, fig. 1). We have met with nothing resembling this vase in all our mound work on the St. John's. Unfortunately, a portion of the rim suffered slight mutilation through contact with a spade, while on the other side a part was missing through a former break. A small pot with scalloped rim, but otherwise undecorated, broken, but not beyond restoration, was found during the investigation (Plate III, fig. 2). Another, somewhat larger but of the same pattern, was recovered unbroken. But one entire vessel was met with in the upper or pink sand layer.

TOBACCO PIPES.

Six feet below the surface, and twenty-five feet from the southern margin of the base, with a certain amount of charcoal, in such immediate association that the
same spadeful of sand contained them, were found two tobacco pipes of coarse yellow clay. One was without decoration; the other was shaped to resemble, presumably, the head of the duck (figs. 2 and 3).

A discovery of pipes is almost unique in the river mounds. With the exception of two fragments from a small mound near Lake Poinsett, none have rewarded our labors in twenty-nine sand mounds of the river. Mr. Andrew E. Douglass dis-
covered but one pipe during his extended researches in Florida. One other, of coraline limestone, from a shell heap on the west coast is in his possession. Professor Wyman found none in the shell heaps, and a small fragment from Mulberry Mound is the unique result of our researches in the shell deposits of eighty localities on the St. John's. These pipes are now at the Peabody Museum, Cambridge.

Of all the mounds of the St. John's opened by us that of Dunn's Creek offers most difficulties as to a conclusion looking to an approximate date of origin. Less than half a score of skeletons were found by us, but how many were disturbed by previous workers it is impossible to say. In no other mound on the St. John's, intended for sepulture, have burials been found exclusively of superficial character, and this would indicate an intrusive origin for the burials in the Dunn's Creek mound. On the other hand, it was not the custom of the river Indians to put sherds, arrow heads and vessels of pottery into mounds not intended for sepulchral purposes. The presence of glass, of iron, of bells and of buttons indicates intercourse with Europeans. If we regard the burials as contemporary with the mound it is post-Columbian. If, on the other hand, remembering that absolutely nothing save of aboriginal manufacture came from below the upper layer where the bodies were interred, we consider the interments of a secondary character, then the epoch of the building of the mound remains an open question.

**Murphy Island, Putnam County.**

Murphy Island, on the east bank of the river, ten miles south of Palatka, is the property of H. L. Hart, Esq., of that place. This gentleman will permit no investigation.

In addition to a large shell deposit there are two sand mounds on Murphy Island. The northernmost, almost on the river's edge, is the usual truncated cone but much more symmetrical than the majority of the river mounds, ascending at an angle of thirty degrees. Its height is eleven feet, nine inches; its circumference two hundred and forty feet. The diameter of the summit plateau is twenty-one feet.

About two hundred yards to the south at a short distance from the river is another symmetrical mound, ten feet in height, having a circumference of two hundred and ten feet. It is covered with a forest growth.

**Sand Mound near Norwalk Landing, Putnam County.**

In the pine woods, about one mile west of the landing, in sight of the road leading to the town, was an unstratified mound of white sand. Its height was 8 feet 3 inches; its circumference 132 feet. Its form was unsymmetrical, the summit plateau being disproportionately great. This mound was totally demolished by us during four days of January, 1893.

1Mr. Douglass in private letter.
2American Naturalist, August, 1893, page 717.
CERTAIN SAND MOUNDS OF

HUMAN REMAINS.

Twenty-five interments, all of the bunched variety, were met with. In one case the bundle included the long bones of two bodies. Two crania surmounted it.

The bones were badly decayed and crushed, in many cases nothing remaining but small and friable pieces. By the aid of shellac applied in place, four skulls, in a somewhat fragmentary condition, were saved. One femur gave an index of 114. Five tibiae gave an average lateral index of 63.7, the oscillation exponent being 1.1.

Three humeri were recovered. All showed perforation.

IMPLEMENTS, ETC.

In all, nine polished hatchets, from 3.5 inches to 8.5 inches in length, were found; some associated with human remains, but the majority isolated. In addition the mound yielded a handsome lance head of chert and a perforated stone tablet 2-25 inches in length (fig. 4). Curiously enough, all relics, and the great majority of interments, lay in the eastern half of the mound.

POTTERY.

Throughout the mound were occasional fragments of undecorated pottery. In addition, superficially, were two brightly colored sherds.

CONCLUSIONS.

All burials in this mound are believed to be original. No trace of intercourse with the whites was discovered.

Mt. Royal, Putnam County.

On the east bank of the St. John’s, just below where the river leaves Lake George, in a great grove of bearing orange trees, not 300 yards from the water’s edge, stands Mt. Royal.

Its owner, David Wright, Esq., of Auburn, New York, fully appreciating the interest attached to this famous monument whose makers now are nameless, has long followed the example set by former possessors of the St. John’s largest mound, and kept it intact, carefully guarding it against the depredations of unsystematic relic hunters. Mt. Royal, then, prior to our visit (April, 1893), knew no explorer other than the gopher, the salamander, and the scarlet snake.

1 All crania will be described by Dr. Harrison Allen with the second part of this report.
2 See account of Tick Island.
3 Gopher, local for Florida tortoise, Xenobates polyphemus.
4 Salamander, local for pouched gopher, Geomys tuza.
5 Scarlet Snake, Cemophora coccinea. This beautiful little snake is found burrowing in many of the sand mounds.
THE ST. JOHN'S RIVER, FLORIDA.

For 128 years the existence of Mt. Royal has been a matter of history. The elder Bartram, a Philadelphia Quaker, on his way down the St. John's, January, 1766, stopped at Mt. Royal. Under date of the 25th he writes: " About noon we landed at Mount Royal, and went to an Indian tumulus, which was about 100 yards in diameter, nearly round, and nearly 20 feet high, found some bones scattered on it, it must be very ancient, as live oaks are growing upon it, three feet in diameter; what a prodigious multitude of Indians must have labored to raise it? to what height, we can't say, as it must have settled much in such a number of years, and it is surprising where they brought the sand from, and how, as they had nothing but baskets and boards to carry it in; there seems to be a little hollow near the adjacent level on one side, though not likely to raise such a tumulus the 50th part of what it is, but directly north from the tumulus is a fine straight avenue about 60 yards broad, all the surface of which has been taken off, and thrown on each side, which makes a bank of about a rood wide, and a foot high, more or less, as the unevenness of the ground required, for the avenue is as level as a floor from bank to bank, and continues so for about three-quarters of a mile to a pond of about 100 yards broad and 150 yards long. N. and S. seem to be an oblong square and its banks 4 feet perpendicular gradually sloping every way to the water. the depth of which we could not say, but do not imagine it deep as the grass grows all over it; by its irregularity it seems to be artificial; if so, perhaps the sand was carried from hence to raise the tumulus, as the one directly faces the other at each end of the avenue; on the south side of the tumulus I found a very large rattlesnake sunning himself, I suppose this to be his winter quarters; here had formerly been a large Indian town; I suppose there is 50 acres of planting ground, cleared, and of middling soil, a good part of which is mixed with small shells; no doubt this large tumulus was their burying place or sepulchre; whether the Florida Indians buried the bones after the flesh was rotten off them, as the present Southern Indians do, I can't say; "

Shortly before the Revolutionary War, the younger Bartram (William) went up the river alone as far as what is now called Lake Beresford, passing a night at Mt. Royal. The place had been under cultivation, which was not the case when John Bartram went up the river. "At about 50 yards distant from the landing place," he writes, "stands a magnificent Indian mount. But what greatly contributed towards completing the magnificence of the scene was a noble Indian highway, which leads from the great mount, on a straight line, three-quarters of a mile, first through a point or wing of the orange grove and continuing thence through an awful forest of live oaks, it was terminated by palms and laurel magnolias on the verge of an oblong artificial lake which was on the edge of a green level savanna. This grand highway was about fifty yards wide, sunk a little

1 A Journal kept by John Bartram of Philadelphia, Botanist to His Majesty for the Floridas, upon a journey from St. Augustine up the river St. John's as far as the Lakes. With explanatory Botanic notes. The third edition, much enlarged and improved. London, sold by W. Nicol, No. 31 St. Paul's Church-yard; and T. Jeffries at Charing Cross—Geographer to His Majesty, MDCCLXIX.
below the common level and the earth thrown up on each side, making a bank of about two feet high."

The good Quaker bemoans the change wrought since a former visit by the felling of the trees, but adds that "the late proprietor had some taste as he has preserved the mound and this little adjoining grove inviolate."

In an unpublished manuscript, cited by Squier and Davis,1 the younger Bartram again refers to Mt. Royal:

"The vast mounds upon the St. John’s, Alachua, and Musquito Rivers," he writes, "differ from those among the Cherokees, with respect to their adjuncts and appendages, particularly in respect to the great highway or avenue, sunk below the common level of the earth, extending from them, and terminating either in a vast savanna or natural plain, or an artificial pond or lake. A remarkable example occurs at Mt. Royal, from whence opens a glorious view of Lake George and its environs." He goes on to describe by the aid of a little sketch the highway and mound, making the latter 40 feet in perpendicular height. (His father, years before, by an estimate of half that amount, had come nearer the truth). "What may have been the motive for making this pond I cannot conjecture," he continues, "since the mound and other vestiges of the ancient town are situated close on the banks of the river St. Juan. It could not, therefore, be for the convenience of water. Perhaps they raised the mound with the earth taken out of the pond."

In 1872, Professor Jeffries Wyman visited Mt. Royal while engaged in his researches among the shell heaps of the St. John’s.3 The avenue to the lake was then overgrown with forest trees.

These forest trees have now been largely cleared away, leaving here and there a scattering pine, and the ground has been under cultivation. The avenue is still readily traceable, though its point of union with the mound is no longer visible. Its course is north about half a mile to the pond, where water lilies were in flower at the time of our visit. It consists of a depression from twelve to twenty yards in width at different points, between embankments of sand with an average height of 2.5 feet, and 12 feet in breadth.

**SIZE AND COMPOSITION OF MOUND.**

Mt. Royal has been under cultivation1 and consequently by the wash of the summer rains a considerable quantity of sand from the sides has so raised the level of the territory immediately surrounding, that measurements taken from the apparent base to the summit are diverse and misleading. Its true height from the summit plateau to the base, as shown by measurement at the center of the mound, is

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1. "Travels through North and South Carolina, Georgia, East and West Florida, the Cherokee, Country the Extensive Territories of the Muscogulges or Creek Confederacy, and the Country of the Chactaws." Dublin, 1785, page 57.


4. William P. Wright, Esq., of Drayton Island, informs us that the entire mound has been ploughed over.
16 feet; the circumference is 555 feet. It is composed of the yellow sand of the surrounding fields, with pockets and local layers of white sand alone and above the base. Wherever exposed, the sand at the bottom of the mound was found mingled with pieces of charcoal. Beginning at the margin of the base, a layer of sand colored by admixture of powdered hematite, covered the entire mound. This layer attained a maximum thickness of 7 feet on the northeastern portion of the summit plateau and adjacent slope. The general tint of the layer was what is called crushed strawberry by dealers in ribbons, though at many points, and especially in the vicinity of relics, the sand in considerable quantity was dyed a brick-red, even reaching what is termed Indian red by vendors of colors. At times streaks and local layers of highly colored sand throughout the entire mound led to implements, pottery, etc., and while the discovery of objects in the yellow sand was not uncommon, still in the majority of cases they lay in contact with that having an artificial color. Realizing this fact, the 21 colored men in our employ worked with their hands alone in the presence of sand tinted with the red oxide, and it is doubtless owing to this that but two objects in pottery were broken by the spade during the seventeen days comprising our excavation.

The use of hematite in this connection in mounds has been noted by us upon but three other occasions: at Dunn's Creek; at Duval's, near Blue Creek, Lake Co.; and in the case of the mound a mile due west of Duval's in the piny woods. At Dunn's Creek, it will be remembered, an outer layer of light pink sand was found; at Duval's, as we shall see, a layer of pink lay between strata of white sand, while in the other mound pockets of red sand alone were found, these pockets always marking the presence of deposits. Mr. Andrew E. Douglass noticed a similar use of hematite on the east coast of Florida; while strangely enough a similar custom prevailed among early races in Europe. In the caves of Mentone, Dr. Riviere repeatedly found objects tinted by contact with the red oxide, while Dr. Verneau found a layer of earth in which bodies had been deposited, artificially colored by the use of iron ore.

It is a fact worthy of remark that while an artificial shell deposit of considerable depth borders the water's edge in sight of Mt. Royal not a single Paludina, Ampullaria or Unio was met with in the mound.

EXCAVATIONS.

In the southern portion of the mound, 12 feet from the margin of the base, a trench following the base 89 feet in length, was dug. Its breadth at the beginning was 12 feet, widening after a few feet to 30 feet, again decreasing to 25 feet, the last 26 feet having a breadth of from 37 feet to 40 feet. Owing to the unstable nature of the sand, a considerable convergence to the sides was requisite, so that

1De l'Antiquité de l'Homme dans les Alpes-Maritimes, page 176.
2Nouvelle Découverte de Squelettes Préhistoriques aux Rousset-Rousset, près de Menton, l'Anthropologie, tome troisième, page 252.
even at the broadest portion of the trench the surface of the base exposed had a breadth of but 12 feet.

Starting from the northern side of the mound, 13 feet from the margin of the base a trench 36 feet in breadth was dug along the base a distance of 21 feet. This trench when discontinued had a depth of 8 feet. In addition to these trenches a great portion of the surface of the mound was dug over to a depth of 7 feet.

**HUMAN REMAINS.**

That Mt. Royal was erected for purposes of sepulture is beyond a doubt. In every portion of the excavations, though at considerable distances apart, signs of burials were met with, though meagre and incomplete. In no mound of the St. John’s have human remains been found so fragmentary through the ravages of decay, and it is probable that traces of many burials have entirely disappeared. In certain cases human remains were represented by hardened sand retaining nothing but the shape. Many fragments of bones resembled moistened powder and crumbled at the touch. Beyond a few crowns of teeth no remains were saved. It is probable that an admixture of shell with the sand of the mound would have preserved the bones to a material extent.

**FULGURS.**

While occasional drinking cups, wrought from the *Fulgur perversum*, have been found in various mounds of the river, their occurrence has been marked by no great numbers. The evenly perforated *Fulgur* with ground beak, usually the *carica*, has been met with only in Mt. Royal, where three specimens lay under undisturbed strata, and superficially in the Thursby Mound. The discovery, then, in Mt. Royal of vast quantities of *Fulgurs* is a feature peculiar to that mound.

These conchs were in no case shaped for use as drinking cups by the removal of the columella and inner whorls, nor, with but few exceptions, did they resemble the implements made by the grinding of the beak and the even perforation of the body whorl above, below or above and below the shoulder, as the case may be. The shells in question were seldom unbroken, having in nearly every case a fragment knocked off, and these breaks, by a certain regularity as to their points of occurrence, indicated an intentional fracture. That this fracture was made through the prevailing custom that actuated the perforation, before or after completion, of mortuary pottery in the mounds of the St. John’s there seems to be little reason to doubt.

While scattered *Fulgurs* were met with in every portion of the mound, they occurred in the greatest number beneath the summit plateau and that portion of the mound immediately adjacent, and were rarely found below 7 feet from the surface. They were often encountered lying in actual contact in great deposits; in one case so many as 136 being found together. From the main trench 1,307 *Fulgurs* were
taken; of these but 15 were noted as of the species *carica*, though possibly a few may have escaped particular examination.

**IMPLEMENTS, WEAPONS, ETC.**

While objects of stone, of pottery and of metal were found in great abundance in the mound, there seemed to be no central deposit but a distribution in every direction from below the base to within a few inches of the surface. Though objects of stone were sometimes deposited near the dead, more frequently no traces of burial were apparent with them, and as in the case of the mound at Dunn's Creek, objects seem to have been deposited in a general way to do honor to the dead as a whole. On the other hand, in nearly every case, pottery, and invariably beads, when found, were in close connection with human remains.

**Arrow and Lance Points.**—During the excavation 93 arrow and lance points were met with. In nearly every case the material was chert, sometimes bordering upon hornstone. They were infrequently associated with human remains, and with one notable exception lay usually singly, though sometimes in pairs. Eight feet from the surface and six feet east of the center of the mound, not in immediate association but scattered perhaps through a yard of sand, were 53 small arrow points, ranging between 8 of an inch and 1-4 inches in length. The great majority were of chert, a few of chaledony, and one of chert breccia. None had the tang, and many were rude, though some were of finer workmanship, barbed and serrated. With them lay the claw of a predatory bird, an eagle or a hawk.

In but three cases were arrow heads found in association with celts. Two lance points of chert showed longitudinal strie, giving evidence of intentional polish, the inequalities of the surface being removed and the edges rounded. Another lance head, also of chert, had the tang grooved as for suspension and likewise showed marks of wear. This occurrence of the grooved tang is the first we have met with on the river. One small arrow head in shape and size was the counterpart of one figured by Joseph Jones, M. D., from a stone grave of Tennessee.

Seven feet from the surface and five feet northwest of an imaginary line drawn through the center of the mound, with human molars and various articles of copper, was a small and beautiful arrow head, probably of chert, which contact with the metal had dyed green (Fig. 5).

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2. JOUR. A. N. S. PHILA., VOL. X.
In association with a crystal of quartz were an arrow head and a lance point of chert of graceful pattern (Fig. 6).

A fragmentary portion of an arrow point was found with a marked curvature to the barbs in opposite directions, doubtless intended to impart a rotary motion in flight.

No spear points of unusual size were met with or of types previously unreported.

Polished Hatchets.—In all, 61 polished hatchets, "celts," so-called, were found during the investigations at Mt. Royal. Scattered through every portion of the mound they lay often in bright red sand, never more than three in association. Some of beautiful finish tapered to a blunt point at one end, while others were more rudely fashioned opposite the cutting edge. All sizes were represented, ranging in length between 3-4 inches and 9-5 inches. One hatchet, upon which a sandy deposit had formed, clearly showed where a heavy cord had twice encircled it. The material of the hatchets was, as a rule, the usual trap rock, sometimes porphyritic, though a microscopic examination, kindly made by Dr. Goldsmith, showed the rock in certain cases to be of sedimentary origin, non-cleavable, argillaceous, closely bordering on claystone.

Polished Chisels.—Six polished implements, evidently chisels, were met with; the smallest, 3-75 inches in length, gracefully shaped, still showing striæ received during its manufacture (Fig. 7). Another having a length of 4-75 inches was almost cylindrical (Fig. 8).

The longest chisel, a beautiful implement of highly polished greenstone, tapered gracefully from the cutting edge to a blunt point. Its length was ten inches. It was found on the N. N. W. slope of the mound, one foot from the surface (Fig. 9). We believe this specimen to be unique.

In the collection of the National Museum implements of this character and length are wanting in stone, though present in copper from Wisconsin. The type is not represented in the Museum of Natural History of New York.

Gorget.—A tablet 4-6 inches in length by 1-7 inches was found on the western slope 2-5 feet from the surface. Human teeth alone were in association. It was notched at either end and perforated at one end as for suspension. It was presumably worn upon the chest as a gorget (Fig. 10).

Ceremonial Implements.—Two implements of the rare form known as spade-shaped were found in Mt. Royal. Both were of polished claystone. The smaller, with a length of 9-5 inches, had four notches or tally marks upon either side. It was found 18 inches below the surface, 25 feet due south of the center of the mound. The larger, 11-6 inches in length came from about the center of the mound.

1It is well to remember that the depth at which these implements were found does not represent the distance from the surface at which they were originally placed. The entire mound has been under cultivation, as previously stated, and the height has been materially lessened by the storms of centuries in a peninsula having a greater rain fall than any other part of the country east of the Rockies.

2Professor Brown and T. D. Rand, Esq., have made careful examination of all stone implements from Mt. Royal.
Fig. 7. Polished stone chisel (full size).

Fig. 8. Polished stone chisel (full size).

Fig. 9. Polished stone chisel (full size).

Fig. 10. Polished stone gorget (full size).

Fig. 11. Ceremonial implement (full size).
mound at a depth of 5-5 feet from the surface. The notches were uneven in number, eight on one side and ten on the other, as shown in the figure (Fig. 11). As a rule, we have found the number of these tally marks to agree on either side of ceremonial implements.

Unlike so many of our aboriginal relics this implement is of a type unknown in Europe. It is of comparative rarity, though of wide distribution, in the United States. Mr. A. E. Douglass has one from Kentucky with notches, three on each side of the blade which is slightly convex on the sides. It is highly polished. Its length is 15.75 inches.²

We are indebted to Thomas Wilson, Esq, for a report of two of these implements, one of blue trap rock highly polished, found near Columbia, South Carolina; the other from Kentucky. The collection in the Smithsonian Institution is largely comprised of casts, and Dr. Rau, in his "Archæological Collection of the United States Museum," (page 25) takes his figure from a cast.

Colonel C. C. Jones, (Plate XVII, fig. 2;) figures the spade-shaped implement found by Dr. Joseph Jones in Tennessee. Colonel Jones believes it to have been an agricultural tool.

Dr. Joseph Jones⁴ figures the same implement. It is of highly polished greenstone, 18 inches in length, and came from Old Town, Tennessee. He reports others from various parts of the Cumberland Valley. "Several conjectures," he says, "have been formed as to the use of these singular implements. Some have supposed them to have been used in agriculture, the flat head being employed as a spade, and the rounded handle for making small holes in the earth for the deposit of grains of Indian corn; others believe that they were used to strip the bark from trees; others again, that they were used in dressing hides, in excavating caves, or in felling trees after the wood had been charred by fire. It is possible that they may have been used for all these purposes, and also as war-like weapons, since it would be easy to fracture or to cleave the human skull with a single blow from one of these stone implements."

Mr. Thruston⁵ reports a number of these implements from various parts of Tennessee, and rightly, we think, classes them as ceremonial. We consider them of too infrequent occurrence to suggest their employment for any practical use. We have been able to learn of none showing breakage or signs of use, and some reported are too small in size to render them useful as weapons. Moreover, we think the tally marks on certain specimens connect them with the ceremonial class. The two from Mt. Royal, the larger of which we figure, are the first reported from Florida.

Miscellaneous Objects of Stone.—At various depths, carefully noted on the specimens but not of material interest here, were found a "sinker" wrought from a

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1⁰ Prehistoric Amerian," page 170, et seq.
²Mr. A. E. Douglass in private letter.
⁵"Antiquities of Tennessee," page 295, et seq., fig. 208 and Plate XV.
quartz pebble grooved for suspension; an implement of polished hematite, too fragmentary for identification; two pieces of iron pyrites; a bead of ferruginous sandstone, 1.5 inches in length and .75 inch in diameter, with a "celt" in association; a rude fragment of hornstone with cutting edge rounded by use, 3 inches in length by 1.7 inches broad; several pendant ornaments and beads of calcite (Fig. 12), one bead having a length of 2 inches; a chisel-shaped implement of chert breccia, 3.12 inches long; a quartz crystal .87 of an inch long and .5 of an inch thick, with longitudinal groove, the entire surface roughened as by wear. In association were a lance and an arrow head of chert. Crystals of quartz, we are told, were sometimes worn in the ears of the aborigines. A hammer stone of chert; three large marine pebbles, one flat in shape, the others oval, and numerous chips of chert and bits of red hematite were met with during the excavation.

An interesting discovery was a slightly curved cylinder, apparently a natural sandstone deposit, through which ran a perforation, having a shoulder at one end (Fig. 13). It is the opinion of some archaeologists that these cylinders were used in the smoking of tobacco. Of this we shall have something to say later in connection with the Bluffton Mound.

Fourteen feet from the surface and 16 feet south of the center of the mound, with a number of unbroken vessels of pottery, bits of charcoal, a Fulgur, a portion of the body whorl of the Fulgur deeply grooved artificially, in a local stratum of sand colored bright red by the addition of hematite were 951 fragments of chert and of hornstone. These fragments, none exceeding a goose-egg in size, lay scattered over an area of two or three square yards. Fragmentary human remains were in association. It is difficult to assign a motive for this deposit of stone, since none of the fragments were of a size to serve for the manufacture of implements, and in addition contained flaws and defects. Not far distant was a similar deposit of perhaps one hundred specimens. We know of no natural supply of chert or hornstone nearer to Mt. Royal than the limestone of the west coast.

Beads.—Always in connection with human remains, at various depths in the mound, were small discoidal beads of shell, at times in great quantities, single deposits occasionally exceeding a pint. Several beads one inch in length and under, wrought from the axes of large marine univalves, were scattered throughout the mound.

Seven and one-half feet from the surface in the N. N. E. slope of the mound, with human remains and great numbers of small shell beads, was the perforated vertebra probably of a catfish. The use of the vertebra of fishes as ornaments was practised in Europe. Dr. Verneau speaks of the vertebra of a salmon in the caves of Baoussé-Roussé, while the vertebral bones of various fishes are described and figured as coming from the same caves by Dr. Rivière, an earlier explorer.

**Pearls.**—During the course of the excavation a number of globular beads were met with, which examination by means of acid and of the microscope showed to be pearls, the concentric lamination being clearly marked, which would not be the case were the material from the nacreous portion of a shell.

The subject of pearls in southern mounds has been exhaustively treated by Colonel Jones in Chapter XXI. We learn that not one was found in the stone graves by Dr. Jones, while but few rewarded the search of Colonel Jones. We believe the discovery of pearls in the mounds of Florida to be hitherto unreported. The mounds of Ohio yielded pearls to the investigation of Squier and Davis, while a rich harvest lately rewarded the labors of Mr. Moorehead. The largest specimen from Mt. Royal measured '36 of an inch and '26 of an inch respectively in its major and minor axes.

Mr. H. A. Pilsbry of the Academy of Natural Sciences of Philadelphia, to whom the beads were submitted, writes as follows: "Having examined again the beads supposed to be pearls, I can state with confidence that true pearls they undoubtedly are. The curvature of the layers in the specimen treated with acid precludes the supposition that they are beads cut from shell, and indicates a pearl of nearly spherical form, four mm. in diameter. Where etched with acid the characteristic structure of concentric laminae of carbonate of lime appears, the layers of animal matter (conchiolin) which alternate with those of lime having been dissolved away. This loss of organic cement leaves the delicate layers of lime unsupported, and the pearls are consequently very fragile. For the same reason the Unios are peculiarly liable to disintegration, contrasting in this respect with the shells of porcelainous structure, such as *Ampullaria* and *Paludina*, found associated with them in the shell-heaps.

"The pearls were probably, in my opinion, obtained from fresh water mussels (*Unio*). The only marine shell of the Florida coast which could be expected to produce pearls of this size is *Margaritifera radiata* Leach, found abundantly on the Keys, etc.; but sections of the pearls produced by a closely allied oriental *Margaritifera* which I have examined have the layers of lime distinctly thinner and closer than in the specimen submitted to me by you. The so-called pearls of *Strombus* or other gastropods need not be considered, as they have an internal structure totally different from genuine pearls. It is therefore likely that your specimens were taken from river-mussels."

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1 L'Anthropologie, TOME troisième, 1892, page 528.
2 "De l'Antiquité de l'Homme dans les Alpes-Maritimes," page 273, plate XXI.
Pottery.—In that portion of the main trench bordering on the margin of the mound numerous sherds were met with of good material and mainly of the stamped variety. As we believe them to be of a later period washed from the surface and ploughed under during cultivation, they will not be particularly described.

Vessels of pottery were encountered in every portion of the mound, at times singly and again in association with other objects or with each other. The material was of fairly good clay, baked by exposure to fire, with no apparent admixture of shell. As before stated, the presence of pottery, as a general rule, marked an interment.

So great is the pressure exerted by masses of sand that in numerous instances vessels of pottery were crushed beyond recovery. Others, again, allowed of restoration; while a considerable number were recovered intact. As before stated, but two vessels of pottery were broken by contact with the spade, the absence of roots being, of course, a favorable factor in the work. Unbroken pottery in the river mounds is a somewhat unusual occurrence, and beyond the large superficial deposits in the Thursby mound and the specimens from Dunn’s Creek our explorations have been rewarded by but few examples of pottery not in a fragmentary condition.

A number of vessels of patterns entirely new on the St. John’s were found during the work, and will be particularly described.

One point in connection with Mt. Royal deserves special notice. Almost universally in the river mounds each burial is accompanied by small pieces of pottery, to which, in many cases, the shape of the arrow or lance point has been intentionally given. We have previously referred to this custom in the American Naturalist, February and July, 1892, in articles descriptive of the great Tick Island mound. In the Mt. Royal mound, bits of pottery with the skeletons were absolutely wanting, and such isolated fragments as were found had no connection with human remains, and were probably of accidental introduction. We are of the opinion that the former inhabitants of Mt. Royal, of greater possessions than the majority of those who built the other river mounds, were not compelled by poverty to confine themselves to the interment of sherds with the dead.

Small pots of conventional forms were numerous in all portions of the mound, but vessels of any size were absent and no fragments were found except superficially to indicate the use of any of considerable size. Thirteen feet from the surface and 7 feet north-east of the center of the mound was a vessel much resembling a half-barrel in shape. The bottom was missing. Its height was 7½ inches. Its diameter at the aperture was 10½ inches, at the base 6½ inches. The external decoration was stamped. This vessel was the largest found and the depth at which it was discovered showed stamped designs to have been in use at the inception of the mound.

Two feet below the surface was a vessel of yellow clay, 3½ inches in height, 6½ inches in diameter at the top, and 4½ inches in diameter at the base, which was intentionally perforated at the center. Near the upper margin of the vessel on
either side was a small perforation for suspension (Plate III, Fig. 3). This vase of unusual type, gave the impression of a saucer with perforated bottom, placed upon a bowl. It was undecorated.

Two feet below the surface and 15 feet west of the center of the mound was an oblong dish, undecorated, with a portion of the bottom intentionally knocked out. The length of the vessel was 5 inches, its width 3'12 inches with a depth of 1'75 inches (Plate IV, Fig. 1).

Six feet eight inches from the surface, 3 feet north of the center of the mound, was an imperforate bowl 7'75 inches in diameter, and 2'37 inches in height. Its ornamentation was a small diamond pattern conferred through the medium of a stamp.

Fourteen feet from the surface and 16 feet south of the center of the mound in a local layer of bright red sand with human remains and fragments of charcoal, and in connection with a deposit of chert already described, were six unbroken vessels of clay. In addition were a number crushed beyond restoration. Of the unbroken pots all had base perforations intentionally made, and all, with two exceptions, were undecorated. Of these two one was of a model entirely unique in the river mounds (Plate IV, Fig. 2). Diameter at opening 3 inches, maximum diameter 4'5 inches, height 3 inches. The other, a bowl (Plate IV, Fig. 3), had a height of 3 inches, a diameter at mouth of 1'4 inches, with a maximum diameter of 3'75 inches. Of the undecorated vessels in this deposit the largest, a bowl, had a height of 3'25 inches, with a diameter at opening of 4'85 inches. Another was bell-shaped; its height 3'5 inches, its diameter at the mouth 4'85 inches.

Three feet from the surface, with fragmentary human remains, was a rude bead of pottery 2'12 inches in length, with a maximum thickness of 1'12 inches, tapering somewhat toward the ends, and with longitudinal perforation.

Four feet from the surface was a small vessel of colored pottery. A broken surface on either side below the margin indicated the former presence of handles.

Five feet six inches below the surface were four small bowls; one in fragments. All were undecorated, and all were intentionally perforated through the base. Three were of conventional form but the remaining one much resembled a small tureen, an unusual pattern on the river (Plate V, Fig. 1). Its length was 3'75 inches, with a maximum breadth of 3 inches. The height was 2'5 inches.

A tube of pottery of dark color, upon which a high polish had been conferred, was found near the surface. Its length was 3'25 inches, its diameter 7' of an inch.

Four feet from the surface was a vase with flaring top. It was undecorated. The bottom and a portion of the body were wanting. The height of the remainder was 5'5 inches, its maximum diameter 5 inches, the measurement across the mouth 4'25 inches (Plate V, Fig. 2).

In the northern slope of the mound at a depth of 8 feet was a small undecorated pot, intentionally perforated at the base. In shape it much resembled a crucible; its height was 2'75 inches.

1 The term center is used to indicate an imaginary line drawn vertically through the center of the mound.
In the northern slope 6-5 feet down were two small pots; one somewhat in the form of a tureen had a height of 1 inch at the center, a length of 3 inches, with a breadth of 2-25 inches.

Eight feet down in the northern trench was a small oval dish, without perforation.

Twenty-five feet from the northern margin of the base, and 7 feet from the surface, lying on or below the base of the mound in a large pocket of bright red sand, piled upon each other in actual contact and adhering together so that they were lifted from the sand as a whole, were six vessels of pottery surmounted by a large dish. This dish, though broken into fragments by the pressure of the sand, had protected the vessels below. The vessels had the usual base perforation and had the conventional shape of mortuary pottery, with the exception that two had each a handle with a central opening, one projecting laterally, the other vertically (Plate V, Figs. 3 and 4). Their respective dimensions were length, including the handle, 5-75 inches, height 2 inches; length 4 inches, width 3-2 inches, height 2 inches, height including handle 4-8 inches. Two had ears extending from the upper margin, while one gave evidence of having been similarly decorated. The rim of one bowl was plain.

Four feet below the surface, well down on the western slope, was a vessel of pottery in a very fragmentary condition, though admitting of partial restoration. Its height was 6 inches. From a diameter of 3-6 inches it tapered to one of 1-75 inches at the margin of the neck. The margin of the base showed an intentional omission of the bottom. It is possible that this specimen belongs to a class of mortuary pottery to which fuller reference will be made in the description of the Volusia mounds (Plate VI, Fig. 1). With it lay portions of an almost similar vessel too fragmentary for reconstruction.

Numerous other vessels of pottery were found during the excavation, some of which we figure (Plate VI, Figs. 2 and 3; Plate VII, Figs. 1, 2 and 3).

While in certain cases perforation had been made subsequent to manufacture, the great majority of vessels in Mt. Royal showed small base perforations made previous to baking. This curious custom, first called to the attention of archaeologists by us, will be more fully referred to later.

Galena.—In the northwestern slope of the mound 6 feet from the surface and at no great distance from the base, associated with three "celts" was a small piece of galena.

Similar bits of lead sulphide are common in the western mounds and are found in southern mounds north of Florida. Galena was highly prized by the aborigines for its bright appearance and crystalline fracture. We have no record of the reduction of the metal from the ore. We have found but one other bit of galena in the mounds of the St. John's, namely at Tick Island, where its depth indicated an original deposit.
Copper.—In every portion of the mound, superficially and almost on the base where the mound was of the greatest height, were various objects wrought from or coated with, sheet copper. This sheet copper had the appearance of being an Indian product, reduced to the desired thickness by hammering, while the design, apparently produced by pressure, seemed to indicate aboriginal work, an opinion shared by Dr. Dall to whom a specimen of the workmanship in copper has been referred, and by Professor Holmes who has examined the entire collection.

Two feet from the surface was a concavo-convex disc of sheet copper centrally perforated. Its diameter was 1 inch. Such discs are reported from various sections, and somewhat similar ones are figured by Squier and Davis.\(^1\) In one of the mounds they found a block of compact sandstone with circular depressions and suggest the probability (page 207) that these depressions were used as moulds to give the discs convexity through the medium of pressure. Other copper discs closely resembling the Mt. Royal specimens are reported from Tennessee,\(^2\) and described as probably “relics of De Soto,” an opinion which we do not share.

Copper and copper coated beads in various forms were found throughout the mound.

One form consisted of a section of a reed thinly coated with copper, forming a tubular bead. Rau in “The Archeological Collection of the United States National Museum,” page 62, describes similar ornaments, though somewhat longer, from an Indian grave near Newport, R. I. “These tubular ornaments, however,” he says “though covered with verdigris, cannot be very old, considering that each of them encloses a tightly fitting piece of reed of equal length, evidently stuck into the cylinders for diminishing the width of the holes, and even remnants of a narrow thong by which they were connected or attached, have been preserved. It is probable that the tubes are of Indian (not European) workmanship, and their appearance bears witness to a comparatively recent origin.”

We are inclined to believe that a conclusion as to a comparatively modern origin can hardly be based upon the preservation of the reeds and of the thong. The preservative action of the salts of copper is well known.

Beads of sheet copper were found in Ohio by Mr. Moorehead.\(^3\)

Three feet down was a piece of sheet copper, 4 inches by 2\(\frac{1}{12}\) inches pressed to form a central protuberance or boss 1\(\frac{1}{25}\) inches in diameter at the base. It was centrally perforated.

Five feet below the surface was an oblong sheet of copper 2\(\frac{1}{4}\) by 1\(\frac{9}{10}\) inches. The thickly corroded surface was subsequently cleared by the use of dilute acid, showing the plate to be of irregular thickness, varying from \(\frac{1}{16}\) of an inch to almost a cutting edge and revealing an interesting design made, we believe, through pressure, as striæ were plainly visible on the indented surface (Fig. 14).

Three feet beneath the summit plateau were two objects of sheet copper which apparently had been attached to wood, particles being still adherent. One, 1\(\frac{1}{5}\) inches

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square, had in the center a hollow boss from which ran beaded lines to the four corners (Fig 15).

The other, oval, 2½ inches by 2½ inches had also a boss-like, perforated protuberance (Fig 16). Ornaments suggesting this pattern appear in various plates of Le Moyne and notably in Plate XVIII where King Outina is decorated with numbers of them.

In association with them were beads of wood thinly coated with sheet copper, beads of shell and the crowns of nine human molars, one premolar, one canine, and one incisor. The custom of placing human teeth,¹ unaccompanied by other remains, with objects of copper was very noticeable at Mt. Royal, where it was of frequent occurrence. It may be suggested that in a mound where human remains were so greatly affected by decay other parts of the skeleton placed with the metal had entirely disappeared. To this it may be said that bones contiguous to copper are hardly likely to be destroyed. Moreover, as we shall see later, in a low mound in the pine woods of Lake County, teeth, not connected with skeletal remains, were repeatedly found in association with objects of copper, and in this mound the bones were in a much better state of preservation. In but two mounds of the St. John's River have we found objects of copper other than superficially, and in but two (the same) did the burial of human teeth, extracted from the jaw, prevail.

Mr. Moorehead,² in an Ohio mound, found a human tooth with a deposit of copper beads, which "from contact with them was almost as green as the copper itself."

¹ As a rule, but not always, crowns of the teeth alone were met with.
Near the center of the mound, two feet from the surface, unassociated, was a pin or piercing implement of copper; length 2·75 inches, thickness 1 to 2 of an inch. A portion split from the main part indicated its manufacture by hammering from sheet copper.

Twelve feet from the center of the mound, 5 feet from the surface, was an object of great interest, consisting of a sheet of copper 10·6 inches square, centrally decorated with seven depressed concentric circles and having a figure in each corner, the conventional aboriginal bird’s head (Plate 1).\(^1\)

Beneath the upper plate of copper was a layer of reeds laid side by side and bound together by closely woven vegetable fibre. On one side, however, the reeds were replaced by twisted vegetable fibre of equal length and diameter. Behind this layer was a backing of bark about 25 of an inch in thickness. Next came another copper plate bent over on itself, projecting beyond the other layers on one side. It was ornamented with corrugations running in different directions. Behind the copper were fragments of wood one inch in thickness, probably remnants of a plank serving as a final backing to the various layers. An interesting fact noted in connection with the upper plate was that a broken portion had been repaired by the aid of rude copper rivets.

This object, worn as a breast plate, might seem sufficient to stop an arrow,\(^2\) and probably is of the nature of the copper chest pieces seen by the huguenot Laudomière, and figured by Le Moyne.

Immediately below this object were small fragments of a human cranium with teeth, and two pearls, one with lateral perforation. In addition, covered with a thin coating of sheet copper, were portions of the upper and of the lower jaw of a small mammal identified by Professor Cope as the gray fox. The mandible showed perforations as for suspension. In the upper portion the thin metallic coating had been turned in to cover the interior of the orbit. Teeth of the deer, treated in the same manner with sheet copper, have been found in an Illinois mound.\(^3\)

Six feet from the surface were ten cylindrical beads of wood, thinly covered with sheet copper, averaging 1·06 inches in diameter and 2·75 of an inch in height. With them were five elongated beads of a like character tapering toward each extremity; also two cylindrical beads of shell; the crowns of two human molars, and one premolar; all bright green through contact with the metal.

Objects of wood, copper coated, have been found in the stone graves of Tennessee.\(^4\)

Seven feet from the surface was the small and beautiful arrow head to which reference has been made. In association with it were beads of copper, or copper-

\(^1\)The upper copper plate, greatly corroded, was unfortunately broken in transit. It is, however, capable of restoration. A careful sketch on scale was made at the time of its discovery.

\(^2\)Wonderful accounts, however, as to the power of the Indian bowmen are given by Cabeza de Vaca and by the chroniclers of De Soto.

\(^3\)Bulletin of the Buffalo Society of Natural Sciences, March, 1887, cited by Nadaillac.

coated, still strung on a cord of vegetable fibre, with three spherical pendant beads, a large one between two smaller ones. The beads, barrel-shaped, were 6 of an inch in length. With them were human teeth and many small pieces of sheet copper, evidently fragments.

In association with a polished hatchet, 5 feet from the surface, was a piercing implement of copper, similar in shape to the one previously described. Its length was 8-8 inches. With it was a disc of the same metal, badly corroded, with a central boss surrounded by a beaded margin. The diameter of this disc was 2 inches.

Two-and-one-half feet below the surface of the western slope were two objects, probably of soft limestone, the upper surface thinly coated at places with sheet copper, at others exposed by erosion (Fig. 17). In appearance they greatly resembled large cuff-buttons. Their diameter was 1-75 inches; diameter of the expanded portion of the shank 1-12 inches; height 6 of an inch. They were probably ear plugs worn in an enlargement of the lobe of the ear, a use to which, it has been surmised, the spool-shaped copper ornaments of the mounds in other localities were put. Many of Le Moyne’s plates\(^1\) represent ear decorations of surprising size. While his pictures are doubtless exaggerated, they are unquestionably based upon facts observed by him during his visit to Florida, (1565).

Somewhat similar ear plugs are figured as coming from a stone grave of Tennessee.\(^2\)

Three feet from the surface, unassociated, was a bead apparently of limestone, copper-coated, one inch in length and 8 of an inch in diameter. At various depths throughout the mound were beads of clay and of shell similarly coated.

In the northwest slope, 6 feet from the surface, was a sheet of copper about 6 inches by 6 inches, in two fragments. It was enclosed in a matting apparently of reeds, flattened or split and woven together. Such matting is described as found in other sections of the country.

The discovery of copper in considerable quantity is new to the records of mound investigation in Florida. In the publications of the Smithsonian Institution no reference is made, we believe, to the occurrence of copper in the mounds of that State, nor have authorities at the Institution been able to indicate references of such a character. Mr. Douglass, during his extensive mound investigations on the east coast, found but two objects of copper: one, a bead in the mouth of a skull, which he believed to be intrusive; the other, a fragment of a spool-shaped ornament.\(^3\) Excluding a hawk-bell and metal buttons, probably brass, from the Dunn’s Creek mound, and plated wire of copper or brass found in association with iron at Mulberry mound, all of which articles were clearly of European origin and

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1. *America Narrativa,* De Bry, Frankfort, 1591.
2. Antiquities of Tennessee.\(^4\) page 168.
3. Andrew E. Douglass, Esq., in private letter.
all superficial, we have found copper in but two mounds of the St. John's River, in both cases scattered from the base to within a short distance of the surface.

That the Indians of what are now our Northern States made use of copper in pre-Columbian times is gainsaid by none.

That, ignorant of the art of reduction from the ore, they called into requisition native copper, and that this native copper, found in sufficient quantity in the Lake Superior region only, consists of the pure metal with occasional admixture of metallic silver, is generally admitted.

That the Indians of our Southern States were in possession of a certain amount of copper at a period too early to account for its acquisition under the hypothesis of barter with, or plunder from, the whites is indicated by the early chronicles.

The source of supply of this southern copper has not been definitely shown.

Careful examination of the western mounds shows the implements of copper to have been hammered into shape, and the sheet copper at times to have been produced by rolling between stones. Now in these same mounds are found drinking cups wrought from the *Fulgur perversum*, with beads and pins fashioned from the axes of great marine univalves native to the southern coast. The presumption that such objects were obtained by barter seems allowable enough and one would naturally look for copper from the western territory in the mounds of, or near, those localities from where the implements of shell were derived.\(^1\) In point of fact, objects of copper, either of, or resembling, the western type, have been found in certain Southern States and have been described as of native copper from Lake Superior, though presumably without the requisite analysis. A complete investigation by chemical tests might reveal the material to be as stated, and would certainly enhance, in any event, the interest attached to the copper. Certain writers, moreover, seem to consider the evidence of malleability displayed by the copper described by them as indicative of native metal. In point of fact, any fairly pure copper though reduced from the ore, could with perfect readiness be hammered into shape. In such matters too many precautions cannot be taken, and in making deductions "it is well to beware of the expected."

Specimens of copper from Mt. Royal were submitted by us to Messrs. Booth, Garrett & Blair of Philadelphia. The result of the analysis made by Mr. Garrett is given herewith:

\(^1\) The piece of copper, 'from an Indian mound,' which you left with us a short time ago, yielded to our analysis:

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<tr>
<td>Copper</td>
<td>99.258 per cent.</td>
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<tr>
<td>Lead</td>
<td>0.758 per cent.</td>
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\(^1\) For the results of investigation in such localities see: C. C. Jones, *op. cit.* pp. 220, et seq., and 223, et seq. Thruston, *op. cit.* pp. 25, 70, 169.


"We also examined the sample for silver, antimony, tin, bismuth, iron and zinc, but found no indication of their presence.

"The sample was very much corroded and was cleaned with acids before analysis.

"We do not think that this copper came from Lake Superior, since we have never found lead in any sample that we have examined; neither can we find any record of its presence in any published report."

Extended investigation shows no report of the presence of lead in native Lake Superior copper.

The result of this analysis indicates the copper in Mt. Royal as obtained:

1. through intercourse with Europeans,
2. from aboriginal sources other than the Lake Superior region.

Of this matter we shall speak farther in Part II of this report.

Miscellaneous Objects.—On the base of the mound, near the center, associated with pottery, in the neighborhood of the chert and hornstone fragments already described, was the columella of a marine univalve, ground at the beak.

During the excavation, the enamel-like covering of the crowns of two teeth of the man-eating shark were met with.

Conclusions.

So great a mass of sand is piled up at Mt. Royal that a total demolition of the mound was not attempted, and we are, therefore, debarred from forming final conclusions. Among the hundreds of objects taken from the great mound was not one bead of glass nor implement of iron, nor was any object met with obviously of European manufacture, or of necessity connecting the mound with a period subsequent to the arrival of the whites.

Small Sand Mound near Mt. Royal.

Four hundred yards north by east of the great mound was a small sand mound which we totally demolished. Its height was 3 feet 2 inches, its circumference, 195 feet. It was unstratified. A little west of the center was a pocket of shell on the base. No skeletons were met with, nor relics of any sort, with the exception of two fragmentary arrow points of chert.

Sand Mound near Hitchen's Creek, Volusia County.

About half a mile south of Volusia Bar, Hitchen's Creek, a waterway connecting the river with Lake George, enters the St. John's. On the left hand side, going up, about a quarter of a mile from the point of union, is the home and grove of Miles Revels upon a large deposit of shell. A quarter of a mile north of the house in the palmetto hummock is a sand mound 5 feet 8 inches in height and 243
feet in circumference. The mound is of a brown loamy sand filled with palmetto roots. Upon it is a small frame house. A trench, 10.5 feet by 7 feet, along the base on the east side showed no stratification.

Human remains in a bad state of preservation were met with. Two feet below the surface was a small pendent ornament of hard trap grooved for suspension (Fig. 18). The presence of the dwelling prevented satisfactory investigation.

**Sand Mound Near Duval’s, Lake County.**

Directly opposite the point of union of Hitchen’s Creek with the St. John’s, Blue Creek joins the river. This name is given to a waterway which, making a detour, joins the main stream about three miles farther south, forming an island of what otherwise would be a portion of the main land. On the right hand side of Blue Creek, going south, about half way up, is a shell deposit some two acres in extent. The spot is uninhabited, but is reported to belong to a person named Duval. Following a path running north through the clearing and turning west into the pine woods, one comes upon a sand mound about 200 yards distant from the creek. The mound is now virtually demolished. Its height was 5.5 feet, its circumference 165 feet. It was thickly covered with scrub oak and scrub palmetto whose roots, permeating the mound, made satisfactory investigation difficult.

**Composition of the Mound.**

About one foot beneath the surface of the mound, which was otherwise composed of the white sand of the surrounding territory, ran a layer of pinkish sand, having a maximum thickness of 18 inches. At places, especially in the neighborhood of any deposit of pottery or of implements, the sand had been given a brick red hue.

Chemical analysis showed the coloring matter to be pulverized hematite. This tingeing of the sand, it will be remembered, was noticed at the Dunn’s Creek mound and at Mt. Royal. We shall refer to it again in the case of a mound shortly to be described.

About 15 feet from the southern margin of the base and three feet below the surface was a small local deposit of *Paludine*. Otherwise the mound was devoid of shell.

**Human Remains.**

Burials were all original, lying under the unbroken stratum of pink sand. They were mainly on or below the base and were all of disconnected bones, crania greatly preponderating. Occasionally one or two long bones lay together, but no ribs nor any of the smaller bones were apparent, save occasional cervical vertebrae.
in connection with the skulls. At one spot near the center of the mound, with no long bones in association, at a depth of 6 feet, were 6 crania almost in contact. With them were a lance point of chert and several fragments of pottery.

The affinity of certain plants for nitrogenous elements was well exemplified in this mound. Masses of roots, in some cases almost solid, filled the skulls, forming a perfect cast of the cavity, somewhat resembling a cocoanut when the moldering remains fell asunder.

No bones were in condition for measurement.

With the exception of several arrow points and 2 pots, one semi-ovoid in shape (Plate VIII, fig. 1), nothing of interest was recovered.

About 100 yards southwest of the burial mound is a low sand mound of unusual shape. Partial excavation yielded nothing. A diagram is appended.

Sand Mound in Pine Woods, Lake County.

Following the trail from Duval's clearing and passing the two mounds just described, at a distance of about 2 miles in the pine woods we found an unstratified mound of pure white sand containing occasional pockets of red sand surrounding deposits of implements, pottery, etc. Its shape was a symmetrical truncated cone. Its height was 4 feet 4 inches, its circumference 180 feet. It was leveled to the base.
Owing to its isolated position its existence was known to but two or three persons and no investigation had ever been attempted.

HUMAN REMAINS.

In this mound, burials were of the bunched variety.

_Crania._—In all, 30 crania were met with, of which several were saved. At times bundles of long bones were found without the skull, while in other portions of the mound fragments of isolated crania were encountered. At times great bunches of long bones were found with two or three crania in association. These bunches were taken out in a solid mass, almost without exception thickly enveloped by roots. Roots of the scrub palmetto ran in numbers through the shafts of the long bones, partially filled the crumbling skulls and appeared in bunches through the sockets of the eyes. Most skeletons lay near or upon the base. Exactly in the center of the mound, in actual contact, were seven crania surmounted by a mass of long bones lying at all angles and in all planes. With the long bones lay mandibles, pelves and scapulae, but smaller bones were wanting.

_Humeri._—Five humeri showed three perforations, a percentage of 60. Of the perforated, two were from the left side and one from the right. Two were male and one of uncertain attribution.

### Femurs.

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**IMPLEMENTS, ORNAMENTS, ETC.**

Unassociated, completely encysted in a mass of roots, was a spherical bead of calcite having a diameter of one inch.

Apparently unassociated with human remains were several small pieces of sheet copper; one fragmentary cylinder with overlapping edges, fashioned from sheet copper; four human incisors and one canine; nine shell beads with a diameter of one inch each, and sixteen smaller beads of shell.
THE ST. JOHN’S RIVER, FLORIDA.

With no human remains in the immediate neighborhood were an unwrought river pebble; a fragment of sheet copper; a small implement of shell that crumbled upon exposure to air, and a pendent ornament of hard polished trap rock (Fig. 19).

In another portion of the mound was a small copper cylinder with overlapping edges, and a piece of sheet copper.

With a portion of the shaft of a human femur were a number of shell beads; one bead of calcite; small pieces of sheet copper; fragments of decaying wood, upon which the metal had served as a coating; several small bones of lower animals, dyed a bright green from contact with the copper, and a beautiful hoe-shaped implement of polished trap rock, 7-3 inches in length, with a maximum breadth of 5-2 inches (Fig. 20).

The hoe-shaped type of implement is hitherto unreported from Florida. Colonel Jones’ describes a specimen from Georgia which differs from the attribution of Squier and Davis who classed one of its type among ornamental axes. The implement found by us seems to show slight marks of wear upon the edge, while the specimen described by Colonel Jones has marked abrasions. A somewhat similar implement is figured as from Arkansas, and is described by Professor Holmes as an “implement or ceremonal stone.” The Smithsonian collection includes three of these implements from Louisiana, and we read of an object of light blue slate from Canada suggesting this type though the shank is more elongated.3

At several points in the mound the crowns of human teeth were found in association with copper which had imparted to them a bright green color. This inhumation of teeth, unassociated with other human remains, we have noticed in but one other mound of the St. John’s, namely, Mt. Royal. As we have previously stated, Mt. Royal and the mound under discussion were the only two among all the river mounds investigated by us which yielded copper showing aboriginal design.

Analysis of the copper from this mound was made by Mr. Garrett, of Booth, Garrett and Blair, who returned the following report:

“The last sample of copper from an Indian mound which you submitted to us was almost, if not quite, oxidized through and through, and therefore we could not remove the earthy matter from its surface, but treated the whole with acids, etc.

“The sample consisted almost wholly of copper with traces of lead, and also a little iron and alumina, with a little sand; these last three substances coming from the earthy coating. We found no silver in the sample.”

The result of this analysis is virtually the same as that of the copper from Mt. Royal.

2Third Annual Report Bureau of Ethnology, page 470, fig. 152.
3Annual Report Canadian Institute, 1887, page 82.
Fig. 20. Hoe-shaped implement (full size).
Pottery.—The pottery of this mound showed marked peculiarities which will be described at length by Professor Holmes. Three small pots, perforate as to the base, were taken unbroken from various portions of the mound. One with an upright projection from the side (Plate VIII, fig. 2) closely resembled a class of pottery to be described later in connection with the Thursby mound. In this case, however, the projection, or handle, did not start from a thick mass at the bottom and extend upward along the side, but had its origin at the margin of the aperture.

Sherds wrought to resemble rude arrow heads were notably absent in this mound, as we have noticed to be the case where the makers of the mounds seem to have been well provided with objects of value for inhumation.

Near the eastern margin of the mound was a solid animal head of pottery 4-75 inches in length, with a maximum diameter of 21 inches. The body was wanting (Plate VIII, fig. 3). Professor Cope considers this head as probably having formed part of an effigy of the marsh rabbit. Arthur E. Brown, Esq., Superintendent of the Zoological Society of Philadelphia, is strongly impressed with the reptilian cast of features, and thinks it not unlikely that the fragment represents the head of an Iguana, an animal found in regions south of Florida.

Near the eastern margin of the mound, just below the surface, was a spool-shaped object of pottery with central longitudinal perforation. Length 6-5 inches; 5 inches and 4 inches in diameter at ends. A broken surface at each extremity debar any determination of the use of this curious object (Plate VIII, fig. 4).

Entirely unassociated, was found a curious pendent ornament of clay, perforated for suspension (Plate IX, fig. 1).

Another remarkable object was a coarse, thick, hollow, truncated cone of pottery, laterally flattened, 4-4 inches in height, 6-5 inches in greatest diameter, maximum width 4-4 inches. The bottom had been intentionally omitted in manufacture. On either side of the upper margin were apparently remnants of a handle (Plate IX, fig. 2).

The gem of the collection from this mound was an animal effigy in clay, probably representing a turtle. The head was extended, the tail curved upward, the body was hollow. The sides and legs were ornamented with lines and dots in a pattern common to certain sherds in the mound. Remains of red pigment were traceable upon the body. From point of snout to tip of tail this curious effigy measured 11-7 inches, its average width being 4 inches, its height 4-5 inches (Plate X).

During the demolition of the mound certain sherds were found allowing of partial restoration, the result indicating a gracefully shaped urn (Plate XI).

Conclusions.

The mound in the pine woods near Duval’s well illustrates how certain sand mounds, resembling each other in a general way, vary in detail. The inhumation
of teeth unassociated with the jaw; the presence of sheet copper with aboriginal designs; the admixture of pulverized hematite with the sand in places, and the burial of objects of value, unassociated with human remains, as if through respect for the dead in general, would seem to connect the builders of this mound with the race that heaped up Mt. Royal.

On the other hand, the total absence of polished hatchets and the presence of curious effigies and forms in pottery are a departure, so far as our investigations indicate, from the customs of those who built Mt. Royal.

Low Sand Mounds near Volusia, Volusia County.

The small town of Volusia lies on the right hand bank of the St. John's about 8 miles above Lake George. Shell deposits line the river's bank, while the Dillard grove in the rear is situated upon great ridges and heaps of shell. In woods about 400 yards northeast of the town was a group of low sand mounds probably five in number. The country is somewhat uneven in character and various knolls might readily be mistaken as of artificial origin. The mounds lay near together and were unstratified, consisting of the same brown sand as the surrounding territory.

The mound of the greatest altitude had a height of 3 feet 3 inches; the lowest was but 1 foot 9 inches in height.

These mounds were partially excavated during July, 1892, by Charles and Barney Dillard of Volusia, this being the only occasion when work was done upon any mounds included in this report otherwise than in our immediate presence. From the mounds on this occasion were taken many fragments of large vessels which we have examined and found to be of coarse yellow clay, made by means of the coil by which, it will be remembered, a vessel of pottery was constructed much after the manner of a straw hat. These fragments were apparently all of vessels having perforations in the bottom, intentionally made previous to baking. Red pigment had been used for purposes of decoration. The pottery was otherwise unornamented. How much pottery was broken through imperfect methods of excavation we are unable to state. Two large fragments (Plate XII, figs. 1 and 2) and a vessel in perfect condition (Plates XIII and XIV) are now at the Peabody Museum. The shading in the illustrations indicates the painted decoration. The unbroken vessel has a height of 15.5 inches, its breadth is 19 inches, the aperture is 10 inches in diameter; while the perforation at the base, made previous to baking, has a diameter of 3.5 inches. This urn-shaped vase is characterized by Professor Putnam as "an entirely new form of utensil for archaeologists to puzzle over." Another large pot, now in the Wagner Free Institute, Philadelphia, has a height of 10.25 inches, a maximum diameter of 15.5 inches with a diameter of 9.5 inches across the aperture. Through the base is a perforation made previous to baking, having a diameter of 2.5 inches. The ornamentation of this vessel consists of bands laid on with red pigment. One encircles the upper margin.

THE ST. JOHN'S RIVER, FLORIDA.

this band three others extend vertically, two being surrounded by double curved stripes, the other by only one.

In addition to this pottery, nothing, with the exception of two arrow heads and human remains, rewarded the search of the Dillards.

November 13, 14, 15, 16, 1892, were devoted by us to careful work on such portions of the mounds as remained. The burials were all of the bunched variety, the cranium surmounting the bundle of long bones arranged horizontally. Upon at least four occasions—a feature never noticed elsewhere in our mound investigation—large fragments of pottery were placed in actual contact on the skull. In one case the top of a large vase laid over a skull had somewhat the appearance of a hat. When, as was sometimes the case, the cranium lay beneath the bundle of long bones this did not occur. One skull showed an ugly perforation, oval in shape, 5 of an inch by 3/2 of an inch, in the right half of the occipital bone and occupying the center of the triangle formed by the median line of the bone, the right half of the superior transverse line and the lambdoidal suture. The blow seemed to have been delivered obliquely. There was no splintering of the inner table nor any exostosis, nor were any scratches or cuts apparent on the outer surface suggesting trepanning.

No crania were saved in condition for measurement.

Of 6 humeri, 4 showed perforation.

One tibia showed an index of 64.4.

One femur gave an index of 136.

Lying in immediate association with a bunched burial were found together two arrow heads; three chipped implements of chert, the largest having a length of 5 inches; one spear head; four chips; two cores; a fragment of sandstone, and three pieces of shell implements.

Several additional arrow heads were found during the excavation. While fragments of large vessels were numerous, admitting of partial restoration, our search yielded but one unbroken vessel, a small earthenware pot decorated with crimson pigment. In this case a hole had been intentionally knocked in the bottom, and not made previous to baking.

In none of the river mounds have we seen pottery approaching the size of that from the low mounds of Volusia; while the curious custom of manufacturing mortuary pottery with intentional perforation of the base previous to baking, a class of pottery that could serve no purpose in the land of the living, is especially emphasized in these mounds. We are of the opinion that the breaking in pieces of whole pottery when interred with the dead did not obtain with the Indians of the river, since vessels when found broken lay in place as crushed by the weight of sand. When disconnected fragments have been found with a skeleton they have often proved to be of different patterns, and never capable of restoration. The mutilation of pottery by perforation at the bottom is referred to by Squier\(^1\) as practised by

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\(^1\)Aborig. Mon. of the State of New York, page 71, foot note.
Florida Indians and by those of Oregon "to remove any temptation to desecration of the grave which might otherwise exist."

Mr. Beauchamp tells us, speaking of later Indians, that "one feature of the copper kettles found in the ossuaries, or bone-pits, is hardly creditable to the Canadian Indians, at least the Hurons. When placed in graves they were almost universally perforated at the bottom, to render them useless, and so prevent robbery of the tomb." We presume reference is made to the kettles.

Of this same custom prevailing among the Hurons we read elsewhere that "after the arrival of the French, brass kettles were often buried with the bones. These were purposely damaged at the time of interment by having a large hole knocked in the bottom with a tomahawk. As many as twenty of these kettles have been found in some ossuaries, especially those of the townships of Medonte. Besides kettles, they buried copper and glass beads, wampum, pipes, pottery, copper and stone axes, chisels, and, in fact, almost everything to be found in a Huron household."

We are of the opinion that the mutilation of pottery was practised in the observance of some sacred rite, rather than for removal of incentive to theft. Unbroken articles of great value to aborigines, as we are told, were placed with the kettles by the Hurons, while we have observed how mounds, perfect mines of wealth, were left unmolested by the Indians of Florida, inspired, doubtless, by a superstitious terror or reverence for the dead.

We are unable to find, however, that Indians other than those of the St. John's River, made mortuary pottery with perforation of the bottom previous to baking.

Nothing indicating contact with Europeans was found on the base of the Volusia mounds. One bead of blue glass was thrown out from the largest mound while digging the second course. That is to say, one series of spadefuls had been dug from the surface. A spade penetrates about 8 inches. If the bead lay on top of the contents of the spade, as to which we have no means of knowing, its depth below the surface was 8 inches. If, on the other hand, its position was beneath the surface of the second course, it may have attained a depth of 16 inches. These mounds are reported by the inhabitants to have been under cultivation, and well marked furrows are in the neighborhood. A considerable party working with trowels a number of days would, it would seem probable, have discovered beads with the skeletons had any existed, and it is our belief that this solitary bead, at one time superficial, owed its position when found to the agency of the plow.

Bluffton.

Bluffton, formerly Orange Bluff, lies on the east bank of the St. John's, about four miles south of Volusia, Volusia County. It has long been under cultivation

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1The American Antiquarian, May, 1880, page 167.
2Annual Report Canadian Institute, 1887, page 88.
and many objects of interest have been found in the vast shell deposits now covered with orange trees. In addition to many shell heaps there are upon the place a conical mound of sand and shell, which has not been thoroughly investigated, and a mound of sand somewhat more oblong in form than the usual truncated cone. For permission to investigate this mound we are indebted to William Edgar Bird, Esq., the owner. Professor Wyman, a score of years ago, made a superficial examination of one of these mounds and finding skeletons, naturally supposed the tumuli to have been erected for purposes of sepulture. While both mounds at Bluffton contain intrusive burials, the results of our investigations show that the sand mound, at least, had probably been constructed for a different purpose.

In the month of March, 1879, we were permitted to make a superficial examination of the sand mound, and were rewarded by the discovery of the skeleton of a man, lying a short distance beneath the surface. In association were a tube of stone (Fig. 21) and a fragment of human skull ornamented with incised lines (Fig. 22).

This section of cranium possessed deep interest, since at that time the discovery of no other ornamented piece of human bone was on record in the United States, while but two specimens showing workmanship had been reported.1

Of this fragment of human bone, now in the Peabody Museum of Archaeology, Professor Putnam writes as follows: "I have looked up the piece of skull that you sent in 1879 from the mound at Bluffton, and enclose an outline of the same showing the lines cut upon the fragment. It is beyond question a piece of the parietal bone of a human skull. It was probably a circular ornament cut from a parietal bone such as I have found several times in Ohio, some of which are very elaborately carved and correspond to the shell ornaments of the same circular shape. I have also seen one of these circular pieces of parietal, from an Indian grave in Ontario, not carved but simply perforated for suspension, so that this cutting pieces of the human skull for ornaments seems to be rather widely spread—say Florida, Ohio, Canada."

1 "Fresh Water Shell Mounds of the St. John's River, Florida," page 37.
2 Jeffries Wyman, op. cit., page 63.
3 JOUR. A. N. S. PHILA., VOL. X.
An analysis of the stone tube is reported from the Peabody Museum as follows: "Rock seems to be a light volcanic rock, probably a tufa derived from the lava called andesite. Not found nearer than the Rocky Mountain region in the U. S."

The occurrence of cylinders of stone and of pottery is reported from Florida to Canada. Their use is uncertain, though the weight of opinion inclines to their employment in the smoking of tobacco. Fig. 23 represents a tracing made from Troano Codex, by H. C. Mercer, Esq., to whose courtesy we are indebted for its use.

At the time of our second visit (1892) the mound was 14 feet in height and 305 feet in circumference at the base. On the summit was the usual plateau. Upon the sides grew live oaks of considerable size, the circumference of the largest being 9 feet at a distance of 5 feet from the ground. The sand of which the mound is mainly composed seems to have an admixture of clay, rendering it cohesive and difficult to dig.

On the east an excavation was made with a width of 5 feet at the start, broadening almost immediately to 8 feet, then to 11.5 feet and decreasing to 10 feet and to 8 feet at the end. This trench, at times converging toward the base, was 38 feet in length, with a maximum depth of 12 feet.

The mound is built on a large deposit of shells which forms its base and extends on every side beyond. At the point where the trench was begun it was necessary to dig through 2 feet of sand to reach the shell deposit. Of these, one foot belonged to the present height of the mound, and the other foot may be considered as a part of the original height before a stratum of sand of that thickness was formed on the surrounding shell deposit. The excavation passed through the center of the mound which is not entirely regular in shape, being somewhat elongated to the north and south. It would seem, judging from the various strata as shown in the plan, that a smaller mound, having its apex to the east of the present center of the mound, had been covered with light brown sand containing a slight sprinkling of shell and a certain percentage of clay, and that this outer layer had not been put on in a way to continue symmetrical stratification.

About 25 feet from the beginning of the trench, the strata C, D, E, F (see plan) began abruptly. It is highly probable that these layers owe their discontinuance at this point to some previous comparatively superficial excavation. The strata B, C, D, E, F, viewed in connection with other mounds, present no remarkable features, with the exception of the "muck" layer, D, which we have seen in but one other mound in the river. No reference to such a stratum existing in any

1 Annual Report of the Canadian Institute, 1887, page 41.
THE ST. JOHN'S RIVER, FLORIDA.

A, center of plateau; B, brown sand and shell; C, lighter brown pure sand; D, "Muck" layer; E, brown sand with slight admixture of shell; F, shell; G, brown sand with slight admixture of shell; H, shell base; K, apex of shell base, L, balls of sand; M, point where C, D, E, F, were lost; N, beginning of excavation.

other mound of the State has come to our notice. The material, while in the mound and damp, could be moulded like wax, and slices cut from it resembled the section of a truffle. Some hundreds of yards from the mound is what is termed a "muck pond," and from this was probably taken the material which, with an admixture of clay and sand formed the stratum.

The point at which the various strata reached their highest, with the exception of the outside covering of brown sand, was distant 8 feet east of the termination of the trench, at which point these strata had considerably descended from said apex. At the base was a shell ridge (K), probably an irregularity of the shell deposit previous to the formation of the mound.

About 5 feet from the surface, above the apex of the shell ridge (K), were found two balls (L), nearly round and about one foot in diameter. They were apparently composed of a mixture of sand and clay, with an intermingling of bits of charcoal and fragments of calcined shells of Unto. The balls had apparently been subjected to heat, having a hard outside coating varying from 25 to 5 of an inch in thickness. They were broken with great difficulty.

HUMAN REMAINS.

With the exception of intrusive burials which were frequently met with at a short distance below the surface, no human bones were found during the entire excavation. From intrusive interments three humeri were obtained, all perforated. Two tibiae belonging to one body had marked anterior curvature. Their indices were 73.8 and 75.8

IMPLEMENTS, ETC.

Three broken arrow heads, superficial and probably belonging to the period of the burials; a tubular bead of shell 2-1 inches in length, 3 feet from the surface (Fig.
CERTAIN SAND MOUNDS OF

24); three flint flakes, various depths; implement of deer horn 5·5 feet down, much resembling the wedge of elk horn figured in Plate XVIII, Smithsonian Report, 1886, Part I.

Pottery.—With the exception of two fragments on the immediate surface, no pottery was met with during the entire excavation. The shell deposit of Bluffton is the largest in area of any on the river, covering in all about 35 acres, attaining at one point a thickness of 25 feet. In the shell deposits north of the mound, pottery is sparingly met with. It is abundant in the great orange grove to the south. In the immediate neighborhood of the mound a number of excavations had a negative result in respect to the pottery. A natural desire on the part of the owner to avoid injury to his trees prevented a more extended excavation, or a total demolition of the mound subsequent to which conclusions could be more accurately drawn. The entire absence of pottery and of burials other than superficial in a stratified mound would be an anomaly on the river.

SMALL SAND MOUND IN PINE WOODS, LAKE COUNTY.

Immediately opposite Bluffton about a quarter of a mile from the western bank of the river is a small mound of white sand. Previous investigators have made exploration useless.

TICK ISLAND, VOLUSIA COUNTY.

This interesting mound has been four times investigated by us, the results of the first three investigations having been embodied in two articles in the American Naturalist, February and July, 1892, respectively entitled "A Burial Mound of Florida" and "Supplementary Investigation at Tick Island." In all sixteen entire days have been devoted to Tick Island, exclusive of considerable time given to the shell deposits in the vicinity of the mound.¹

Tick Island is reached from the St. John's River by turning east and crossing Lake Dexter to the mouth of Spring Garden Creek, and by following the course of this creek until a tumble-down wharf of palmetto logs is reached, whence a path half a mile in length leads to the burial mound.

Tick Island is separated from the mainland by a narrow waterway, its other boundaries being Lake Woodruff and Spring Garden Creek. The Island presents in parts a wild appearance, covered as it is with gnarled live oak and towering palmetto, with trailing vine and tangled undergrowth, where the presence of the rattlesnake imparts a certain risk to exploration. With the exception of one small house upon the island, at intervals occupied by the hired man whose care it is to look after the orange grove, the nearest point where quarters can be secured is at Astor, eight miles distant on the river.

¹The description of Tick Island and of the earlier investigations are condensed from the articles referred to above.
The burial mound, 17 feet in height (spirit level and tape line measurement), in circumference 478 feet, is conical in shape, save to the East, where from the summit a gradual slope extends into a winding causeway or breastwork.

The base of the mound is composed of shells, apparently brought from the neighboring shell-fields to serve as a foundation in the marshy soil.

Across the center of this layer of shells from north to south runs a ridge of pure white sand. Above this ridge of white sand is a stratum of dark brown loamy sand mingled with shells, while the sides of the ridge are rounded out with brown sand in which shells are wanting, thus forming a symmetrical mound. At the center of the mound the brown sand layer was 6 feet 2 inches in depth and the white sand layer 5 feet 8 inches, leaving to the shell base a thickness of 5 feet 5 inches above the level of the margin of the base of the mound. In the northern trench the white sand layer was encountered almost at the start. On the western side it was found at a distance of 30 feet from the margin, while on the southern side it began at 20 feet.

As has been stated, a long and winding causeway joins the Tick Island mound, which on this side, sloping to meet it, is much less steep than elsewhere.

In the rainy seasons, the territory surrounding the burial mound becomes soft and swampy, and a causeway to the place of sepulture would prove of great convenience, and for this purpose the causeway probably served. The raised pathway terminates at a large bean-shaped shell, or refuse heap, upon which and the adjacent acres of shell-fields the Indians doubtless lived.
The length of the causeway, following its curves, is 392 feet, its average height 4 feet; the average breadth of base 25 feet, and average breadth of summit 15 feet.

Leaving one end of the bean-shaped shell heap is a less well defined causeway 228 feet in length. It skirts a portion of the base of the mound, but its point of union, if it ever existed, has disappeared.

In addition to numerous shafts, three trenches were made:
1.—From the northern margin, 46·5 feet long, 13 feet broad and 9 feet deep at the end.
2.—From the western margin, 54 feet in length, 8 feet broad, diverging to 14 feet, and 10 feet deep at the end.
3.—Beginning on the southern slope of the mound, 12 feet from the margin of the base, 53 feet broad, converging to 11 feet in breadth, 43 feet from the start.

These trenches all followed the convex base of shell which attained a height of from 5 to 7 feet at and near the center of the mound.

HUMAN REMAINS.

The great Tick Island mound as an ossuary exceeds any other on the St. John's of which we have cognizance; for while at Ginn's Grove probably, and at Mulberry Mound certainly, more human remains are found on an average in the same area, yet the size of these mounds, in nowise comparing with that of Tick Island, renders much less numerous the total burials contained in them.

Superficially in the brown sand layer were skeletons in anatomical order, possibly intrusive. Throughout the entire brown sand layer were disconnected bones and portions of skeletons in anatomical order. At one place, for example, lay a pelvis, one humerus, one clavicle, one unbroken femur, one in fragments, a piece of the shaft of a tibia, an os calcis, three cervical vertebrae, a fragment of another humerus and a piece of a radius. The breaks were ancient. Jaw bones lay some feet away from other portions of the skeletons. It was evident that remains taken from the bone house had been interred without any attempt at order. Some skeletons, however, probably original, were found in anatomical order in the brown sand or upper layer. At four feet from the surface, not far from the base of the mound, was the skeleton of a young person, as shown by unattached epiphyses. The skeleton was in anatomical order throughout. One wisdom tooth had made its appearance, while the other three were still embedded in the jaw. The first left lower molar was much worn through the dentine, the second was so in places; while the right first molar showed dentine in spots. In the upper jaw also dentine was apparent in the first molars. This excessive wear, remarkable in one so young, has been noticed by us previously in the mounds, and is probably attributable to the nature of the food. If the men of Tick Island were identical with the makers of the shell heaps, the worn condition of the teeth can

\[\text{The skeletons from which, after exposure, the flesh had rotted or been stripped were stored in the bone house against the next date for general interment.}\]
be really understood, a percentage of sand being contained in the shell fish which formed their principal article of diet.\(^1\)

In the white sand layer, burials, save at the top and along the shell base of the mound, were very infrequent, though toward the center a few were found. Both in the shell and above it burials were contiguous at times, and at no point were they widely separated. But one layer of bodies extended into the shell. The bones were usually in anatomical order, though bunched skeletons were met with. The mingling of forms of burial is common on the St. John's as in other portions of the United States.\(^2\)

_Crania._—No crania were saved, all being crushed and decayed beyond hope of recovery. No signs of decay were observed in any teeth, though the marks of an alveolar abscess were in one case apparent. In the four mandibles preserved the teeth are all present.

_Humeri._—During our first two investigations at Tick Island, no notes as to human remains were taken, the bones being sent direct to the Peabody Museum, Cambridge.

During the third investigation 46 humeri were recovered; of these, 16 were perforated, giving a percentage of 34.8.

In the course of the fourth investigation (March, 1893) extreme care was taken. In no case was an instrument\(^3\) used in the removal of sand from the fossæ, while a magnifying glass was called into requisition where a shadow of a doubt existed as to the nature of the perforation. During the entire investigation a trained anatomist was on the ground, and, with three exceptions where determination was impossible, all humeri found were included in the classification.

In the determination of sex, comparison with other portions of the skeleton was sometimes employed. In other cases, where the structure of the bone left room for doubt, the humerus was uniformly placed in the uncertain class.

We have thought it well to keep separate the lists of the bones found in the upper and lower strata, not through the belief that the upper layer was a later addition to the mound or that we consider all its human remains intrusive, but it seems best to keep apart the bones from the base which are beyond suspicion.

**Brown Sand or Upper Layer.**

<table>
<thead>
<tr>
<th></th>
<th>Male.</th>
<th>Female.(^4)</th>
<th>Uncertain.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rights</td>
<td>7</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Lefts</td>
<td>3</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>10</td>
<td>7</td>
</tr>
</tbody>
</table>

Total humeri 46; perforated 25; a percentage of 54.3.

1 We have eaten both *Palaudine* and *Amphollaris* in the form of soup.
3 Gentle motion in water readily disengages sand from the fossæ.
4 The crushing in transit of one perforated humerus precludes data as to its side and size of perforation. The side of one unperforated humerus has been overlooked. These perforated humeri can be seen at the Academy of Natural Sciences, Philadelphia.
CERTAIN SAND MOUNDS OF

WHITE SAND LAYER.

<table>
<thead>
<tr>
<th></th>
<th>Male. Perforated.</th>
<th>Female Perforated</th>
<th>Uncertain Perforated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rights</td>
<td>0</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Lefts</td>
<td>2</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>

Total humeri 88; perforated 15; a percentage of 17.5. Grand total of humeri 84; perforated 49; a percentage of 57.6.

Size of Perforation. White Sand. Measurements are given in mm.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>2</td>
<td>4.75</td>
<td>5</td>
<td>4.5</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>5</td>
<td>6.7</td>
<td>11.5</td>
<td>2.5</td>
<td>2.76</td>
</tr>
<tr>
<td>Uncertain</td>
<td>8</td>
<td>3.3</td>
<td>7.3</td>
<td>3.3</td>
<td>1.47</td>
</tr>
</tbody>
</table>

Brown Sand. Measurements are given in mm.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>10</td>
<td>8.35</td>
<td>12</td>
<td>6</td>
<td>1.45</td>
</tr>
<tr>
<td>Female</td>
<td>7</td>
<td>5.6</td>
<td>9</td>
<td>3</td>
<td>1.7</td>
</tr>
<tr>
<td>Uncertain</td>
<td>7</td>
<td>7.3</td>
<td>9.5</td>
<td>4.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

For details as to the perforation of the septum between the olecranon and coronoïd fossa the reader is referred to Dr. Topinard's Éléments d'Anthropologie Générale, page 1015, et seq., and to an interesting paper by Dr. D. S. Lamb in the American Anthropologist for April, 1890, entitled "The Olecranon Perforation," from which we have borrowed the subjoined table:


** \* ** * The extent of the mean deviation of every member of the list from the general average. For the calculation of the same, the difference between the general average and each member of the list is determined, considering it of like value, whether negative or positive; the sum of all these differences is then divided by the number of individuals in the list. If one indicates the individual differences by \( d \), the sum of the individual differences by \( S_d \), and the number of the members in the list by \( n \), the oscillation exponent corresponds to the formula \( \sqrt{\frac{S_d^2}{n}} \).

To demonstrate the significance of the oscillation exponent in estimating the value of a list, we shall assume that we are dealing with two lists having the same number of members and the same sum, therefore, also the same average, but which are very different. One of the lists consists of the members 1, 2, 3, 11, 12, 15; the other of the members 8, 7, 7, 7, 8. The sum of each of these lists is 42; the average for each is therefore \( 42/6 = 7 \). But the differences between the individual members of the first list and the average are 6, 5, 4, 1, 3, 5; the sum of these differences is 15; the oscillation exponent is therefore \( \sqrt{\frac{15}{6}} \). In the second list the differences are 1, 1, 1, 1, 1; their sum \( = 5 \); their oscillation exponent \( = \sqrt{\frac{5}{6}} \). The size of the oscillation exponent shown, therefore, how closely the members of a list group themselves about the mean; the greater the oscillation exponent, the less uniform (typical) the list, and vice versa."

\* In this list is included as one the sum of a double perforation.
THE ST. JOHN'S RIVER, FLORIDA.

<table>
<thead>
<tr>
<th>No. of</th>
<th>No. of</th>
<th>Per</th>
</tr>
</thead>
<tbody>
<tr>
<td>humeri.</td>
<td>foramina.</td>
<td>cent.</td>
</tr>
</tbody>
</table>
| 89     | 48     | 54  A. M. M. coll.,...
| 150    | 69     | 46  Bull. Anthrop. Soc.,...
| 39     | 39-2   | Topinard,  
| 82     | 34-5   | "    
| 80     | 33-2   | "    
| 20     | 6      | 30  The author,  
| 62     | 17     | 28  A. M. M. coll.,  
| 67     | 18     | 28  Pruner-Bey,  
| 122    | 25-8   | Topinard,  
| 166    | 21-8   | "    
| 97     | 21-7   | "    
| 61     | 12     | 20  A. M. M. coll.,  
| 28     | 14-1   | Topinard,  
| 30     | 12-1   | "    
| 86     | 10-6   | "    
| 388    | 10-6   | "    
| 288    | 7-5    | A. M. M. coll.,  
| 27     | 2      | 7   Anthrop. Soc. Paris,  
| 16     | 1      | 6   A. M. M. coll.,  
| 200    | 3-5    | Topinard,  
| 96     | 5      | 5   A. M. M. coll.,  
| 140    | 4-6    | Topinard,  
| "218   | 4-1    | "    
| 52     | 3-8    | "    
| "218  | 3-2    | Bull. Anthrop. Soc. Paris,  
| 30     | 0      | 0   Topinard,  

authority.

Prehistoric Arizona Indians.
Guanches, Canary Islands. (Verneau).
Yellow and American races.
Melanesians.
Private collection, mainly negro and mulatto.
Indians mounds, U. S.
From Vaureal, France.
Guanches of Canary Islands.
Dolmens and grotttes around Paris. Polished stone.
African negroes.
Prehistoric Indians, ancient cities, New Mexico.
Melanesians.
Dolmens. De Quiberon.
Caverns of l'Homme mort, Lozere. Polished stone.
Dolmens, Lozere. Polished stone.
Mostly white soldiers.
Prehistoric French, Parisian from IVth to XIllth centuries.
Contemporary Indians.
Parishans of Cemetery of Innocents. (Hamy and Sauvages).
Parishans of Middle Ages. (Broca and Batallard).
Europeans of America. Wyman, Peabody Museum.

* Probably same collection.

Length and Torsion of the Humerus.—It is quite evident that comparatively few humeri can be recovered suitable for measurement for length and for torsion, owing to the necessity for the preservation intact of the articular portions.

All measurements for length of long bones are made with the planchette and square.

In determining the degree of torsion we have followed the method of Schmidt with a slight variation. This modification has to do with the determination of the transverse axis of the elbow joint. To fix this line the bone is held perpendicularly with the lower end uppermost, the inner margin presenting itself to the eye. A thread, one end of which is held against the inner surface of the bone by the thumb of the hand grasping the humerus, is carried over the center of the inner margin of the trochea, stretched along the middle line of the articular surface, and carried down the opposite side of the bone to be retained by a finger. The articular surface is then held directly beneath the eye, and the exactness of the line determined. The points at which the thread crosses the articular margins are marked with ink and in the subsequent measurement are made to coincide with a straight line across the base of the instrument. The head of the bone passes above into a notch.

1 See Topinard "Éléments d'Anthropologie Générale," page 1043.
2 "Anthropologische Methoden," page 294 et seq.
3 JOURN. A. N. S. PHILA., VOL. X.
CERTAIN SAND MOUNDS OF

in a sliding shelf which holds the protractor with margin parallel to the base line, and a needle made to coincide with the line previously drawn across the head indicates the degree of torsion.

The results obtained by this method vary from those of Broca, who made use of the inter-epicondilar axis in place of the axis of the elbow joint. An objection to the use of the epicondyles is their variability in size and direction.

HUMERI (BROWN SAND).

Measurements are given in mm.

<table>
<thead>
<tr>
<th>Sex</th>
<th>Side</th>
<th>Length</th>
<th>Torsion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>Right</td>
<td>305</td>
<td>125°</td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td>303</td>
<td>106°</td>
</tr>
<tr>
<td>Uncertain</td>
<td></td>
<td>291</td>
<td>117°</td>
</tr>
<tr>
<td>Uncertain</td>
<td></td>
<td>283</td>
<td>124°</td>
</tr>
</tbody>
</table>

HUMERI (WHITE SAND).

Measurements are given in mm.

<table>
<thead>
<tr>
<th>Sex</th>
<th>Side</th>
<th>Length</th>
<th>Torsion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>Right</td>
<td>292</td>
<td>142°</td>
</tr>
<tr>
<td>Male</td>
<td>Left</td>
<td>320</td>
<td>115°</td>
</tr>
</tbody>
</table>

Femurs.—The index of diameter is taken with the caliper square at the middle of the shaft. The percentage is derived at by dividing the antero-posterior measurement by the lateral measurement.

No femurs were measured as to index where the shafts were incomplete, an accurate determination of the center of the bone being thus assured.

FEMURS FROM BROWN SAND LAYER.

<table>
<thead>
<tr>
<th>Number</th>
<th>Average Index</th>
<th>Maximum Index</th>
<th>Minimum Index</th>
<th>Oscillation Exponent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>22</td>
<td>124·3</td>
<td>133</td>
<td>108</td>
</tr>
<tr>
<td>Female</td>
<td>18</td>
<td>114</td>
<td>121</td>
<td>100</td>
</tr>
<tr>
<td>Uncertain</td>
<td>9</td>
<td>118·7</td>
<td>123</td>
<td>106</td>
</tr>
</tbody>
</table>

FEMURS FROM WHITE SAND LAYER.

<table>
<thead>
<tr>
<th>Number</th>
<th>Average Index</th>
<th>Maximum Index</th>
<th>Minimum Index</th>
<th>Oscillation Exponent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>9</td>
<td>125</td>
<td>138</td>
<td>110</td>
</tr>
<tr>
<td>Female</td>
<td>9</td>
<td>110</td>
<td>121</td>
<td>104</td>
</tr>
<tr>
<td>Uncertain</td>
<td>8</td>
<td>115</td>
<td>122</td>
<td>108</td>
</tr>
</tbody>
</table>
The St. John's River, Florida.

For the purpose of comparison we give a table of indices of the femur given by Dr. Topinard in his "Éléments d'Anthropologie Générale," page 1019, where, in addition, can be found full details as to the pilastered femur.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Anonymous femur</td>
<td>158.0</td>
</tr>
<tr>
<td>1</td>
<td>Cro-Magnon</td>
<td>128.0</td>
</tr>
<tr>
<td>5</td>
<td>Great Canaries, No. 5</td>
<td>117.5</td>
</tr>
<tr>
<td></td>
<td>&quot; No. 1</td>
<td>97.5</td>
</tr>
<tr>
<td>1</td>
<td>Minimum of the latter</td>
<td>90.9</td>
</tr>
<tr>
<td>9</td>
<td>Cavern de l'Homme Mort (polished stone)</td>
<td>109.6</td>
</tr>
<tr>
<td>1</td>
<td>Minimum of same</td>
<td>95.6</td>
</tr>
<tr>
<td>15</td>
<td>Grotto of Bray (polished stone)</td>
<td>106.7</td>
</tr>
<tr>
<td>15</td>
<td>Grotto of Orrony (polished stone)</td>
<td>109.3</td>
</tr>
<tr>
<td>15</td>
<td>Parisians</td>
<td>109.2</td>
</tr>
<tr>
<td>20</td>
<td>African negroes</td>
<td>105.8</td>
</tr>
<tr>
<td></td>
<td>Minimum of same</td>
<td>71.8</td>
</tr>
<tr>
<td>13</td>
<td>New Caledonians</td>
<td>127.6</td>
</tr>
<tr>
<td>2</td>
<td>Rachitic femurs</td>
<td>111.1</td>
</tr>
<tr>
<td>8</td>
<td>Anthropoids</td>
<td>79.7</td>
</tr>
</tbody>
</table>

Attention is called to the maximum index of one femur found at Tick Island; namely, 153. Its mate has been submitted to Dr. Topinard who has kindly furnished the following note: (translation).

"A description of a diaphysis of a femur, submitted to me by Mr. Clarence B. Moore, from a mound at Tick Island, Florida.

"Femur from the right side, originally about 45 centimeters in length, belonging to a subject, male in all probability, about 1.67 meters in height.

"It has a slight inward curve or bend, the center of incurvation corresponding to the junction of the upper and the middle thirds where the two lips of the linea aspera begin to separate.

"The lower end of the specimen is circular, or rather oval, with maximum diameter antero-posterior, showing that a good extent of the bone is lacking at this extremity.

"The upper end terminates below the trochanters, and shows the usual flattening from before backward.

"The middle two-thirds of the diaphysis are compressed laterally, thus losing the prismatic, triangular form ordinarily found at this level. Nevertheless three faces and three borders present themselves: an anterior face, narrow, rounded and limited by the two anterior borders also rounded; an external face plane or slightly convex; an internal face concave longitudinally; and a thick posterior border drawn out into a pilaster.

"The breadth of the linea aspera is notable, measuring 8 millimeters. Below, the margins separate for their course to the condyles; above, the separation is still greater, the internal margin passing toward the lesser trochanter, the external toward the greater."
"To judge by the eye one would place the degree of pilaster at 5 in a table limited by the terms 0 and 6. But in the absence of the extremities a misjudgment is easy.

"By determining the minimum width and the maximum antero-posterior diameter of the bone in the middle region where the femur shows the least thickness the following figures are obtained: width 23 millimeters, antero-posterior diameter 35 millimeters, giving as the index of the transverse section of the femur 152.2, the width being taken as 100.

"The method of the minimum and of the maximum is the one which I employ. One might present the objection that it is necessary to take the two measurements at the same level. But what level shall we choose? The minimum width does not occur at the same point as the maximum antero-posterior diameter; it is found at a point 45 millimeters higher up. If both measurements are taken at this level we have, width 23, antero-posterior diameter 34, index 147.8. If, on the other hand, we make both measurements at the level of the maximum antero-posterior diameter we have, width 24, antero-posterior diameter 35, index 146.0. The difference is appreciable. To escape the difficulty we could take the level midway between these two, giving, width 23, antero-posterior diameter 34.5, index 146.0.

"I believe this last mentioned point was the one adopted by Mr. Clarence B. Moore, as I perceive that it is indicated by a transverse scratch of the finger nail. He is perhaps right in principle, but in practice I believe my process the better. What is really sought? The relationship of the most marked transverse flattening to the greatest antero-posterior development, the two being in inverse ratio and the effect of one and the same case.

"For that matter the result is practically the same in the present instance whether we regard the index as 150 or 152. The femur from the mound at Tick Island has one of the most marked linear asperse of which we are cognizant; it surpasses the femur of Cro-Magnon and approaches the exceptional femur which we have cited in our Elements of Anthropology. If the remaining femurs from the same mound are as flat, we could say that it is an important characteristic of the race to which they belonged.

"In conclusion I would remark:

"1. It would be well to arrange a convenient nomenclature for this character; to find a term to express it.

"2. In my Elements of Anthropology I followed the method introduced by Broca for the determination of its index, taking the width as 100.

"The reverse would be more rational, taking the antero-posterior diameter as 100. In the case of the femur at hand this would give 65.7, which shows at a glance by what percentage the width is exceeded by the antero-posterior diameter."

Five measurements for length have been taken. Two are projections on the axis of the shaft, one from the head, the other from the great trochanter; two give the same measurements with the bone in natural position, while the fifth includes

1 Dr. Topinard’s judicious suggestions were received as we went to press, too late to avail ourselves of them.
the distance between the tip of the great trochanter and the articular surface of the external condyle.

**Brown Sand Layer. Measurements are given in mm.**

<table>
<thead>
<tr>
<th>Sex</th>
<th>Projected on axis</th>
<th>Oblique Position</th>
<th>Great Troch. to Ext. Condyle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Head</td>
<td>Great Troch.</td>
<td>Head</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>406</td>
<td>441</td>
<td>461</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>450</td>
<td>438</td>
<td>445</td>
</tr>
</tbody>
</table>

**White Sand Layer. Measurements are given in mm.**

<table>
<thead>
<tr>
<th>Sex</th>
<th>Projected on axis</th>
<th>Oblique Position</th>
<th>Great Troch. to Ext. Condyle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Head</td>
<td>Great Troch.</td>
<td>Head</td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
<td></td>
<td>450</td>
<td>440</td>
<td>437</td>
</tr>
</tbody>
</table>

**Tibia.**—The platycnemic (sabre-shaped) or laterally flattened tibia, has long been considered a racial characteristic. Its occurrence was reported among the races of caves, barrows and mounds, and among early and unmixed races. It is, however, notably wanting in the skeletons of Spy. Dr. Manouvrier in his "Mémoire sur la Platycnémie chez l'Homme et chez les Anthropoides," an able and exhaustive paper, maintains that "platycnemia results from the need of a surface upon the tibia, broader, more extended, more advantageous for the insertion of the posterior tibial muscle. It results from the marked activity of this muscle, and is in no wise due to the relative predominance of the muscles of the anterior region of the leg, a predominance invoked without proof by various authors.

"Platycnemia favors the resistance of the tibia to an antero-posterior flexion, but it is not produced through need of this resistance alone.

"The function of the posterior tibial muscle, which by its marked activity produces or maintains platycnemia in the human species, is not its direct function, which is the flexion-adduction of the foot, but, in fact, its inverse function, the immobilization of the leg in those movements in which the weight of the body tends to tilt it forward.

"The inverse action of the posterior tibial is called for particularly in running and in walking over rough and hilly ground. Platycnemia, then, should be looked for principally among peoples living in countries more or less mountainous, people following the chase."

" (page 542) "Thus platycnemia in man could be a character transmitted by a climbing anthropopitheus, but it is not a character of either evolution or functional inferiority. The resemblance to the monkey is a purely morphological character retained, be it observed, by a function essentially human; it tends to disappear, among civilized people, only through a diminution of this activity." (Translated).

1 La Race Humaine de Néanderthal ou de Canstadt en Belgique, Recherches Ethnographiques sur des Ossements Humains, découverts dans les dépôts quaternaires d'une grotte à Spy et détermination de leur âge géologique, par Julien Fraipont et Max Lohest. Extrait des Archives de Biologic, tome VII, 1886, page 656; et seq.—See also "Dictionnaire des Sciences Anthropologiques," page 1696.

CERTAIN SAND MOUNDS OF

It is evident that Dr. Manouvrier is a believer in the transmission of acquired characteristics, and through this he would doubtless partially explain the marked platycnemic character of tibiae from the mounds and shell heaps of Florida, a section the monotonous evenness of which is proverbial. In addition, in a discussion on platycnemia following an analysis of the above quoted paper given in advance,\(^1\) to an objection raised as to the level nature of the country where many American platycnemic tibiae are found, Dr. Manouvrier explained that the act of climbing could not always by itself be considered the cause of platycnemia, and that this modification of the tibia was more probably due to the \textit{inverse} action of the posterior tibial muscle in connection with running and jumping. According to Dr. Manouvrier, platycnemia is of somewhat less frequent occurrence and less marked in very large tibiae and in the tibiae of women.

The measurement of the tibia for platycnemia is made at the level of the nutrient foramen. The index is ascertained by dividing the transverse diameter by the antero-posterior diameter, the reverse of the method employed in the case of the femur. Dr. Manouvrier considers as markedly platycnemic all tibiae with an index below 55; as hardly perceptible from 65 to 69, and of the ordinary form with an index of 70 and over.\(^2\) Dr. Schmidt considers within the limits of platycnemia all indices under 65.\(^3\)

During our second exploration at Tick Island 55 tibiae were measured, giving an average index of 63.9. Two tibiae, the most platycnemic, were mates, their indices being 51 and 51.7. Unfortunately, these data were obtained by the aid of ordinary calipers, which allow in some cases a certain obliquity of measurement.

On our fourth visit to Tick Island the following results were obtained:

\textit{Brown Sand, or Upper Layer. Measurement with caliper square.}

\begin{center}
\begin{tabular}{|l|l|l|l|l|}
\hline
Tibia. & Total. & Average Index. & Maximum Index. & Minimum Index. & Oscillation Exponent. \\
\hline
Male . & 19 & 62.4 & 79.4 & 51.1 & 2.76 \\
Female . & 23 & 64.4 & 73.6 & 54.8 & 4.67 \\
Uncertain . & 4 & 62.8 & 68.8 & 59.9 & 2.45 \\
\hline
\end{tabular}
\end{center}

\textit{White Sand, or Lower Layer. Measurements with caliper square.}

\begin{center}
\begin{tabular}{|l|l|l|l|l|}
\hline
Tibia. & Total. & Average Index. & Maximum Index. & Minimum Index. & Oscillation Exponent. \\
\hline
Male . & 11 & 60.4 & 71.8 & 53.5 & 4.6 \\
Female . & 11 & 63.9 & 74.4 & 57.6 & 4.1 \\
Uncertain . & 10 & 60.3 & 65 & 57 & 2.2 \\
\hline
\end{tabular}
\end{center}

ORNAMENTS, IMPLEMENTS, ETC.

From the surface to the base of the mound, associated and unassociated with human remains, were found ten arrow heads and two lance points. Of the lance points one was rude and massive; the other slender, somewhat resembling what is sometimes termed a drill. The material of these points is chert, hornstone and chalcedony. Upon two occasions, three arrow heads were found in association each time with human remains, once superficially, twice, six feet below the surface.

Ten and one-half feet from the surface, with a small hornstone arrow head and human remains, was a sheet of mica 3 inches by 5 inches. This mineral, of comparatively frequent occurrence in mounds to the north of Florida, is very infrequently observed in that State. Upon no other occasion, with the exception of a minute fragment in Mt. Royal, has it been found by us; while Mr. Douglas, in 40 mounds on or near the east coast, met with it in but one. There are mines of sheet mica in North Carolina.

But two of the instruments known as "celts" were found in the mound at Tick Island. Both were superficial and apparently unassociated.

Great numbers of small shell beads were found in connection with human remains, almost invariably near the skull. Eighteen inches from the surface, near the skeleton of an infant, was a barrel-shaped bead wrought from the columella of a large marine univalve. Its length was 1-4 inches, with a maximum thickness of 8 of an inch. In the perforation at one end still remained a small bead of the kind so numerous in the mounds, leading to the belief that these larger beads sometimes served as central ornaments in strings of smaller ones. Mr. Thruston figures a large bead in this association as the probable method of arrangement.\(^1\)

In the white sand layer, with no human remains in association, was a rude pendant ornament of shell, grooved for suspension.

In a mass of brown sand, a "cave" from above, was a stiletto-shaped instrument of bone (Fig. 25). Its length was 9-25 inches; its diameter at the top, from which the articular portion of the bone had been removed, was 1-22 inches. Below the upper margin it was encircled by an incised line while on one side, running longitudinally, were three perforations extending to the central cavity of the shaft. These perforations had each a diameter of 25 inch, and were from 50 to 75 of an inch apart. The implement tapered to a flat point. With the exception of a fragment, doubtless belonging to a similar object, we have met with nothing recalling the stiletto in any of the sand mounds of the river, though at Mulberry Mound, a shell heap of Orange County, two wrought from the canon bone of the deer were found by excavation.\(^2\)

 Implements of the stiletto shape are by no means infrequent in other sections of this country or in Europe. At the National Museum are three implements of bone somewhat resembling the implement from Tick Island. They are about 7-5 inches in length, with rounded points and have but one lateral perforation. They are decorated with three sets of three encircling lines and were found by Dr. J. C. McCormick in a

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Footnotes:
mound in Jefferson Co., Tenn. Professor Haynes is of the opinion that objects of this type were used in the weaving of baskets.¹

In some of the western mounds we learn of their manufacture from the bone of the elk. A peculiar interest attaches itself to the specimen at Tick Island. Professor Cope is of the opinion that in all probability this implement was made from the delicate femur of a young person or of a woman, from which continued scraping has removed all traces of the linea aspera.

We have seen that objects, probably used as gorgets, were made from the human skull, but the record of implements wrought from the shaft of human long bones is meager indeed in this country. Professor Wyman reports² the finding of a worked humerus in a Massachusetts shell heap. Professor Haynes exhibited to the Boston Society of Natural History³ an implement made from the upper half of a human humerus. "The ball of the joint forms the handle, while the shank has been cut down one-half and sharpened to a point."

The use of human bones as implements was not unknown in pre-historic Europe. During the first excavation two portions of the human skull were found, one with two perforations of about the diameter of an ordinary lead pencil, the second with a similar hole in the center and the evidence of another on its margin. These perforations are too small to suggest trephining. The fragments were probably portions of gorgets or head ornaments. We are told of perforated portions of crania in Canada, of one of which we read that it "may have been interlaced with brightly dyed grasses, feathers or porcupine quills, and thus worn on the breast, or it may have formed a base of adornment for head gear.⁴

Six and one-half feet from the surface, in the white sand layer, with a quantity of shell beads, was a lump of galena, coated with carbonate. One foot above in the brown sand layer was an interesting deposit of long pins and bodkins of bone. With one exception, all were in fragmentary condition, though three permitted of subsequent restoration (Figs. 26-31).

One long pointed implement, broken near the head, had been repaired by the aid of perforations drilled in either fragment near the fracture, for the purpose of attachment through the medium of a cord or sinew for which a groove had been worked on either side (Fig. 26). The head of one needle, the point of which was unfortunately missing, showed considerable artistic taste (Fig. 27).

Six feet seven inches from the surface, beneath human remains, was a large Fulgur perversum, fashioned into a drinking cup by the removal of the columella and the inner whorls. The aperture was turned toward the surface of the mound, while above it, as if a species of cover, was a large sherid in fragments. Carefully packed within the shell were two small marine shells; a Fulgur, species canaliculata, and a young Murex spinacostata from which the spines had been carefully removed by grinding; one bone awl, grooved around the head; a pendant ornament fashioned

¹ Proceedings Boston Society of Natural History, Feb. 15, 1886.
³ Feb. 15, 1886.
⁴ Annual Report of the Canadian Institute, 1887, page 53, fig. 107.
Piercing implements of bone (full size).
from the axis of the *Fulgor*, grooved at both ends and partially cut away (fig. 32): two pieces of fungus; a pear-shaped pebble, grooved for suspension (fig. 33): a flat pendent ornament of shell 2½ inches in length, grooved at the upper portion with central perforation in the groove (fig. 34), and a small fragment of pottery.

Along the top of the white sand, with the bones of a child and a quantity of small shell beads, was a pendent ornament fashioned from the lip of a marine univalve, having a length of 4½ inches, a width of 1½ inches. One end was perforated. This pendant doubtless served for personal decoration in connection with the beads. In association with it were eight marine shells—*Arca pexata*, one *Arca incongrua*, one *Pectunculus*, and five specimens of *Pecten* with a fragment of another. These shells were all perforated and probably served as a necklace.1

*Pottery.*—Twenty-seven feet from the margin of the base in the southern trench, 7 feet beyond where traces of the white sand layer were first apparent, was the first burial in the white sand layer. At this point the brown sand, or upper stratum, was 5 feet 3 inches, and the white sand below, 2 feet 4 inches, in thickness. Immediately above was a pot with a rounded unperforated base, 7½ inches in height, with a maximum diameter of 7½ inches midway between the base and aperture. Its diameter at the mouth was 5½ inches. Below the aperture was an incised line encircling the pot, surmounting a line of semi-perforations 2½ of an inch below, while beneath these was a circle of red paint. Near the margin of the aperture on either side was a small perforation for suspension.

1 Necklaces of shells were used by primitive man both in Europe and in this country. See M. Rivière, "*De l'Antiquité de l'Homme dans les Alpes-Maritimes*," plate XXI, and C. C. Jones, *op. cit.*, page 518, and footnote, 519.
THE ST. JOHN'S RIVER, FLORIDA.

The finding of an entire vessel of any size in the mounds of the St. John's is of such rare occurrence that special stress is laid upon this discovery.

Not far distant from the vessel above described, with human remains, was an elongated bowl of graceful pattern, 7-75 inches in length with a maximum width of 6-5 inches. Its depth was 3 inches. A portion of the bottom had been knocked out. At either end the rim became concave to the extent of .25 of an inch. When inverted the pot much resembled in shape the carapace of a turtle. In immediate association was a fragment of human skull, calcined, and the crown of a human molar blackened by fire.

On the base of the mound was a bit of pottery, the fragmentary condition of which was a matter of regret. In shape it strongly suggested the beak and canal of the Fulgar when given the form of a cup (Plate XV, fig. 1). Reproductions in clay of drinking cups of shell are reported from other sections. In this specimen the curve was peculiarly graceful.

Twelve feet from the surface on the base of shell was a fragment of a small jar with curious ornamentation (Plate XV, fig. 2).

In former excavations three small pots were found by us at Tick Island. All were unperforated as to the base and lay with original burials. Two were undecorated, one of a design previously unreported is figured in the American Naturalist, July, 1892.

On the base also in the various trenches were sherds of excellent material and artistic decoration (Plate XV, fig. 3), quite unlike any met with in numerous excavations in the adjacent shell heaps.

Many small bits of pottery placed with bodies had been intentionally given the form of an arrow head. We shall refer again to this custom.

It will be noticed that at the Tick Island mound the perforation of the bottoms of vessels, either by intentional fracture or in construction previous to baking, did not obtain to the same extent as in certain other mounds of the river.

CONCLUSIONS.

During our extended investigations in the Tick Island mound absolutely nothing indicating contact with the whites was met with, nor were objects of polished stone found other than superficially. In comparison with the mass of material handled the objects discovered were but few, and when we consider the results yielded by the mounds at Dunn's Creek, at Norwalk Landing, in the pine woods near Blue Creek, and at Mt. Royal, we are led to believe that poorer and probably earlier Indians piled up the sand mound at Tick Island.

SAND MOUND NEAR DE LEON SPRINGS, VOLUSIA COUNTY.

To reach De Leon Springs it is necessary, after leaving the St. John's, to pursue a somewhat devious course as shown by the map. A considerable shell deposit borders the Springs.
In the pine woods, three-quarters of a mile to the north, is a sand mound in the form of a truncated cone. Its height is 9 feet, its circumference 450 feet. It is unstratified and is composed entirely of white sand, with the exception of pockets of shell, mostly *Unionidae*, found along the base, and of a shell ridge in the center having a height of 4 feet.

A trench 9 feet in breadth and 35 feet in length was dug along the base through the center of the mound. During the entire excavation, with the exception of one superficial burial, neither human remains, pottery nor implements of any sort were found, though small bits of charcoal were abundant.

**Thursby Mound, Volusia County.**

This mound was visited by us during the winter of 1892 and 1893. It lies on the east bank of the St. John's one-half mile north of Lake Beresford, immediately opposite the shell bluff of Hantoon Island. But 50 yards from the water it is hidden from view by oaks and palmettoes, while on it grow giant live oaks, one 12 feet 3 inches in circumference 5 feet from the base. A causeway of shell connects it with a shell ridge bordering the river. It is the property of Mrs. L. P. Thursby, of Blue Spring, favorably known in connection with antiquarian research in Florida since the time of Professor Wyman. Permission was readily granted to investigate the Thursby mound and the large shell deposits bordering the famous Blue Spring some miles farther south.

The mound is very symmetrical. Its height above the surrounding level is 11 feet, its circumference 500 feet, its form the usual truncated cone.

On the northern side was started an excavation 9 feet from the margin and at that point vertically 3 feet from the base. Its width at the start was 8 feet, diverg ing to 13 feet and converging to 9 feet at the end, at which point the trench was 14 feet in depth. Throughout its course, a distance of 25-5 feet, it followed the base. The mound lies upon a deposit of shell which extends beyond it on the south and west, but is not traceable toward the swamp on the northern side. Upon this shell deposit, around the mound, a layer of dark colored sand had formed to a thickness of 3 feet, thus encroaching upon the height of the mound which, from the summit platean to the base of shell, upon which were bones, has a vertical height of 14 feet, as shown by the excavation. This shell base, it is worthy of remark, did not have an ascending slope, as is the case at Tick Island, at Bluffton and at Ginn's Grove, but seemed to be perfectly level.

Upon the base lay about 6 inches of dark brown sand, differing greatly from the pure white sand above. At a distance of 22 feet from the margin of the base of the mound and 8 feet from the surface began a second layer of shell, with 4 to 5 inches of brown sand on top, and having 3 feet of white sand between it and the layer of brown sand lying upon the shell base. The second layer of shell upon which burials were made in the brown sand extended but 6 feet towards the center, where all traces of it were lost.
This stratum was in its turn surmounted by white sand which lay beneath the brown sand composing the surface of the mound.

**HUMAN REMAINS.**

Superficial skeletons in anatomical order were numerous. Original interments were mainly confined to the shell base, the first being encountered 22 feet from the margin and 9 feet from the surface, and to the shell layer above, though some badly decayed skeletons were found in the white sand. Their infrequency of occurrence is in marked contrast to the quantities of bodies met with at Ginn's Grove and at Tick Island. The bones lay in anatomical order, though it is not impossible that a different form of burial exists in other parts of the mound.

During the first investigation no crania were saved.

Three humeri from the original burials were imperforate; eleven from superficial burials showed seven perforations, a percentage of 63.6.

Five tibiae from original burials gave an average index of 62. An equal number from interments near the surface showed an average index of 64.

Our second investigation was confined to superficial portions of the mound.

Four crania and two calvaria were saved.

*Humeri (superficial).*—Of 21 humeri 13 showed perforation, a percentage of 61.9.

**Humeri (Superficial.)**

*Measurements are given in mm.*

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Average Perforation</th>
<th>Minimum Perforation</th>
<th>Maximum Perforation</th>
<th>Oscillation Exponent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>3</td>
<td>6.1</td>
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<tr>
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<td>7</td>
<td>5.8</td>
<td>2.5</td>
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<td>1.9</td>
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</tbody>
</table>

Of the 13 perforated humeri 7 were from the right side and 6 from the left. Grand total of superficial humeri 32, perforations 20, or 62.5 per cent.

*Length and Torsion of Humeri.* *Measurements are given in mm.*

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</table>

**Femora (Superficial).**

*Index.*

<table>
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<tr>
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<td>119</td>
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CERTAIN SAND MOUNDS OF

Length. Measurements are given in mm.

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<th>Head</th>
<th>G. T.</th>
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Table (Superficial)

Index.

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</table>

WEAPONS, IMPLEMENTS, ORNAMENTS, ETC.

With the original burials lay bits of pottery of good material, some showing traces of a red pigment. With the exception of a lance head of chert 5 inches in length (Fig. 35) nothing of interest was found with the remains other than superficially.

Fig. 35. Lance head of chert (full size).

Eighteen inches from the surface in the northern slope of the mound was found the point of an implement of bone, recalling the entire implement met with at Tick Island. Unfortunately, this one was too fragmentary for identification.

Superficially, with a skeleton in close association, was an axe of iron (Fig. 36), and a polished "celt" 3.25 inches in length. It has been thought by some writers that inasmuch as no allusion to these implements of stone can be found in the early Spanish chronicles, and as the "celt" escaped the vigilance of the Huguenot writers and the pencil of Le Moyne, the supply in Florida had disappeared by inhumation prior to the coming of the whites. The finding of a "celt" associated with iron leads us to a different conclusion.

Axes of iron of the type discovered in the Thursby mound are of wide distribution. They are reported from California, from New York, and we read that no
less than 300 iron tomahawks were ploughed up in a field in Canada. We have
met with them in Florida, also, at Dunn's Creek, at Raulerson's near Lake Harney
and at the Indian Fields on Lake Ruth.

With intrusive burials were two small polished hatchets of stone and a small
"sinker" or pendent ornament, grooved at one end for suspension, wrought from a
pebble.

Precious Metals.—Superficially, with the skeleton of a woman, in close proximity
to a cervical vertebra, associated with beads of shell, was an ornament
of sheet gold, oblong in shape 6 of an inch by 77 of an inch. Its
weight was 18 grains. Around the margin on one face were indentations, while a deeper and larger one occupied the center at the inter
section of two diagonal lines. Near the center of the margin of one
of the narrow sides was a perforation for suspension (Fig. 37):

With a skeleton 6 inches from the surface, in close proximity to the cranium.
was an ornament of sheet silver. In shape it somewhat resembled a crescent though the inner border lacked suf-
ficient concavity. Its length was 1-58 inches, its maxi-
imum breadth 72 of an inch. Its weight was 50 grains.
In the center was a large, indentation made by repeated
impact of a pointed implement. Around the margin
were small indentations, of which three, perforate, doubtless served as means of
attachment to a band or a garment. It was greatly oxidized (Fig. 38).

Pots and Effigies of Pottery.—It was reserved for the Thursby mound to
reward our labors by a find hitherto unreported, we believe, not alone in Florida
but in any part of the United States. In an oblong space, 6 feet in breadth and
about 25 feet in length, beginning 18 feet from the center of the summit plateau
on the southeastern slope and extending to the margin of the base, from 4 inches
to 1 foot below the surface was a deposit of pottery amazing in number and variety
of specimens, including pots, dishes, bowls, effigies of animals, of plants and of

1. Annual Report Canadian Institute, 1867, page 11.
various other objects. The vessels of pottery, probably with but one exception, were of the coil method of manufacture which, it will be remembered, consisted of welding together coils of clay. These vessels varied in diameter between 1.35 inches and 4.75 inches. All but two had a perforation in the bottom made previous to baking. Many contained coils of clay upon the inner surface of the base from which a projection extending along and above the side served as a handle to the vessel (Figs. 39-41). Others had parallel bars of pottery along the base, the use
of which it is difficult to determine (Fig. 44). In all 75 specimens of vessels of pottery were recovered, of which but 4 were decorated. In two cases larger vessels contained smaller ones inverted.

No less than 48 animal effigies, ranging from 2 to 7 inches in length, were recovered in almost unbroken condition. Among these were 8 fishes and 10 turtles. Many showed perforations as for suspension. Some were of spirited design, giving evidence of considerable artistic feeling. These effigies were submitted to Arthur E. Brown, Esq., to whom we are indebted for suggestions as to the identification of some of them. Among them were recognizable two species of turtle, probably the logger-head and the snapper; several species of cat, including probably the puma and the wildcat; bears; squirrels; a wild turkey; possibly a dog, and in all probability a beaver. Several otters, also, were identified, while one effigy somewhat resembling that animal, held in its mouth a round object in no wise suggesting the fish diet of the otter (Fig. 45). One effigy, though unbroken, offered no clue for identification and must be put down as a freak of fancy. The snout closely resembled that of a tapir, but in other respects the effigy had nothing in common.
CERTAIN SAND MOUNDS OF

Fig. 41 (full size).

Fig. 45 (full size).

Fig. 46. Decorated pot (full size).

Fig. 47. Small pot (full size).

Fig. 48. Vessel suggesting turtle (full size).

Fig. 49. Pottery plate (full size).
with that animal. It cannot be considered a representation from life of any mammal of Florida past or present (Fig. 52).

Included among representations of the vegetable kingdom were twelve acorns, some exceedingly natural and cleverly represented; a gourd; an ear of corn, very life-like; possibly the bud of a water lily, and several other vegetables of uncertain attribution.

Among the unidentified were 41 specimens, including a large class of objects, some resembling a potato covered with knobs (Fig. 53), others with numerous spines somewhat resembled the sea urchin or possibly a shell (Fig 54). Their attribution is a mystery. Other unidentified specimens were a large bead-shaped object perforated longitudinally (Fig. 63), and an article having the form of a dumb-bell (Fig. 64), possibly intended to represent an ear plug similar to those figured by Le Moyne.

In all 292 objects of pottery, whole or but slightly damaged, were taken from the Thursby mound, the work being done by hand, owing to the close association of the various pieces. In addition to these, 62 fragments representing distinctive portions of animals and of vessels of especial interest were saved, while 408 sherds, mainly portions of bowls and pots showing perforation previous to baking, were added to the collection. Innumerable fragments were left upon the surface of the mound.
CERTAIN SAND MOUNDS OF

Fig. 52 (full size).

Fig. 53 (full size).

Fig. 54 (full size).

Fig. 55. Squirrel (full size).

Fig. 56. Squirrel (full size).

Fig. 57. Possibly wild cat (full size).

Fig. 58. Possibly wild cat (full size).
Fig. 58. Wild turkey (full size).

Fig. 59. Possibly puma (full size).

Fig. 60. Possibly puma (full size).

Fig. 62. Unidentified (full size).
CERTAIN SAND MOUNDS OF

It is interesting to note that while the discovery of a deposit of small perforated animal effigies of clay is hitherto unreported within the limits of the United States their occurrence in Mexico is mentioned. Clay images from Georgia figured by C. C. Jones' bear no resemblance to the effigies from the Thursby mound. A turtle of pottery has been taken from a Tennessee stone grave.2

Whether the animal effigies from the Thursby mound are representative of the fauna of Florida or not it would be difficult to decide. The panther is still met with in unfrequented places; the bear is not uncommon; skins of the otter are a considerable item among the exports of the State; the wild cat makes the raising of domestic fowl precarious; the wild turkey (a separate variety in Florida) still gobbles in the woods; squirrels are seen on every side. The beaver was an article of diet in the time of De Soto3 and some remained so late as the journey of William Bartram.4

The existence of the dog on the St. John's in prehistoric times is a matter of uncertainty. On the north the shell-heaps of Georgia hold its remains,5 while Mexico on the south had a domestic animal resembling it.6

During the winter of 1892, the writer discovered a portion of the mandible of a dog in a shell-heap near the St. John's River, Florida. Its species has not been

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5 C. C. Jones, op. cit., page 196.
Possibly heaver [full size] Fig. 18. Probably snapping turtle (full size).

identified. Full particulars, including a note by Professor Cope, can be found in the American Naturalist. July, 1893, from which we make the following extract:

"Professor Wyman's searches yielded no canine remains, nor has the writer hitherto upon any other occasion found, to the best of his knowledge, any portion of the skeleton of the dog in the river mounds. Wyman was aware of no evidence to show the presence of domestic dogs on the river in early times, and cites Le Moyne's list of animals supposed to have been seen by the French (1565), from which the dog is omitted. On the other hand, Cabeça de Vaca, Treasurer of the expedition of Pamphilo de Narvaez (1527) found dogs among the natives during his wanderings along the coast of northwestern Florida, and in other portions of his journey. He makes no comment as to their origin, as he doubtless would have done had they been pointed out as curiosities, and it is hardly reasonable to suppose that at so early a period, their derivation can have been from a European source. The bones of dogs are reported from a shell-heap at Tampa. The writer learns, however, that this discovery was superficial. De Soto, who landed at Tampa, had numerous fierce dogs, and found great quantities of dogs among the Indians of Georgia. Bones supposed to be of the dog are in the stone graves of Tennessee."
CERTAIN SAND MOUNDS OF

Fig. 70. Possibly dog (full size).

Fig. 71. Unidentified (full size).

Fig. 72. Possibly alligator head (full size).

Fig. 69. Unidentified (full size).
Fig. 73. Possibly otter (full size).

Fig. 78. Fish (full size).

Fig. 74. Unidentified (full size).

Fig. 75. Probably loggerhead turtle (full size).
Dr. Dall regards it as presumable that the coyote has been domesticated along our southern border from time immemorial, though perhaps as an occasional curiosity in many tribes rather than as a usual companion. During nine years' exploration he found one dog's skull in an Alcadian shell heap, a prehistoric deposit, and only one.¹

The dog has never yet been found fossil in Florida, though the fossil fauna of the State would suggest its presence.²

The late Colonel Jones,³ referring to the Florida Indians as represented by Le Moyne,⁴ speaks of “the flesh of fishes, deer, alligators, snakes, dogs and other animals previously smoked and dried on a scaffold.”

As we have stated, the dog is omitted from the list of animals seen by the French, nor is it referred to in any description of the plates. Colonel Jones' statement, therefore, is based upon no authority beyond a resemblance noticed in certain animals represented in the plates. It would be difficult in the work of Le Moyne to distinguish a dog from a grey wolf, or from some other quadrupeds of Florida, especially as the carcass represented is skinned.

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¹W. H. Dall, private letter.
²Cope
⁴Brevis Narratio, plates XXII, XXIII, XXIV.
THE ST. JOHN'S RIVER, FLORIDA.

Fig. 80. Unidentified vegetable (full size).
Fig. 82. Unidentified vegetable (full size).
Fig. 83. Unidentified vegetable (full size).

Fig. 84. Acorn (full size).
Fig. 85. Acorn (full size).
Fig. 86. Acorn (full size).
Fig. 87. Acorn (full size).

Fig. 88. Acorn (full size).
Fig. 89. Acorn (full size).
Fig. 90. Unidentified (full size).
Fig. 91. Unidentified (full size.)
CERTAIN SAND MOUNDS OF

Fig. 92. Unidentified (full size).

Fig. 93. Unidentified (full size).

Fig. 94. Unidentified (full size).

Fig. 95. Unidentified (full size).

Fig. 96. Unidentified (full size).

Fig. 101. Unidentified (full size).
Fig. 96. Unidentified (full size).

Fig. 97. Unidentified (full size).

Fig. 98. Unidentified (full size).

Fig. 99. Unidentified (full size).

Fig. 100. Unidentified (full size).

Fig. 102. Unidentified (full size).

Fig. 103. Unidentified (full size).
During the progress of the investigation a number of sherds were met with from vessels of much greater size than any discovered by us in perfect condition. They were stamped in squares or in diamonds and were not in association with the remainder of the vessels to which they belonged. It was evident that these and innumerable fragments of small pots were interred with uninjured objects.

Beneath a portion of the deposit were found 10 to 12 skeletons of adults. They were covered by about one foot of sand which included the pottery. They were apparently a continuation of the interments with which were the gold and the silver ornaments. The iron axe was found in a different portion of the mound.

It will be noticed that nothing indicating intercourse with the civilization of Europe was found other than superficially in the Thursby mound.

Huntoon Island, Lake County.

Immediately opposite the Thursby mound on the west bank of the St. John's is Huntoon Island. At this place are great shell deposits, a section being laid bare by the action of the river. A short distance from the river bank are two symmetrical mounds of shell with a certain admixture of sand. Their nature has not been determined, though a superficial examination was made by Professor Wyman. Unfortunately for the cause of science, Mrs. Thursby, the former owner, has recently disposed of the property to Mr. G. A. Dreka of De Land, who refuses permission to investigate.

Sand Mound at Stark's Grove, Volusia County.

On the southeastern shore of Lake Beresford is Stark's Grove. Near the water's edge is a small deposit of shell, while about 400 yards from the dwelling is a mound of sand about 200 yards east of the lake. Its height is 8 feet, its circumference 370 feet. On the south a marked depression exists from which the material of the mound was probably taken. The mound bears no mark of previous investigation, its owner, Mrs. Stark, to whom we are indebted for permission to explore, having carefully preserved it from unsystematic search. An excavation in the center showed the mound to be formed of various strata, including shell. At a depth of 2 feet lay a skeleton immediately under a 9 inch stratum of shell. With it lay a few fragments of pottery roughly ornamented in squares. From the lower jaw every tooth was missing and the alveolar process had been entirely absorbed. Neither humerus was perforated, while the one tibia recovered gave an index of 84. This mound was not sufficiently investigated to admit of final conclusions.

Sand Mound near Fort Florida.

Fort Florida, the residence of D. G. Bartola, Esq., is situated on the eastern bank of the St. John's, about a mile south of the mouth of the Wekiva River. The mound lies in the hammock about 300 yards northwest of the river and a quarter of a mile northeast of the residence. Its circumference is 240 feet, its height 6½ feet. Shell fields bordering the river are referred to by Wyman. This mound, however, escaped his notice, though one opened by him¹ is not far distant on the river's bank. On the northwestern side of the mound, 11 feet from the margin of the base, a trench was carried through the center of the mound at the level of the base. The mound was stratified, though the individual layers varied in thickness at different points.

Thirty-one feet from the margin of the base on the west side of the excavation, where the strata were clearly defined, above the dark brown sand upon which the mound was built, were the following layers:

- **Base.**
  - White sand, 8 inches.
  - Muck, 7 inches.
  - White sand, 1 foot 11 inches.
  - *Paludina* mingled with brown sand, 4 inches.
  - White sand, 1 foot.
  - Black loamy sand, 2 feet 5 inches.

A deposit of loam on the surrounding territory will account for the apparent discrepancy in height.

Throughout the excavation, sherds of good quality, plain and stamped in squares, were met with.

In the center of the mound were found portions of a human skeleton disturbed by a shaft sunk by a previous investigator.

Sand Mound near Northern End of Lake Monroe.

(Volusia County).

Near the railroad bridge crossing the St. John's at its exit from the lake is a unsymmetrical mound of sand. It lies back of the hammock land bordering the river on the eastern bank. It is not visible from the channel. Its height is 8 feet 5 inches; its circumference, 275 feet. It is composed of pure white sand unstratified. No shell deposit is in the immediate vicinity. Six feet from the margin of the base of the southwestern portion of the mound a trench was dug 13 feet in breadth, converging to 10 feet at the end and 37½ feet in length. At a depth of 9 feet water was reached. Beyond one piece of charcoal, absolutely nothing was found denoting human agency in the erection of the mound. An observer, in the absence of trees, could, from its summit, sweep the river and the adjacent lake

CERTAIN SAND MOUNDS OF

GINN'S GROVE, ORANGE COUNTY.

The burial mound at Ginn's Grove, known as Speer's Landing in the time of Professor Wyman, lies on the left bank (going down) of a lagoon, in full view of the river, about three miles from Sanford overland, or seven miles by water. It is built upon a shell-heap, and shell-heaps and shell-fields lie adjacent. It has twice been investigated by us (January 28, 29, 30, 1892; January 22-27 inclusive, 1893). Upon the first occasion, the mound was the property of Dr. A. C. Caldwell, of Sanford; upon the second, of J. N. Whitner, Esq., of the same place. To both these gentlemen our thanks are tendered for cordial permission to investigate.

The mound which has been superficially dug into by tourists and excursion parties from Sanford, is oval in shape. Its circumference is 300 feet, that of the summit plateau 140 feet. Its height is 10 feet measured from the northern side, though a decided depression on the opposite or swamp side would make the height somewhat greater. The shell-heap upon which it is built has an upward slope, so that between the central portion of the summit plateau and the shell base there are but 5-5 feet of sand. The mound is composed of two distinct layers of sand rising at about the same angle, the stratum immediately above the shell being of pure white sand absolutely free from shell, while the layer above the white is of brownish sand with shells intermingled. Investigation of the subjacent shell-heap showed it to be composed of the ordinary refuse of the shell deposits of the river. It extends beyond the mound and was doubtless selected as a point of vantage for the erection of the burial place.

A trench was dug on the northern side, 22 feet horizontally from the margin of the base, 14-5 feet in length, 5-5 feet in breadth, with a maximum depth of 10-5 feet, and another on the eastern side beginning at the margin and extending along the shell base 60 feet in length, 16 feet in breadth converging to 10 feet at the end. Eight men were engaged upon the investigation which, through the white sand layer, was carried on mainly with the trowel.

HUMAN REMAINS.

Remains, undoubtedly original burials, lay in the shell in one layer and in the white sand immediately above. In nearly every case, the long bones lay horizontally in connection with the cranium, though upon several occasions the skeletons were in anatomical order.

While aware that various forms of burial are sometimes met with in the same mound, we are of the opinion that certain skeleton at length or flexed, with all the bones of the body in anatomical order, may be the remains of those deceased within a short period prior to the time selected for emptying the dead houses or pens. Skeletons when deprived of flesh, hold together by means of the ligaments. We have seen in Siam, in a walled inclosure, where the bodies of the poor were exposed
to vultures and to dogs, human remains, though denuded of flesh, sufficiently adherent to permit of elevation on a pole. It is probable also that those dying about the period of a general interment, were placed without exposure among the bunched bones.

In numbers of cases, vertebrae were found in regular order near the skull. Again, many of the smaller bones were present in anatomical order, foot bones in connection with the tibia and fibula. In many cases, however, the smaller bones were entirely wanting, while at times, single bones wholly isolated were met with.

Near the center of the mound were 7 crania, some in actual contact, all within a radius of 3 feet, while one yard distant were four others in close association. With these crania were a certain number of bones not in anatomical order, and by no means the full complement of so many skulls.

While in bunched burials, bones of one individual seemed, as a rule, to be kept together, such was not always the case, for upon occasions not only were discrepancies in size noticeable, but long bones in pairs belonged to the same side of the body.

Immediately below the surface of this mound were flexed burials in anatomical order. These we took to be intrusive.

A number of disconnected bones, ignored in our tables, were found in the brown sand at points where considerable disarrangement had taken place through previous superficial investigations.

_Crania._—Though heated glue and solutions of shellac were at hand during the greater part of our investigation no crania were preserved. No decay was noticed in any tooth.

_Humeri._—During the first investigation of 42 humeri, 9 were perforated, a percentage of 21.4

In the course of the second investigation of 73 humeri beneath unbroken strata in white sand or in shell, 28 were perforated, or 38.3 per cent. 1

Four humeri belonging to superficial burials showed one perforation.

**Humeri. Original Burials.**

*Measurements are given in mm.*

<table>
<thead>
<tr>
<th></th>
<th>Perforated</th>
<th>Average Diameter</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Oscillation Exponent</th>
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<tr>
<td>Male</td>
<td>9</td>
<td>6.6</td>
<td>4</td>
<td>11</td>
<td>25</td>
</tr>
<tr>
<td>Female</td>
<td>7</td>
<td>6.8</td>
<td>5</td>
<td>9</td>
<td>1</td>
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<tr>
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<td>12</td>
<td>6.2</td>
<td>2</td>
<td>10</td>
<td>2</td>
</tr>
</tbody>
</table>

Of the 28 perforated humeri, 12 were from the right side and 16 from the left.

1 We have stated elsewhere the great precautions taken by us as to the determination of the perforation of the humerus.

11 JOUE. A. N. S. PHIL., Vol. X.
CERTAIN SAND MOUNDS OF

LENGTH AND TORSION OF HUMERI.

Measurements are given in mm.

<table>
<thead>
<tr>
<th>Sex</th>
<th>Side</th>
<th>Length</th>
<th>Torsion</th>
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<tbody>
<tr>
<td>Male</td>
<td>Right</td>
<td>303</td>
<td>128°</td>
</tr>
<tr>
<td>&quot;</td>
<td>&quot;</td>
<td>342</td>
<td>135°</td>
</tr>
<tr>
<td>&quot;</td>
<td>&quot;</td>
<td>304</td>
<td>118°</td>
</tr>
<tr>
<td>&quot;</td>
<td>Left</td>
<td>330</td>
<td>100°</td>
</tr>
<tr>
<td>&quot;</td>
<td>&quot;</td>
<td>304</td>
<td>114°</td>
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<td>115°</td>
</tr>
<tr>
<td>Female</td>
<td>Right</td>
<td>290</td>
<td>115°</td>
</tr>
<tr>
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</tr>
<tr>
<td>&quot;</td>
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<td>128°</td>
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<td>335</td>
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</tr>
<tr>
<td>&quot;</td>
<td>&quot;</td>
<td>313</td>
<td>118°</td>
</tr>
</tbody>
</table>

Femora.—Forty-four femora found during the second investigation in the white sand stratum or in the shell showed an average index of 112, the lowest 89, the highest 132, the oscillation exponent 7-8.

LENGTH OF FEMORA.

Original Burials.

<table>
<thead>
<tr>
<th>Sex</th>
<th>Projection on Shaft</th>
<th>Normal Position</th>
<th>Great Troch. to Ext. Condyl.</th>
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<tbody>
<tr>
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<td>Head. 450</td>
<td>Great Troch. 428</td>
<td>Head. 447</td>
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<tr>
<td>&quot;</td>
<td>448</td>
<td>436</td>
<td>435</td>
</tr>
<tr>
<td>&quot;</td>
<td>452</td>
<td>440</td>
<td>447</td>
</tr>
<tr>
<td>Uncertain</td>
<td>418</td>
<td>409</td>
<td>416</td>
</tr>
</tbody>
</table>

Tibiae.—Our first investigation yielded 36 tibiae from all depths, giving an average index of 64-9.

Forty-two tibiae from original burials, exhumed during our second visit, gave an average index of 65-2, the lowest being 57, the highest 74, the oscillation exponent 3-3.

LENGTH OF TIBIA.

FROM SUPERIOR ARTICULAR SURFACE TO TIP OF INTERNAL MALLEOLUS.

Measurements are given in mm.
No implements of stone of any sort were found.
With superficial burials at length were two scrapers of shell.
With many of the bodies were fragments of pottery to which the triangular shape of the arrow head had been given.

In disturbed and undisturbed strata were fragments of pottery decorated with red pigment.

Seven feet from the margin of the base and 3 feet 10 inches from the surface was found what presumably had served as the handle of a vase. The fragment, 3 inches in length from tip of beak to back of head, probably represented the head of a vulture, (Plate XV, fig. 4). The lined decoration was clearly incised. Portions of the head, represented by shading in the figure, were colored crimson. In our experience of technical work in pottery in the river mounds this head represented the limit of aboriginal endeavor. Unfortunately, as the white sand layer did not extend to the point where this relic was found, it cannot be said positively to have lain under unbroken strata, and therefore to be definitely identified with the period of the construction of the mound; but as a fragment of a vase similarly colored and lined (Plate XV, fig. 5) was discovered upon the base with undisturbed layers above, the head is probably contemporary with the mound.

Six feet from the surface lay 3 skulls in actual contact, forming a species of triangle. In association was a fragment of a pot, including a handle terminating in the head of a bird, (Plate XV, Fig. 6). Somewhat similar patterns are figured from Arkansas. 1

CONCLUSIONS.

In this mound, though the work was largely done with the trowel, nothing indicating contact with Europeans was met with.

Dr. Brinton, it is true, found beads of glass in this mound, 2 which led him to attribute to it an origin comparatively modern, and this opinion has been widely disseminated by Colonel C. C. Jones 3 who quotes it on page 236.

We are inclined to believe the beads to have been superficial:

1. From analogy. Several mounds in the same section have beads on the surface similar to those described by Dr. Brinton. A very careful search by us has failed to discover any at greater depth in any of them.

2. From negative testimony. If the builders of the Ginn's Grove mound had possessed such beads, we think some would have been placed with the scores of burials exhumed by us.

3. No mention is made by Dr. Brinton of bunched burials. This form largely predominates along the base.

1 Fourth Annual Report Bureau of Ethnology, 1882-1888, Fig. 379, page 286.
2 "Florida Peninsula," page 170.
4. Dr. Brinton states (page 173) that a class of Florida mounds is unstratified, citing Ginn’s Grove as in that class. In point of fact the Ginn’s Grove mound affords a good example of stratification. Its lower stratum, it is evident, was not reached by him.

In the same field where the mound at Ginn’s Grove stands is a much smaller one. A trench run partially through it showed a shell layer 3 feet from the surface. No implements nor human remains were found.

Black Hammock. Orange County.

The name, Black Hammock, is given by Professor Wyman to a shell deposit and small mound on a lagoon on the western side of the river, about half a mile south of the entrance to Lake Jessup. The name is not now in use. The sand mound was superficially dug into by Professor Wyman. Its height is 3 feet 9 inches, its circumference 170 feet. A spear point or knife of chert, and several arrow heads were obtained by excavation. At the base of the mound lay quantities of bog-iron. Numerous unsystematic investigations have rendered this mound valueless for scientific research.

Thornhill Lake.

A short distance south of Black Hammock a small creek (see map) leading to Thornhill Lake enters the St. John’s on the eastern side of the river. Bordering the small sheet of water is a sand mound, symmetrical in shape with the usual summit plateau. Upon it grow a number of palmettoes. Previous investigations have been superficial in character. The mound is 11 feet in height, measured from the north; a marked depression on the south would make it appear of considerably greater altitude. On the north side, 30 feet from the margin of the base, a trench 28 feet long by from 8 to 10 feet wide was dug. At the centre of the mound the excavation attained a depth of 10 feet, where lay a base of shell, the surface of the shell-heap on which the mound was built. The southwestern corner of the trench seemed to be at the apex of the mound, and at that point the stratification was as follows:

- 6 inches—Surface layer of brown sand.
- 1 foot 6 inches—White sand.
- 5 feet—Brown sand with slight sprinkling of shell.
- 3 feet—Pure white sand.

Below was a conglomerate of charcoal, calcined shell and sand, as hard as stone, beneath which was the ordinary debris of the shell-heap.

Human Remains.

Skeletons were in anatomical order, but 7 in all being met with. These lay in the brown sand layer and in the white sand layer below. Several skeletons lay upon the back with hands crossed upon the abdomen. In one case the legs were
drawn up and stretched widely apart. In another they were flexed and turned to the side.

No crania were saved.
Five fibiae, all believed to be original, gave an average index of 63.
Of 9 humeri, 6 showed perforation, or 66.6 per cent.

IMPLEMENTED, ETC.

With the skeleton of a woman 5.5 feet below the surface were fragments of bones of edible animals, one flint flake and a number of shell beads near the cranium.

Unassociated at a depth of 6.5 feet was a rude three-sided lance or arrow point of chert, 3 inches in length.
Four feet below the surface, far removed from the other human remains, was the lower third of a human humerus, much charred by fire. During the entire investigation, no pottery, fragmentary or otherwise, was met with. We consider the excavation at this place insufficient to allow any conclusion.

Fifty yards north of the large burial mound is a smaller one 8 feet 10 inches in height, with a circumference of 205 feet. The mound is composed of brown sand with a sprinkling of shell, and like its neighbor is built upon a shell deposit.

We hope to give full details of these mounds in the second part of this report.

Cook's Ferry (King Philip's Town). Orange County.

Cook's Ferry is on the west, or left bank of the river going down, about five hundred yards north of Lake Harney. A large shell heap rises from the water's edge, and in the neighboring orange grove is a mound of sand in shape the usual truncated cone. The height of the mound is 11 feet 8 inches measured from all sides save the S. E., where ground of a higher level reduces the height to 10 feet. The trench at its base, described by Dr. Brinton\(^1\), is no longer apparent. The present circumference of the mound is 245 feet. This mound has been superficially dug into in many places, and its surface until recently offered an abundant harvest of beads of glass. One of a number of beads from this place was covered with pure gold leaf; some others resembled those from Santa Barbara, California, presumably derived from the early Spaniards\(^2\). From the owner of the mound we obtained a number of beads superficially found there, with an ornament of silver (Fig. 104), and a disc of metal centrally perforated and encircled near the margin by a line of indentations. Quite unexpectedly, an application of nitric acid proved the disc to be of gold (fig. 105). These ornaments of precious metal were probably contemporary with the beads, and derived from Spanish sources.

From the southern portion of the mound sand has been hauled for fertilizing purposes, leaving bare a portion of the base extending inward 10 feet from the margin. At this point a trench 31 feet

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\(^1\) "The Floridian Peninsula," page 171.
\(^2\) Professor Putnam in letter.
CERTAIN SAND MOUNDS OF

broad at the beginning, converging to 12 feet across at the end a distance of 31 feet from the starting point, was made. Its depth at the centre of the mound was somewhat over 11 feet. In addition a considerable portion of the surface of the mound was gone over superficially. The mound was not markedly stratified. It was mainly composed of brown sand, without admixture of shell, though rising from the level of the base was a mottled layer, composed of an admixture of white and of brown sand. At the centre of the mound this layer was 5-5 feet from the surface.

HUMAN REMAINS.

Superficial burials were met with, and a limited number on the base. Of the base burials virtually nothing remained, while disconnected bones met with in the body of the mound were in an equally bad state of preservation. No crania were saved.

Four tibiae gave an average index of 61.8; lowest index 61.6; highest 67.1.
Five femurs gave an average index of 115; lowest index 105; highest 119.
One humerus saved was unperforated.

IMPLEMENTS, ETC.

With the base burials were several arrow heads of chert, while near the base unassociated, was a flake of yellow chert slightly serrated (fig. 106).

Superficially was found, in connection with human remains, a crescent of chert, smooth on one side, with a convex chipped surface on the other. A portion of one horn of the crescent was missing, as was an apparent former projection from the centre of the outer margin. The present length of the implement is 3-9 inches. It is impossible to determine its nature, the projection formerly extending from the outer margin probably excluding it from the category of stone crescents found in various portions of the country. Figures 107 and 108 represent both sides of this curious object.

Absolutely nothing indicating contact with Europeans was found on or near the base of the mound.
THE ST. JOHN'S RIVER, FLORIDA.

Fig. 107. Crescent of chert (full size).

Fig. 108. Same, opposite side (full size).

MANSFIELD'S, VOLUSIA COUNTY.

On the eastern shore of Lake Harney, near the palmetto cabin of Mr. Mansfield, is an unstratified mound about 2.5 feet in height. Its circumference is 120 feet. It has been under cultivation. Excavation revealed nothing of importance.

RAULERSON'S, VOLUSIA COUNTY.

At the southeastern end of Lake Harney, near where the river enters the lake, surrounded by palmettoes are two cultivated shell fields belonging to a man named Raulerson. One of these fields is in the form of a ridge, the southern extremity of which is a mound 6 feet in height above the level of the marsh to the south, and 180 feet in circumference. Its height above the remainder of the shell ridge is but 1 foot 3 inches. Its shape is regular, save to the south where it slopes to the adjoining marsh not over a hundred yards from the shore of the lake.

The mound has entirely escaped the notice of all previous investigators, and in 1875 the writer killed a wild cat in its immediate neighborhood without becoming aware of the existence of the mound. It was then thickly covered with palmettoes and its presence, or at least its nature, was certainly unknown to a man named Tanner, whose cabin formed the only residence on the borders of the lake. At Tanner's death the house was occupied by a man named Mansfield, who also was unaware of the presence of an artificial formation upon the place. In the summer of 1891 Mr. Singleton, the tenant, cut down the palmettoes with a view to the cultivation of the spot, since shell hammock is highly prized in Florida; but neither plow nor grubbing hoe was used upon the surface of the ground, which was, previous to the
investigations of the writer, filled with the roots of former trees. The mound, then, was absolutely virgin. In digging a post hole at the southern margin of the mound, Singleton threw out a considerable number of bones. Near these lay a gorget of shell scalloped around the edge, with three perforations and three concentric circles on the face. (Fig. 109).

A careful search with trowels was made in the upper portion of the mound, where alone were burials, during several days of the winter of 1892, and again in the succeeding year.

The composition of the mound is as follows:

A—1 ft. 3 in. Composed of a mixture of sand and loam filled with human remains. With them were fragments of plain pottery.

B—1 ft. 9 in. Composed of powdered shell, mainly Unios, and sand, with fragments of plain pottery and broken bones of edible animals, chiefly the deer.

C—1 ft. 6 in. Crushed Unios, some showing marks of fire, with plain pottery and an implement of shell.

At a depth of 4 feet the artificial portion of the mound ended. Continued excavation showed it to have been built upon a small eminence of white sand and minute fragments of marine shell, dating their origin from the period of the submergence of the peninsula, and having no connection with the artificial portion of the mound. It was apparent that numbers of burials had been made upon the rounded extremity of a shell ridge which doubtless considerably antedated the superficial portion of the mound.

The second visit to Raulerson's was exhaustive. Two preliminary excavations, each 9 feet by 4 feet by 2 feet 3 inches deep to shell base showed quantities of human bones, often broken and in the greatest disorder without the slightest anatomical connection. In the first excavation not a fragment of a tibia was met with, a fact clearly indicating the very unequal distribution of the bones. In a second excavation, near a cervical vertebra were found 19 beads of glass.
Next a considerable portion of the surface of the ground was carefully gone over with trowels, laying bare great numbers of split, broken and shattered human bones, with fragments of pottery. With disconnected human remains was found a handsome carved circular gorget of shell, with a diameter of 4.25 inches (Fig. 110).

It consisted of a cross in the centre surrounded by a circle within an eight pointed star, the star surrounded by a circle scalloped at the edges. In the centre of the gorget was a perforation, while near the margin of the outer circle were two others, evidently for suspension. This beautiful ornament, unique for Florida, or at all events for the river, was slightly broken during the digging, while certain portions were wanting through earlier breakage.

Gorgetts of shell, with circles, stars and half moons were worn in historical

1 In this connection the reader is referred to "Art in Shell," Second Annual Report of the Bureau of Ethnology, 1880-1881, page 183, et seq.

Mr. Andrew E. Douglass, whose familiarity with the antiques of Florida and long continued personal researches among the mounds of the east coast lend great weight to his opinion, writes as follows:

"I have quite a number of shell gorgets, but not one from Florida, nor have I seen any from that State in any collection. Still this is but negative evidence as to their existence as I have not seen so large a number in collections, though so far as they have been figured by Holmes and others I have no recollection of any attributed to that State. Your find, therefore, appears to be quite unique. Indeed, I remember exhuming but one gorget (and that of slate) from any of the mounds I have explored in that State."

12 JOUR. A. N. S. PHILA., VOL. X.
times by Indians of Virginia. We are told that certain gorgets sometimes sold for three or four buckskins already dressed.

Excavations on the southern, eastern and western slopes of the mound showed large numbers of bones entirely unassociated, and in addition burials in anatomical order with certainly one of the bunched variety. This interment consisted of the cranium with one femur immediately below it. At a short distance on the same level, lay the lower jaw, the chin towards the skull. Below this jaw was a humerus, while on the other side of the cranium, parallel to each other, were a radius, an ulna and a humerus. With one burial in anatomical order were two steel or iron fish spears, a chisel of the same metal with a curved cutting edge, and a small earthenware pot, undecorated and somewhat crushed. All these lay near the cranium, as did a large number of glass beads with one of shell. With another skeleton lay the blade of a knife; a portion of an implement resembling an adze; two chisels with curved edge; two fragmentary chisels; a fish spear and a spike, all of iron or steel and all greatly affected by rust.

**HUMAN REMAINS.**

_Crania._—A number of cranial bones were saved.

_Humeri._—Of 37 humeri, 13 were perforated, a percentage of 35.

**Femurs.**

_Index._

<table>
<thead>
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<th>Sex</th>
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<th>Minimum</th>
<th>Maximum</th>
<th>Oscillation Exponent</th>
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<td>192</td>
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**Length and Torsion of Humeri.**

*Measurements are given in mm.*

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<thead>
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<th>Sex</th>
<th>Side</th>
<th>Length</th>
<th>Torsion</th>
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<td></td>
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<td></td>
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<td></td>
<td></td>
<td>327</td>
<td>117°</td>
<td></td>
</tr>
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<td>135°</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>397</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>316</td>
<td>137°</td>
<td></td>
</tr>
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THE ST. JOHN'S RIVER, FLORIDA.

Length of Femurs.

Measurements are given in mm.

<table>
<thead>
<tr>
<th>Sex</th>
<th>Projection on axis</th>
<th>Oblique Position</th>
<th>Great Troch. to Ext. Condyle</th>
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</thead>
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<tr>
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<td>G.T.</td>
<td>Head.</td>
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<td>427</td>
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<td>410</td>
</tr>
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<td>&quot;</td>
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<td>409</td>
<td>411</td>
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<td>422</td>
</tr>
<tr>
<td>&quot;</td>
<td>419</td>
<td>404</td>
<td>415</td>
</tr>
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</table>

Tibiae.—On the first visit 7 tibiae gave an average index of 63.9.

The final investigation yielded the following results:

<table>
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<tr>
<th>Total</th>
<th>Average Index</th>
<th>Minimum Index</th>
<th>Maximum Index</th>
<th>Oscillation Exponent</th>
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</thead>
<tbody>
<tr>
<td>Male</td>
<td>67.8</td>
<td>54.6</td>
<td>73.9</td>
<td>2.6</td>
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<tr>
<td>Female</td>
<td>68.3</td>
<td>65.3</td>
<td>71.7</td>
<td>2.2</td>
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<tr>
<td>Uncertain</td>
<td>69.3</td>
<td>67.7</td>
<td>71.4</td>
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</table>

Length of Tibia.

From superior articular surface to tip of internal malleolus.

Measurements are given in mm.

<table>
<thead>
<tr>
<th>Male</th>
<th>Female</th>
<th>Uncertain</th>
</tr>
</thead>
<tbody>
<tr>
<td>360</td>
<td>340</td>
<td>360</td>
</tr>
<tr>
<td>340</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Persimmon Mound, Volusia County.

About two miles north of the Indian Fields on the right hand side of the river going down is a large lagoon 400 yards distant from the channel (see map). On the bank of this lagoon is a shell deposit covering about 5 acres. This field has been under cultivation. At its eastern end is an eminence not differing in composition from the remainder of the field. On this knoll an excavation 8 by 9 feet was made. Its depth was 7 feet through the shell deposit. One foot below the surface at the northern side of the excavation a layer of white sand 3 inches in thickness at this point sloped to the southern side, increasing in thickness until at 3 feet below the surface its diameter was 1 foot. At the southwestern corner it disappeared. Upon this sand lay about eight skeletons, though the close pack-
ing of the shell around them prevented an exact determination either of their number or, in every case but one—an ordinary flexed skeleton—of the position of interment. During the entire excavation not a single fragment of pottery was found, nor was an implement of any sort brought to light.

**HUMAN REMAINS.**

Four humeri showed one perforation.

Four tibiae gave an average index of 58.3.

No crania were saved.

It is perhaps hardly fair to class as a burial mound a shell knoll but slightly raised above the level of the surrounding shell, as was the case with Persimmon Mound. The conditions of interment in many respects recalled those in the great shell-heap at Orange Mound not far distant, an account of which we have given in the American Naturalist for July, 1893.

**INDIAN FIELDS, BREVARD COUNTY.**

Some ten miles south of Lake Harney in a direct line, but fully double that distance by the winding stream, the only means of access, are the Indian Fields, a large shell deposit said to have been cleared and cultivated by the Indians.

At this spot is a burial mound of sand 5 feet in height and 375 feet in circumference at the present time. It is probable that frequent excavations made at various times have increased the circumference at the expense of the height. The surface of the mound showed many beads of glass. No serious investigation was attempted, as the search of casual explorers had rendered it of little value.

**LONG BLUFF, ORANGE COUNTY.**

Long Bluff, on the west bank of the St. John's, has an extensive shell deposit of no great depth. Some distance from the water is a mound of sand 3 feet in height and 75 feet in circumference. Partial examination yielded nothing of interest.

**MULBERRY MOUND, ORANGE COUNTY.**

Mulberry Mound is an island lying on the west bank of the St. John's but a few hundred yards below where the river leaves Lake Poinsett. The island is mainly composed of a large shell-heap rising abruptly from the river's edge. It has been fully described by us in the American Naturalist, August, 1893.

In connection with the shell-heap, 45 feet northwest is a burial mound of sand and shell having a circumference of 300 feet and a height of 8 feet 3 inches.

Six days (1892-1893) were devoted to this mound with a party of eight, working mainly with the trowel, the portion of the mound containing burials being virtually demolished. The mound was composed of the following layers:
Three feet three inches—Brown sand with a certain intermingling of shell containing skeletons.

One foot—Layer, black in color, river mud and sand intermingled, with virtually no shell. The river mud was not a deposit, being above high water mark and was evidently brought to start the burial mound, probably from the strip of black loam connecting the two mounds. On the upper surface of this layer were a certain number of burials, or rather bodies placed upon it had sunk in. There were no bones in the lower portion of the layer.

Two feet—Shell, crushed and whole, with a certain percentage of sandy loam, the regular debris of the shell-heap. No human remains.

Two feet—Shell, crushed and whole, same as layer above in composition, but percolation of water had rendered the mass almost a solid conglomerate. In this layer were found four or five human bones.

Two feet—Under water; crushed shell and sandy loam; plain pottery.

**HUMAN REMAINS.**

Beneath a summit plateau 35 feet in diameter were the greater number of skeletons, all in anatomical order though in various forms of flexion. Beginning at 6 inches from the surface, skeletons lay in a matted mass intertwisted above and below each other until at places it was impossible to distinguish bones belonging to one skeleton from those surrounding it (Fig. 111).

Fig. 111. Stratton of interments, burial mound, Mulberry Mound. (From photograph by author).
Interments did not continue throughout the mound, the sides of which had been extended and raised to protect the burials from the river at high water.

With a female skeleton, somewhat over 4 feet from the surface was a number of fragments of human bones charred and calcined, including portions of the lower maxillary, of the femur, a metacarpal bone, one of the phalanges and other fragments unidentified. As cremation previous to interment was not practised in the case of any burials met with in the mound, this case can hardly be considered as belonging to that form. The skeleton in immediate association was unaffected by fire.

To illustrate one of various forms of flexion we quote from our field notes: "Skeleton C. lay 4 feet from the surface in a dorsal position with head turned to one side, arms parallel with body, forearms flexed upward with bones parallel with humeri, thighs flexed over abdomen, legs flexed on thighs, making tibiae parallel with femurs; vertebrae and ribs beneath with pelvis in proper position. To a casual observer this skeleton would have seemed to be a bunched burial as the bones of the extremities lay side by side."

**Tibiae (first visit).**—During our first visit 66 tibiae gave an average lateral index of 66.2.

**Humeri (first visit).**—Seventy-six humeri from all parts of the mound showed 40 perforations, a percentage of 52.6. Of these 23, coming from a depth of 2.5 feet from the surface or less, showed 13 perforations, or 56.5 per cent.

Fifty-three humeri, believed to be undoubtedly original burials, contained 27 perforations, a percentage of 50.9.

**Crania.**—During our second investigation two calvarias were saved, one superficially and one of especial interest being from the very base of the mound. As previously stated, all crania will be described by Dr. Harrison Allen in Part II of this report.

**Humeri (second visit).**—Upon our second visit (February, 1893), if possible more care was taken than before in respect to determination of the olecranon perforation. Fosses were cleared by the aid of water. A magnifying glass was called into requisition, and three perforations of doubtful origin were discarded from the list. All perforated humeri may be seen at the Museum of the Academy.

Of 41 humeri possibly intrusive 20 were perforated, giving a percentage of 48.8. The perforations were distributed as to sex as follows: Male, 6; female, 6; uncertain, 8.

Of 23 humeri from original burials, 11 showed perforation, a percentage of 47.8; the perforated humeri being male, 7; female, 3; uncertain, 1.

---

1 Among these humeri are included many doubtless from original burials, since, as we shall see, no certainly intrusive interment was found at a depth greater than 18 inches, while all bones within 25 feet from the surface are classed as possibly intrusive.
### Length and Torsion of Humeri, Possibly Intrusive

Measurements are given in mm.

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<td></td>
<td></td>
<td>306</td>
<td>129°</td>
</tr>
<tr>
<td>Uncertain</td>
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<td>284</td>
<td>118°</td>
</tr>
<tr>
<td></td>
<td></td>
<td>298</td>
<td>115°</td>
</tr>
<tr>
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<td>298</td>
<td>119°</td>
</tr>
<tr>
<td></td>
<td>Left</td>
<td>294</td>
<td>130°</td>
</tr>
<tr>
<td></td>
<td></td>
<td>290</td>
<td>127°</td>
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### Length and Torsion of Humeri, Original Burials

Measurements are given in mm.

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<th>Sex</th>
<th>Side</th>
<th>Length</th>
<th>Torsion</th>
</tr>
</thead>
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<td>Male</td>
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<td>298</td>
<td>119°</td>
</tr>
<tr>
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<td>Left</td>
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<td></td>
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<td>290</td>
<td>127°</td>
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### Femora, Possibly Intrusive

Index.

<table>
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<th></th>
<th>Number</th>
<th>Average Index</th>
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<td>104</td>
<td>130</td>
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### Femora, Original Burials

Index.

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### Length of Femora, Possibly Intrusive

Measurements are given in mm.

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<tr>
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</thead>
<tbody>
<tr>
<td>Sex</td>
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<td>Head</td>
</tr>
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<td>Male</td>
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<td>441</td>
<td>453</td>
</tr>
<tr>
<td></td>
<td>425</td>
<td>412</td>
<td>422</td>
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CERTAIN SAND MOUNDS OF
LENGTH OF FEMORA, ORIGINAL BURIALS.

Measurements are given in mm.

<table>
<thead>
<tr>
<th>Sex</th>
<th>Projection on shaft</th>
<th>Oblique Position</th>
<th>Great Troch. to Ext. Condyle</th>
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<td>Head</td>
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<td>414</td>
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<tr>
<td>&quot;</td>
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Tibia, Possibly Intrusive.

Index.

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<td>73-9</td>
<td>1-9</td>
</tr>
<tr>
<td>Female</td>
<td>15</td>
<td>66-7</td>
<td>75</td>
<td>3-2</td>
</tr>
<tr>
<td>Uncertain</td>
<td>3</td>
<td>64-4</td>
<td>70</td>
<td>4-</td>
</tr>
</tbody>
</table>

Tibia, Original Burials.

Index.

<table>
<thead>
<tr>
<th>Number</th>
<th>Average Index</th>
<th>Minimum Index</th>
<th>Maximum Index</th>
<th>Oscillation Exponent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>11</td>
<td>66-3</td>
<td>73-1</td>
<td>3-4</td>
</tr>
<tr>
<td>Female</td>
<td>5</td>
<td>62</td>
<td>65-6</td>
<td>3-7</td>
</tr>
</tbody>
</table>

Although determination of sex was arrived at in our presence, often aided by the possession of other bones from the same skeleton for comparison, it has been thought best in this case to apply to the Tibiae the method used by Dr. Manouvrier in his exhaustive paper on platycnemia, which paper is referred to at length in our account of the Tick Island mound.

The learned Doctor takes the sum of the lateral and antero-posterior diameters of each tibia and arranges the sums thus obtained in sequence from the greatest to the least. This list he divides into three equal parts, considering the first third as males; the second third as uncertain, though mainly undersized men; while the bones of females are presumed to be included in the last portion of the list. The preponderance of males over females he attributes to the greater fragility of feminine bones.

Forty-four tibiae from Mulberry Mound give the following results by this method:

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>First Third</th>
<th>Second Third</th>
<th>Last Third</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Male)</td>
<td></td>
<td>(Uncertain)</td>
<td>(Female)</td>
<td></td>
</tr>
<tr>
<td>Possibly Intrusive</td>
<td>28</td>
<td>69-9</td>
<td>68-2</td>
<td>65-2</td>
</tr>
<tr>
<td>Certainly Original</td>
<td>16</td>
<td>67-6</td>
<td>66</td>
<td>60-5</td>
</tr>
</tbody>
</table>

The average of the 44 tibiae, irrespective of sex, gives an index of 66-8.
THE ST. JOHN'S RIVER, FLORIDA.

LENGTH OF TIBIA.

FROM ARTICULAR SURFACE TO TIP OF INTERNAL MALLEOLUS.

Measurements are given in mm.

<table>
<thead>
<tr>
<th>Positively Intrusive: Male</th>
<th>Original Burials: Sex Uncertain</th>
</tr>
</thead>
<tbody>
<tr>
<td>351</td>
<td>329</td>
</tr>
<tr>
<td></td>
<td>336</td>
</tr>
</tbody>
</table>

These bone measurements from the small sand mound adjacent to the great shell-heap, known as Mulberry Mound, are of considerable importance, since on the St. John's River no other burial mound can with certainty be attributed to the period of the shell-heaps. As before stated, Mulberry Mound is an island shell-heap, the nearest solid ground being two miles distant, and it is therefore most unlikely that Indians living far away should resort to this shell-heap for purposes of sepulture. Nor is the supposition tenable that later Indians living upon the shell-heap erected the entire burial mound. These Indians relied upon agriculture mainly as a means of support, and it is certain that the limited area of the shell-heap could not have supported over a single family at one time. That later Indians did inhabit the shell-heap we shall presently see, but they must have been few in number, and consequently contributed but a small quota to the interments in the mound.

Certain points relative to the long bones from Mulberry Mound are worthy of remark:

1—The low index of the femurs.
2—The high index of the tibiae.
3—The fact that in platycnemetic tendency females exceeded males.
4—The unusually high average occurrence of perforation of the humerus.

To those accepting the theory of Dr. Manouvrier that lateral flattening of the tibia is largely brought about by unusual activity on steep or rough territory, the absence of lateral flattening in the male tibia, and the small development of the linea aspera of the femur will serve as additional evidence, since the males of Mulberry Mound must have spent their time mainly in canoes. The greater platycnemetic tendency among the women is not difficult to explain under the same theory, as the constant ascent and descent of the steep sides of the mound imposed upon those remaining upon the shell-heap the greater portion of their time, would be peculiarly conducive to a lateral flattening of the shin bone.

IMPLEMENTS, ORNAMENTS, ETC.

With the calcined bones already referred to, in immediate association with the skeleton of a woman, was the closed shell of a small tortoise, which probably had served as a rattle.

13 JOURN. A. N. S. PHILA., VOL. X.
But three arrow points were met with; one superficially, two with original burials.

With the lowest layer of bodies were two fragments of tobacco pipes of clay. (Figs. 112 and 113).

A somewhat similar fragment was found at considerable depth in the adjoining shell-heap.\(^1\)

Six inches from the surface, near the cervical vertebrae of a woman, were a considerable number of small white glass beads.

One foot down, with the skeleton of a child of about 6 years of age, were a pair of shears; a sheet of glass 3.5 inches by 5.12 inches, iridescent from age; an ornament of loosely wound copper or brass wire; a number of friable beads of glass; a glass button placed in a small cardium, and a large bead of pressed clear glass.

Near by, 1 foot below the surface, singularly enough with the skeleton of a woman, were an iron implement with blade 8 inches in length; an iron ferule; a flat implement of iron 2 inches by 5 inches, and two iron fish spears 7 inches and 9.75 inches in length respectively. All were badly corroded.

Eighteen inches below the surface, with a male skeleton, was a knife of iron or of steel on which the bone handle still remained.

Pottery.—We have more than once had occasion to speak of fragments of pottery buried with the dead, upon which the shape of the arrow head had been intentionally conferred. This custom, we have noticed, prevailed where, probably through poverty, little else in the way of implements or ornaments was interred. It was especially noticeable at Mulberry Mound where not a single vessel of pottery, whole or in fragments, was found during the entire excavation (Figs. 114 and 115).

\(^1\) American Naturalist, August, 1896.
THE ST. JOHN'S RIVER, FLORIDA.

Fragments of pottery shaped to imitate the arrow head (full size).

It will be remarked that nothing indicating other than aboriginal workmanship was found below 18 inches from the surface of the burial mound.

FORT TAYLOR, BREvard COUNTY.

On the southwesteru shore of Lake Winder, visible from the lake, is a sand mound covered with forest trees. Its present height is 14 feet, its circumference 475 feet. The summit plateau has been increased and the height possibly lessened to make room for a house which formerly had a position on the mound. Many excavations had previously been made and surface finds of silver plates reported. We have not seen them.

An excavation was begun 19 feet from the margin of the base, at which point it was estimated that surface wash and debris thrown down by former investigators would be avoided. The mound is built upon shell. Fourteen feet from the starting point and 8 feet from the surface was encountered a layer composed entirely of Unios, 4 inches in thickness. At this point began skeletons, lying upon the shell. The bodies were flexed and at some points were almost in contact. They were badly decayed. The mound was of brown sand unstratified, with the exception of the layer of shell already mentioned. Its shell base had sloped upward two feet at the point of termination of the trench, which was there 12 feet in depth.

HUMAN REMAINS.

Of three humeri, one showed perforation.
Four tibiae gave an average index of 64-6.

POTTERY, IMPLEMENTS, ETC.

With the exception of sherds, some of which had been shaped rudely to resemble the arrow head, no pottery was met with, nor were any implements whatever found.
EARTHENWARE OF FLORIDA:
COLLECTIONS OF CLARENCE B. MOORE.

By W. H. HOLMES.

Exploration has not yet gone far enough on the peninsula of Florida to give archaeologists a firm grasp on the problems of its prehistoric art. The general nature and range of the remains are pretty well understood, as they form no marked exception to the rule in this latitude, but little has been done in the study of those details that must be relied upon to assist in assigning the art remains to particular tribes and stocks of people, in correlating them with culture features of neighboring regions and determining questions of chronology. The extensive and careful researches of Mr. Clarence B. Moore seem destined to fairly initiate this important work, and there is every reason for hoping that results until now apparently unattainable may step by step be brought about.

It is on the ceramic evidence perhaps more than any other that we must depend for the solution of problem of time, people and culture, and to this branch of investigation the most careful and painstaking attention must be given. Unfortunately the present paper had to be prepared rather hastily and under conditions not calculated to yield the most satisfactory results. The collections utilized represent a limited number of localities and their discussion necessarily lacks the peculiar lucidity that characterizes the presentation of actual personal research in the field.

Historic Aborigines.—The group of tribes occupying Florida during the period of discovery and conquest by the Spanish, belonged to what is known as the Tamuquanan linguistic stock. These people have now entirely disappeared and little is definitely known of their arts or history. Other tribes have since occupied the territory but none have been permitted to remain save a band of Seminoles some 200 strong who now occupy portions of the Everglades. There appears to be but the most meagre record of the making or pottery by any of the historic tribes of the peninsula, yet pottery making was the rule with the southern Indians and we may fairly assume that most of the tribes found in possession were potters, and that much of the earthenware now found in the mounds and shell-heaps belonged to tribes of the historic linguistic stocks of the general region.

There are traces of several rather imperfectly defined groups or varieties of ware in the State, a fact which may in the end prove to be of very considerable importance in ethnic history. The Tamuquanan peoples are doubtless fully represented, but Muskogean influence must have been felt, and at least one of the principal varieties of pottery found on the peninsula was more highly developed than elsewhere with this more northern people. It seems that even the Algonkian family may possibly be represented in certain fabric marked wares of the northeast.
There are traces of intrusive ideas and probably of peoples from the west, and in
time evidences of Carribean influence will probably be made apparent. As it
stands, however, we have such slight historic knowledge of the native ceramic art
of Florida that no part of its products can be fully and definitely connected with
any tribe or stock of people.

*Uses of ceramic evidence.*—The most important archaeologic function of the cera-
mic art relates to the history of American occupation rather than to the history of
particular peoples. The wares imbedded in the successive layers of midden refuse
give hints of change and progress, and the absence of sherds in the subordinate
strata point probably to a time when pottery was not used, or to a period so remote
that it has totally disappeared. We may reasonably hope that ceramic evidence
will materially assist in determining the origin and succession of peoples and in ar-
riving at a somewhat definite chronology of events. These wares are as yet too
meagerly represented in our collections to afford valuable data illustrative of the
evolution of the art. The specimens at hand do not appear to extend either above or
below, in artistic grade, the wares of historic tribes and the aesthetic features are so
varied and confused that they cannot readily be placed with reference to any
scheme of aesthetic development.

*General characteristics.*—The pottery embodied in the collections here con-
sidered comprises a number of varieties or groups not yet fully defined. There are
specimens rivalling the best work of the lower Mississippi region, and others so
rudimentary as to hardly deserve the name of earthenware. One group is wholly
unique, consisting in the main of toy-like forms of rude workmanship and exhibiting
decidedly abnormal if not non-Indian characters such as might be given by
modern natives practising a degenerate art.

In general the pottery of the shell deposits appears to be rude, while that of
the mounds, save the wares mentioned above, and usually that scattered over
dwelling sites, is of a higher grade, often exhibiting neat finish, varied and refined
forms and tasteful decorations.

*Technology.*—The clay used, considering the whole state, seems to have had a
wide range of composition and to have been subject to varied methods of treatment.
The inferior wares show poorly selected materials and rude treatment and the better
grades are characterized by finely prepared paste. Much of the ware is of unusually
low specific gravity as if rendered porous by weathering or the decay of some of
the denser ingredients.

The tempering materials are also varied. Much of the shell-deposit ware
seems to have been tempered with fibrous vegetable matter, such as pounded grass
or bark, thought by Wyman to be palmetto fiber, which burned out in firing or has
disappeared through decay leaving the paste light and porous. In some parts of
the State rather coarse sand or pulverized rock was employed and rarely pulverized
shell was used. In many sections the paste is exceptionally free from tempering
ingredients, being fine grained and chalky.

The vessels were built usually of wide coils which in many cases were so
poorly welded together that the vessels tend to fall to pieces along the jointage. In some of the ruder pieces the coils are still traceable, especially on the inner surfaces where neat finish was difficult or unnecessary. The walls of the ruder wares are thick, clumsy and uneven, those of the better varieties thin, uniform and evenly dressed. The finish is also varied, ranging from the roughest hand-modelled surfaces through variously roughened to well polished surfaces. In many cases a thin coat of finer clay has been applied to the exterior to hide the coarse materials and render polishing easy.

The baking or firing seems to have been of several grades and varieties; usually, however, the surfaces show the mottlings characteristic of the open air treatment common with the tribes of the United States. As a rule the paste has been somewhat whitened to a greater or less depth by volatilization of vegetable elements, the interior of the mass remaining dark or black. In some localities decided reddish and yellowish tints are seen, a result of oxidization of the iron contained in the clay.

The forms are diversified in the extreme. The larger vessels of the class devoted to culinary operations are simple in outline, ranging from deep round-bottomed bowls to wide-necked pots. These larger vessels have been especially subject to breakage and few are recovered in their entire state. The smaller more trivial articles are well preserved. Small bowls and cups of toy-like appearance are common. A bowl with roundish body and constricted lip is typically Floridian. Bottles are rare while eccentric forms are rather common. Handles are varied yet of somewhat exceptional occurrence, as if exotic, and feet or added bases of any sort are rarely seen, the bottoms being rounded, conical or slightly flattened. Squarish outlines and flat bottoms are sometimes met with. Animal forms are rather common and occasionally a shell or fruit is imitated.

Decoration is varied and even heterogeneous, so much so that it can be properly described only in connection with the detailed study of groups. It includes fabric and cord marked surfaces, stamped surfaces, incised and indented figures of many styles and rarely painted figures. The exterior surfaces of vessels otherwise plain have, in some sections, received a wash of red ochre. Decorative effects were also secured by roughening the surface in various ways as by pinching up the soft clay with the finger nails and by modelling ridges and nodes in low or high relief. The lip or rim is often embellished by notching, waving and scalloping.

The textile impressions so characteristic of the earthenware of the eastern and northern United States, and found to some extent in Florida, have never been well understood. The most commonly accepted theory is that the vessels were modelled in baskets or other textile supports and that impressions from these, made upon the plastic material, were rendered permanent by baking. This assumption is not supported by the facts. It is doubtful if baskets were ever used as molds to shape the clay in, and it is not even certain that shallow trays were employed to support the incipient vessel and assist in turning it while the walls were built up as was the custom in the pueblo country. In all the thousands of cases that have passed
under my observation the textile impressions are in disconnected patches or in patterns produced by the application of cords held in the fingers or wrapped on roulette-like modelling tools. The woven textures were wrapped about the hand or a paddle and used as stamps to weld the clay together and at the same time decorate the surface.

Use.—The uses to which the earthenware of Florida has been devoted are probably about as usual in the general region. There were vessels for use in the full range of domestic operations—cooking, carrying, containing, eating, drinking, etc.; there were others for ceremonial occasions and for burial with the dead. There were also figurines representing animals to be used as toys or as ceremonial appurtenances. There were also pipes and beads as well as other objects of unusual shapes not assignable to any known use.

The employment of earthenware in burial is of special interest. The dead were buried in ordinary graves and in sand mounds and exceptionally in shell mounds, and here as elsewhere it was customary to deposit various utensils with the bodies. The vase for food, medicine or property was a universal accompaniment of the departed savage throughout America, and the tens of thousands of specimens now gracing our museums are there by virtue of this well known custom; but there are some curious and interesting features connected with the practice. Over much of the country the vessels were deposited entire and are so recovered by our explorers, but in some sections, notably along the Gulf coast and in the Florida peninsula, a practice had arisen of breaking the vessel before consigning it to the ground. Two explanations may be given of this proceeding; first, that since the vessel was usually regarded as being endowed with the spirit of some creature of mythologic importance, it was appropriate that it should be "killed" before burial that the spirit might be free to accompany that of the dead person; second, that the vessel might not be of value to possible robbers bold enough to desecrate the graves for their store of utensils.

The facts brought out by the recent explorations of Mr. Moore add new features of interest. In cases it is apparent that the vessels were not only broken before burial but that fragmentary vessels were used; and again that, as in the Tick Island Mound and elsewhere, sherds only were buried, serving as substitutes for and representing the entire vessel. An exceptional feature of these phenomena is the presence in some of the burial mounds of sherds broken out to rudely resemble notched spear and arrow points. It would seem that the economic mourners had reached a point of thrift at which the sherd was made to represent the vessel formerly used, and that, enlarging its office, the sherd was modified in shape that it might also represent and take the place of such implements of stone and other materials as were formerly freely devoted to the service of the dead.

Still more remarkable is the practice, which seems to have become pretty general in Florida, of making vessels especially for burial purposes; first, in close imitation of the real vessels but with open bases so that they did not need to be broken or "killed" when inhumed and at the same time did not encourage robbery; and,
second, of such rude workmanship and eccentric forms that no industrial or ordinary use could be made of them by any one.

Another view may be taken of this group of exceptional facts. It may be noted first, that the perforating and making of perforated vessels used in burial and the placing of sherds, shaped and unshaped, with the dead is confined, mainly at least, to Florida and the Gulf coast, and that these practices pertain to comparatively recent times. It may further be observed that articles of European make, Venetian beads, Spanish olive jars, articles of metal, etc., are found in many mounds of this region, thus indicating the very general practice of mound-building during the period following the arrival of the Spaniards—a period extending over a hundred years or more. Considering these points I would suggest the idea that possibly this whole group of extraordinary mortuary practices may have grown up in post-Columbian times. The most prolific sources of gain known to the Spanish were the cemeteries of the aborigines and the seekers of El Dorado and the Fountain of Life were the princes of grave robbers. It would be but natural that people possessing the ready resources of the southern Indians, finding the graves of their fathers ruthlessly desecrated by the invaders in their mad search for gold and pearls, should, while still preserving the spirit of their mortuary customs, cease to consign to the ground any articles of real value. Notwithstanding the seeming improbability of this theory, for the time appears too short to have permitted the construction of such numerous and important works, it will be conceded that the inroads of hordes of avaricious and merciless strangers must have exercised a powerful influence on the habits and customs of the native tribes and such phenomena as these mentioned would seem a not unnatural result.

As to the use of earthen vessels as receptacles for the bones and ashes of the dead we have little information. In the Appalachian districts to the north it was a somewhat usual practice to place the bones or portions of the bones of deceased persons in large vases which were carefully covered with a lid or inverted bowl when buried.

**Ages.**—From numerous and very careful examinations of the phenomena of the shell mounds and deposits, the conclusion is reached by Mr. Moore that the earliest occupants of the St. John's were without pottery and that sufficient time has elapsed since the earlier period of occupation for the development of the art, as indicated by successive stages of advancement in shell-deposit remains. This would be the order of things if events conformed to the ideal scheme of evolution.

In a number of cases where there is a succession of layers in the midden deposits the lower strata are without pottery. Resting upon these are beds containing only the rude forms of ware characterized by thick walls, clumsy shapes and plain surfaces or incised-indentated decorations of primitive character. In the superior beds this pottery gives way to less rude forms having characters typically developed in the leading groups of ware found in superficial deposits and on the surface.

With respect to the absence of pottery from certain deposits or portions of de-
posts, no one is better qualified to speak than the explorer, Mr. Moore, who is convinced from the consideration of many observations both archaologic and biologic that only the one explanation can be given. Without questioning this conclusion I may venture to offer the following points for consideration: (1) It seems that deposits of this class may have been made by tribes not using pottery, although surrounded by pottery-making peoples; (2) that the shell fishers concerned may have been pottery makers but not practicing the art on the fishing grounds, and (3) that vessels may have been made for temporary use on the fishing sites of such inferior quality as to disintegrate and disappear in a brief period. In this connection I would observe that some of the shell utilizing sites in the incipiency of their occupation were probably not well fitted for permanent occupation, and hence but temporarily resorted to. Such conditions of occupation would not encourage the practice there of the ceramic art.

Another factor to be considered in this connection is the fact, brought out by my examination of the shell deposits of Maryland and Virginia, that a ruder, coarser variety of ware, comprising mostly large vessels of peculiar shape, finish and decoration, was made for use on the midden sites and confined very generally to these sites, although the same peoples seem to have made much better pottery and of distinct varieties for use elsewhere.

In many cases articles of European origin have been found in the mounds of Florida, and mound building must have continued for many years after the arrival of Europeans, but numerous mounds of the same class and containing the same native articles yield no foreign relics whatever, and in the great shell mounds and middens such relics are confined to the immediate surface. Ample proofs are found that centuries of pottery making preceded the coming of the whites and this fact coupled with that of the absence of pottery in the inferior strata of many of the accumulations goes to show that the peninsula had been occupied for a very long period.

VARIETIES OR GROUPS OF WARE.

The earthenware of Florida is more than usually diversified in its characters, no other like area within my knowledge yielding an equal number of distinct forms. Convenience of description demands a separation of these wares into a number of groups, but this is as yet a difficult task as the criteria for classification are not well made out. If a single character were sufficient to distinguish a group the work would be simple, but it is generally necessary to consider a number of characters. Thus it is not the use of a particular clay or tempering material, a given range of form or size, a peculiar color or kind of decoration that distinguishes a group, but an assemblage of two or more of these characters in a way distinct from any other assemblage of these characters.

If we take the earthenware of one culture-province and place it alongside of that of a neighboring province we observe that there are marked and easily recognized dissimilarities. The combination of features in the one is unlike the combination in the other although many of the characters in the two groups are alike or re-
FLORIDA.

111

seemle each other closely, and some of the vessels of the one group may even be
duplicated in specimens of the other. We observe also that the diversity of charac-
ters within a given limited area is often so pronounced that the wares may be as-
sembled in well marked groups. The significance of this pronounced diversity is
not always easily ascertained, as the differences may arise from a number of causes,
as for example, differences in the material available within the area, differences in peo-
ple through intermingling or successive occupation, differences in uses to which the
utensils were devoted by a single people or to differences in period of the same
people.

Manifestly the first step in the study of the ceramic remains of the region
should be the separation and analysis of the groups or varieties of products. Then
as research goes on, the significance of these groups with respect to questions of peo-
tle and culture will become apparent.

For present purposes these Florida wares may be segregated under the follow-
ing heads: (1) Florida wares proper, including chalky ware, extemporized ware,
gritty ware, midden ware, etc.; (2) South Appalachian stamped wares and (3)
Gulf coast wares. The limitations of these varieties, geographically or otherwise,
are not well marked, one grading imperceptibly into the others, features combining
in such ways that many specimens occur that cannot be definitely assigned to any
one of the groups.

Chalky Wares.—The groups or varieties of ware especially characteristic of
Florida are somewhat difficult to designate fully, although easily identified by one
familiar with all the southern wares. What appears to be the most important
variety is characterized by the peculiar color and texture of its paste. In typical
specimens the color is a light yellowish gray upon the surface and very dark or
black within the mass. This contrast of color is due to the imperfect volatilization
of the carbonaceous constituents of the clay, save upon the surface. The texture
of the paste is very fine and chalky and it is quite possible to identify the ware by
the sense of touch alone.

Varieties of this ware are numerous. Many specimens are quite plain, the sur-
face having been carefully smoothed with the polishing tool. Occasional vases of
a limited range of form have been painted red, giving a suggestion of western influ-
ence, the use of color being much more general in the Mississippi valley than else-
where. Another variety exhibits incised and punctured decorations of peculiar
types. The figures are in cases elaborated entirely in indentations of varied shapes
and sizes; again solid lines are used alone or both lines and indentations appear to-
gether. Often the outlines of the figures are wide and deeply incised. The pat-
terns are in rare instances partly worked in low relief; generally they are highly
conventional. Very frequently stamps were used in finishing the pottery of the St.
John’s province, the plain rather minute reticulated pattern being the favorite. The
stamped wares are described separately.

The chalky pottery appears to be connected in some of its characters with mid-
den ware proper as well as with the extemporized variety. In form the vessels of
this group exhibit great variety. The bowl was a favorite shape. Sometimes the body was hemispherical and again it was conical. A common form is a deep bowl of graceful outlines with much constricted lip.

*Extemporized Ware.*—The explorations of Mr. Moore on the St. John's have brought to light a form of earthenware not heretofore observed in any locality and likely to give rise to considerable discussion. It is found in the sand mounds, generally at no very considerable depth although in some cases as in Mt. Royal it occurs with original burials throughout the mass of the mound. It consists of vessels or pseudo vessels, vessel-like articles, animal figurines, and various objects of eccentric shape all of rude construction and finish. As a rule these objects have the appearance of toys made by hands unskilled in the manipulation of clay and practically untrammelled by the traditions of native art.

The clay used was generally crude and untempered, the construction was careless and hasty and the baking was slight. The few specimens worthy of being called vessels are so crudely made that they would be of little service in any of the usual offices of a vessel. As a rule the vessel forms were perforated beneath while the clay was yet soft, the opening being left rough as cut or punched or dressed down rudely after the manner of the normal opening at the opposite end. They repeat in a measure the forms of the real pottery but with many trivial variations. Decoration is confined to the most elemental incised and indented figures and relieved features.

The animal forms are rarely so well modelled as to render the idea of the modeller intelligible. The panther, wolf or dog, the squirrel, turkey, turtle, fish, etc., are more or less forcibly suggested. The size is usually small, and the clumsy forms, modelled with the unaided fingers, are solid or nearly so, the more massive portions having been roughly perforated with a stick to prevent cracking and falling to pieces in the process of baking. Vegetal forms are extremely rare in the normal native art of the United States, the gourd appearing in some cases as a model for earthen vessels, but here a number of attempts have been made to represent acorns, flowers, buds, ears of corn and the like. A large number of unclassified forms, equally rude with the preceding resemble cylinders, cones, beads, the hour glass, the druggist's mortar, etc. Seeking among the ceramic products of the United States in our Museums I find occasional examples of small rudely made toy-like figures, that may possibly fall into the same general class as these Florida figurines.

The most satisfactory evidence of the close relationship of this pottery with the normal wares of Florida is its occurrence in a number of mounds at considerable depths with original burials and associated intimately with a wide range of relics. Besides this there are many features of the ware that approach in appearance or manner of treatment the ordinary pottery, and we may safely infer that it was made by potters of the later period of occupation for a special purpose not requiring careful finish.

As a rule native art furnishes few examples of trivial work—of objects or uten-
sils having no definite, serious function. I can think of but two ways of explaining their existence; (1) the objects may represent a development of the idea of substitution in burial, articles of value being reserved for further use; and (2) they may be the product of idle fancy operating after the normal traditions of the native art had been lost sight of and possibly in mere wantonness. In the latter case, however, they would hardly be employed in burial.

**Midden Ware.**—The shell deposits of the St. John's furnish varieties of ware said to be confined almost exclusively to these deposits, and supposed to especially characterize the middle period of their accumulation, the earlier period being without pottery and the later having many varieties such as appear on the surface in great plenty. This pottery has been recovered only in the shape of sherds and cannot be studied to the best advantage. Among the fragments I find evidence of considerable variation in texture, treatment and ornamentation. One variety is characterized by a rather fine-grained paste preserving the warm gray colors of the baked clay. The surfaces are finished with the rubbing tool and are plain or have been rather carelessly embellished with patterns of incised straight and curved lines. Another, and the most notable variety, is characterized by the unusual appearance of the paste which has been tempered with a large percentage of fibrous matter, probably cut and finely broken palmetto fiber. This tempering substance has been destroyed by fire or decay leaving the paste highly vesicular and porous and of low specific gravity. Generally these sherds show the decided effects of use over fire. The walls are thick and uneven and the surfaces rudely rubbed down. The forms appear to have consisted mainly of bowls with variously recurved, incurved and otherwise modified rims, and rounded or flattish bases. The diameter varies from a few inches to a foot or more. Examples restored from the fragments which are sufficiently large to indicate the shape and suggest the true character of the ornament are shown in Fig. 1.

![Fig. 1. Restored shapes of midden ware, Tick Island mound.](image-url)

They are from the Tick Island mound and appear typical of what is assumed to be the earliest pottery making period. The execution of the designs is decidedly rude, the incised lines being deep, wide and irregular. The designs themselves, however, seem to comprise not only the archaic forms, seen in a and b, but running scrolls such as occur in the most advanced groups of southern pottery. The angular interspaces are filled in with indentations as seen in c. There is as yet no absolute measure of the value of particular decorative motives in determining the degree of culture progress, but elaborated scroll work can hardly be called archaic and we must conclude either that this ware does not represent the earliest use of
pottery among the shell-mound peoples or that the decorative art had already been practised and matured in arts that preceded the employment of clay. It may be remarked further that the shapes so far as restored are nearly identical with the prevailing shapes of the highest art period of Florida. The evidence of age furnished by conditions of stratification and animal remains may be entirely satisfactory, but determination of period and status of culture based on the character of the art contents of kitchen refuse must be accepted with caution. This fiber tempered pottery was found by Wyman at Old Town, Old Enterprise, Watson’s Landing, Silver Spring and Palatka, but no details of occurrence are given. Mr. Moore obtained specimens from Tick Island, Orange mound, Huntington’s, Mulberry mound and many other localities, all the phenomena being observed with the most careful scrutiny.

Stamped Ware.—The use of the figured stamp and of a variety of figured surfaces in finishing and decorating pottery was common in Florida. The most typical development of the stamped decoration appears to have taken place in Georgia, but extended into the adjoining States. The use of the wooden paddle-stamp so common at one period in this region is now confined to a single people—the Cherokees—who to a limited extent practise the art of their ancestors and predecessors. Whether the stamp belonged to that tribe originally or was adopted from tribes of Muskogean or other stock is not determined.

The highest development of the stamp was in connection with South Appalachian wares which had certain well-defined and persistent features of material and shape. Passing out of the central area yielding this ware, features of form, material and design change as the result of change of physical environment or people. Toward the Atlantic the material changes from a purely silicious paste and tempering to a shell tempered clay, and in the Florida peninsula the stamp was chiefly used in decorating the variety of ware made of a fine porous clay without visible tempering. In Florida also there is a change from the large oblong conical pot found farther north to a deep bowl like vessel of medium size and the stamps themselves seem as a rule less artistic and complex.

The stamped ware of the St. John’s indicates the almost exclusive use of a paddle-stamp the face of which was carved by means of stone, shell or bone knives in checkered patterns, consisting of shallow grooves crossing each other sometimes at right angles and again at oblique angles and numbering generally from five to twelve to an inch. The square or lozenge shaped spaces between the crossed lines being in relief left, when applied to the soft clay, regularly arranged groups of pits as shown in Fig. 2. The Cherokee paddle-stamp, Fig. 3, has the surface characteristics of the St. John’s stamps. A modern Cherokee stamped vase is illustrated in Fig. 4, and the paddle used in decorating it is shown in the same connection.

The use of the stamp in the South Appalachian-Florida province may or may not be indigenous. It certainly does not connect along the Gulf coast with Mexico.

Fig. 2. Sherd of stamped ware, Florida.

Fig. 3. Cherokee paddle-stamp, modern Cherokee.

Fig. 4. Stamped vase and paddle-stamp used, modern Cherokee.
although it may have entered by way of Cuba or the Bahamas. It is the most
general use of this method of ornament known, but represents a much lower grade
of development than the stamped work of more southern countries. It is, how-
ever, much in advance of the practices of the more northern tribes who employed
various improvised stamps to manipulate and diversify the surface of their earthen-
ware.

Gulf Coast Group.—Prominent among the Gulf coast groups of ware is a
variety typically developed in the region of Pensacola. It is characterized by
varied and symmetric forms, gritty but fine-grained paste and tasteful incised pat-
terns including the current scroll, the latter being treated in cases exactly as in the
midden ware of Tick Island. No typical examples of this pottery have been found
on the St. John's, but traces of its peculiar characters occur in a number of cases.

WARES DESCRIBED BY STATION OR LOCALITY.

The collections to be considered represent localities distributed along the St.
John's from Palatka on the north to Lake Washington on the south, a distance of
upwards of 100 miles. They were derived from midden shell deposits, from sand
mounds and to a slight extent from camp and village sites on or near the river. For
convenience of description and reference the pottery of each station or locality will
be presented separately.

Dunn's Creek Mound.—The Dunn's Creek sand mound, the lowest and most
northern station represented in the collection, furnished a considerable series of ves-
sels and fragments of vessels covering a wide range of material form and decoration,
but nearly all of the specimens are of the well-known varieties found in mounds
and on village sites over a large part of the State. Articles of European origin were
associated with many of the burials.

Among the best preserved pieces are a number of bowls, mostly of small size
belonging to the ordinary earthenware of the Florida region, characterized in this
section by a light yellowish gray surface, dark interior paste, fine grain and low specific
gravity. This variety of ware is generally finished with a stamp though sometimes
incised. The bowls or cups are shallow or deep and have upright, expanding or
contracting rims which are scalloped, notched or otherwise embellished. In one
case the lip is thickened and prolonged in heavy projections on opposite sides.
Usually the bottom has been perforated subsequent to baking. The ruder pieces
of this ware, Figs. 2 and 3, Pl. III, seem to connect it with the remarkably rude,
extemporized pottery of which so many specimens have been collected by Mr.
Moore. A good example of the latter ware is presented in Fig. 1, Pl. III. It is
so rude that we are hardly justified in calling it a vessel, although it has a rudely
excavated cavity or bowl. The fresh looking surface is light yellowish gray in color
and the soft, brittle paste where broken is a deep black. The rim projects considerably,
is scalloped on the edge like the corolla of a flower and has deeply incised decorat-
tive lines on the upper surface. The body is long and roundly conical and is encir-
cled by four petal like figures relieved by removing the clay from the interspaces to
a considerable depth by carving while the clay was unbaked. The general surface is slightly rubbed down with a polishing stone. Although considerably mutilated this cup is not perforated below.

A variety of pottery resembling the Pensacola ware in texture and decoration, is represented in this mound by a number of fragments. The paste is dark brown and of gritty texture. The vases have been of medium or rather large size and apparently of somewhat eccentric form, and have been elaborately decorated in incised lines and indentations arranged in figures that owing to their fragmentary state cannot be fully made out. The larger fragment shown in Fig. 1, Pl. II, contains part of a figure very neatly traced and clearly defined by filling the interspaces with fine parallel or hatched lines. I take the figure to be a highly conventionalized life form, and judging by hints obtained from other specimens in the collection the original is possibly a bird. Comparison may be made with Fig. 4, Pl. XV. Other fragments are shown in Figs. 2, 3 and Pl. II. 4. Ware of this general character and decorative treatment extends westward to Alabama and northward into Georgia.

Several fragments of painted pottery representing deep bowls or pots, one of which has a widely and abruptly expanding rim, were obtained from the base of the mound. The red color has been applied with a brush in a thin wash covering the rim in one case, and extending a short distance down the neck or body of the vessel. The surface has a moderate polish and the paste is brown and gritty. Specimens of similar ware are found all along the Gulf coast from Cedar Keys to Mississippi.

Two pipes made of coarse yellowish clay were found at a depth of six feet. They are shown full size in Figs. 2 and 3 of Mr. Moore’s paper, page 14.

Objects of this class are exceedingly rare in Florida, only one specimen, and that a fragment, has so far been reported from a shell heap. The specimens figured are of the same make as the ordinary pottery, one being plain and the other embellished with the form of a bird perched on and forming a part of the bowl. In general shape they correspond closely with the prevailing style of pipes in the south and west.

Mt. Royal.—Mt. Royal, a sand mound near the outlet of Lake George, 555 feet in circumference and 16 feet high, furnished examples of nearly all the ordinary varieties of ware found in this part of Florida. They are not always typical but may be described under the heads of extemporized ware, stamped ware and incised ware. Fragmentary stamped ware was found upon and near the surface. Vessels were buried with the dead throughout the mound, nearly all being broken, probably by the weight of the sand.

The Mt. Royal collection contains a large number of the crudely made articles classed under the head of extemporized ware. There is great diversity of shape and many features are wholly eccentric. The size is small and the workmanship of the rudest possible kind, as if the objects had been made in haste as an offering to be cast into the grave with the dead, or as if they were the mere product of unskilled
hands and idle fancy. It is quite certain that articles so rude and fragile could have served no purpose in the arts; that they were not intended for use as utensils is supported by the fact that in most cases the vessels were made perforate. The paste is crude clay so slightly baked that many of the specimens fairly fall to pieces of their own weight.

The practice of perforating vessels on consigning them to the grave was common along the Gulf coast and across northern Florida, but the making of vessel forms with perforated base has not been observed outside of Florida, and was first made known to anthropologists by Mr. Moore in the American Naturalist. One specimen only of this class, from Franklin County, Florida, is found in the National Museum.

These pseudo vessels take the form mainly of cups and bowls, some being shallow and of simple shape, others deep and with incurved or widely expanding margins. Many are eccentric in outline, and the rims are scalloped or triangular, square or oval, and furnished with rude handles and projections of various kinds.

Fig. 3, Pl. III, illustrates an average specimen with widely expanding saucer-like rim. The clay is gray and somewhat mottled on the surface and dark within. The rudeness of the work is well expressed in the cut. The perforation in the base, made whilst the clay was still soft, is three-quarters of an inch in diameter. Near the upper margin of the rim on opposite sides are two small perforations apparently for purposes of suspension. Fig. 1, Pl. IV, represents an equally rude piece, an oblong cup with base broken out. It was recovered at a depth of six feet in the mound.

Fig. 3, Pl. IV, illustrates a unique piece also quite rude, but signalized by an incised pattern, a disconnected meander composed of short parallel lines one half an inch apart, the space between being filled in with impressions made by a minutely notched tool about one-half an inch across the edge. In this case the top of the vessel has been partially closed, as shown in the cut. The entire surface of the top is ornamented with scattering impressions of the notched tool mentioned above. The perforation in the bottom is one-half an inch in diameter and was made probably after the top was closed, by punching from below, as the edges of the clay are turned inward. The work is such as might be expected of an aimless dabbler in pottery making.

The small cup shown in Fig. 2, Pl. IV, was found at a depth of fourteen feet in a layer of sand artificially reddened with oxide of iron, and accompanied by many fragments of chert apparently the refuse of arrow making. The rim is pressed in at the four sides and rudely embellished with a border of indentations made with the same tool used in marking the upper surface of the specimen just described. The base has a perforation about three-fourths of an inch in diameter punched from below while the clay was soft; the edges have been somewhat rounded off as a finish.

Plate V illustrates four additional pieces of this ware, all being originally perforate or with bases broken out. In one case the perforation has been cut out with
a knife while the clay was soft. Fig. 2 is engraved one-half actual size and represents a small vase with expanding rim, angular shoulder and rough finish. Figs. 1, 3 and 4 are part of a series of small perforate cups of most varied shapes found in a large pocket of bright red sand on or below the base of the mound 7 feet 6 inches deep. Six of these cups were set one within another and somewhat fixed together as if baked in that position and not separated until removed from the mound. Two, Figs. 3 and 4, have perforate handles and resemble dippers or ladles. The rims of others are furnished with pointed projections. This set of cups was protected by a large dish which had crumbled beneath the weight of sand.

Some of the smaller vessels have been slightly rubbed down with a polishing tool, and one or two appear to have been discolored by use. One rude piece resembles a large tobacco pipe bowl; it is reddened and somewhat polished. Another appears to be a bead of irregular, cylindrical form, some two inches long and roughly perforated. Of the same ware is the cup-like piece shown in Fig. 1, Pl. VI. It is irregular in outline, thick, clumsy and perforate. The rims of both ends being finished in the same careless manner. Another of like form and in fragments was found with it.

Of somewhat better quality are the two small cups given in Figs. 2 and 3, Pl. VI. The bottoms were not made perforate and the finish indicates that they were intended for actual use. They do not, therefore, properly belong in the extemporized group, though made, no doubt, by the same hands. One was found at a depth of five feet and the other at six feet. Corresponding closely in style to the preceding, although originally perforate, is the cup illustrated in Fig. 1, Pl. VII, while the peculiar piece given in Fig. 3 of the same plate is of the ruder type.

The stamped ware of Mt. Royal and vicinity is of the ordinary variety found in this section characterized by a light surfaced paste dark within and of low specific gravity. The stamped figures are usually of the simplest type. Specimens found in place in the mound or associated with burials are as a rule rather rude, one piece only, the fragment of a large vessel, showing careful work. Specimens found on the surface, usually in small fragments, exhibit much greater variety and many pieces show excellent finish.

Vessels of this class are nearly all bowls, varying from a shallow, widely flaring shape to a globular body with constricted lip. A few pieces give indications of eccentric contour and in cases the lip is expanded into handle-like projections on two opposing sides. Few specimens have exceeded a foot in diameter and the walls are thin, but for a thickening of the rim, would be extremely fragile. The interior surface and rim are rather imperfectly polished down and the stamp was applied to nearly the entire exterior surface. Usually the pattern was a small checker, but curved lines are seen in some of the pieces.

Pottery apparently of the same make as the stamped ware is in cases undecorated and again is embellished with incised lines exclusively. The rim of a rather rude bowl about six inches in diameter done in the latter style is shown in Fig. 2, Pl. VII. The interior and rim are rudely finished with the polishing tool, the ex-
terior having been well rubbed down. A row of incised triangular figures filled in with indentations is carried around the rim. The piece was found at a depth of 13½ feet and is partially reddened with the oxide of iron in which it was enveloped.

The occurrence of typical specimens of the stamped ware with original burials throughout this mound is a fact worthy of especial notice, for it is a ware widely distributed in Florida and southern Georgia, characterizing in all probability the art of the people found in possession of the region by the Spanish.

Among the sherds of ordinary stamped ware from this locality, but not indicated as coming from the mound, are some bits of heavy, silicious, gritty ware marked with textile surfaces or indentings resembling fabric imprints, and a few bits seem to be cord marked. This ware has analogies with the Algonkian pottery of the middle Atlantic region, but the paste is not unlike that frequently seen in typical Appalachian and Floridian wares.

*Mound in Pine-woods, Blue Creek.*—This mound contained a number of unique pieces belonging mostly to the rude extemporized variety and having the appearance, as in other cases, of hurried work by unskilled hands. The paste is dark within and light gray without, and the finish was left to the unaided fingers or received a very hurried rubbing with the polishing tool.

A few small fragments of the ordinary square-pitted stamped ware, probably from the surface, are in the collection and one vase represented by considerable fragments belongs to the cruder incised pottery; there is an appearance of carelessness in the work, and another cup of the same ware is so rudely made and finished as to apparently connect the makers of the better finished vessels definitely with the fabricators of the extemporized toy-like articles. The vase of cruder incised ware referred to above is somewhat pot-shaped with wide long neck and base approaching the conical shape, and the rim was supplied with two tongue-like projections as seen in the plate. The diameter is about six inches and the height nearly the same. The walls are thin and moderately smooth and the color is brown with traces of red paint. The decorative design is rather elaborate, covering a large part of the vessel, and consists of figures of unusual shape executed in incised lines and small deep indentations. It is illustrated full size in Pl. XI. A fragment showing somewhat similar treatment is given in Fig. 3, Pl. IX.

The extemporized ware comprises several vessel-like articles and unique shapes and two examples of animal figurines, all hastily constructed of ordinary clay and slightly baked. Two rude dipper or ladle-like cups are given in Fig. 2, Pl. VIII, and Fig. 1, Pl. IX. Fig. 4, Pl. VIII illustrates, three-quarter actual size, a rudely made article resembling somewhat in outline a druggist's iron mortar. It is solid with the exception of a rude perforation. A projecting part of undetermined shape has been broken away from the top. Any attempt to assign this object to a definite use is vain for so far as we can see it is a mere work of fancy. The same may be said of several other pieces, two of which appear in Fig. 1, Pl. VIII, and Fig. 2, Pl. IX. The former, a rude scalloped cup finished with an ordinary hatched stamp, came from a mound about two miles distant. The animal figures consist of the un-
couth creature shown in Pl. X, and the head of a larger specimen of like character
given in Fig. 3, Pl. VIII. These are about as rude as could be made.

*Volusia Sand Mounds.*—The pottery obtained from a number of small sand
mounds near Volusia, Volusia County, is exclusively of the painted variety and,
with the exception of a small cup which had a hole broken in the bottom, comprises
only vessels of large size. These vases were made perforate, finished at both ends
with equal care and well polished and painted with stripings of red in simple patterns.

The illustrations presented in Plates XII, XIII and XIV, convey a very excellent notion of such vessels as were recovered in a complete or approximately complete state. Figs 1 and 2, Pl. XII, are thought to represent portions of two distinct vessels, although the dimensions and painted design are closely identical and one represents the mouth proper of a vase and the other apparently shows the base of a vase perforated by cutting away the point of the elongated cone. The painted figures, a vertical chevroned band in one case and a like band and two small circles in the other, are in red on the smooth yellowish gray ground of the paste.

The vase shown, one view in Pl. XIII and another in XIV, is of the painted ware and of unusual size, being 19 inches in greatest diameter and 15½ inches high. It has a globular body with constricted mouth 10 inches in diameter and an opening in the base 3½ inches in diameter, both apertures being symmetric and neatly finished. The surface is polished in the usual way and is decorated with a design in red paint consisting of bands about the apertures connected by six broad vertical bands as shown in Pl. XIII.

A somewhat similar piece is 10½ inches in height and 15½ inches in diameter. The upper opening is 9½ inches in diameter and that in the base 2½ inches. The decoration consists of broad lines in red arranged in three festoons around the upper part of the globular body.

A point of especial interest with respect to these vases is that though of the usual type of ware, of large size and thoroughly finished, yet they are perforate and were originally made so. This gives rise to the question whether or not the perforation could possibly have served a utilitarian purpose, such as the straining of liquids, or whether in this instance, as is certainly the case with the rude extemporized ware, the perforation had reference only to the use of the vase as a mortuary object shaped in accord with the dictates of superstition.

*Tick Island Sand Mound.*—The pottery obtained from this mound is mostly
in a fragmentary state. In the main it seems to correspond with the more ordinary ware found in the mounds and on the surface, being of like grade and character from the lowest to the highest occurrence. The mound was composed of three separate more or less lenticular bodies of material. The lower consisted of a compact mass of shells and yielded no relics. The layer of sand above con-
ained vessels and fragments of vessels deposited as usual with the dead, and the
surface layers were filled with sherds disseminated as if forming a part of the material used in building the mound.

Three small vessels were found near the head of a child's skeleton and aside from these and two other pieces, one of which was perforated, the pottery deposited with the dead was in fragments and, from the fact that few pieces were found that could be joined together, would seem to have been fragmentary when deposited. The occurrence of fragments modified in shape before consignment with the dead would seem to indicate that their employment was probably not, exclusively at least, as representatives of the actual vessels ordinarily used in burial, but intended to subserve some other superstitious end. Some of these pieces were broken into rude triangular shapes and many are so proportioned as to suggest the shape of a spear or arrow point, as seen in Fig. 7. The practice of substituting imitation or representative articles for real tools and utensils as suggested by Mr. Moore, appears to have been common in the Florida region, but was not generally in vogue with the natives of the United States. The construction of vessels perforated when made is sufficient indication of the existence of the idea of substitution, and the use of mere fragments could, it seems, readily follow, but the shaping of the pieces to imitate arrow heads would indicate the existence of ideas of which we have secured no fully satisfactory understanding.

Among the fragments are portions of well made vessels of the prevailing later Floridian types. One specimen from the base of the mound, shown in Fig. 1, Pl. XV, appears to have formed part of a bowl or ladle modeled in imitation of a conch-shell. The workmanship is neat and the surface well polished. Fig. 3, represents part of the lip or rim of a deep bowl about which a scalloped collar in low relief had been modeled and a like fragment is illustrated in an article by Mr. Moore published in the "Naturalist" for July, 1892 (Fig. 1, p. 576).
Only one specimen (Fig. 8) was found, that seems to belong to the extemporized variety (Fig. 2, "Naturalist," July, 1892). This occurred with the crumbling bones of a skeleton buried at the base of the middle or white sand stratum of the mound. We thus have from this mound all the varieties of ware characterizing the later periods of native occupation save the stamped pottery.

The absence of articles made by the whites is noted by Mr. Moore, and this may be regarded as good evidence that the work was done before the Columbian occupation, but it should be noted that in other sand mounds the varieties of ware found here are associated with foreign art, thus connecting the builders of this mound with historic tribes, in all probability of Tamuquanan stock.

Tick Island Shell Mound.—A ridge shaped shell mound, a few hundred yards south of the great Tick Island burial mound, yielded many fragments of pottery of a variety differing from any of those described above. Although pretty generally ornamented it is rude in construction and finish, and pertains, no doubt, to the culinary operations of the shell fishers. In form the vessels, now in sherds, appear to have been simple bowls and pots of medium size with thick walls and moderate
symmetry. Restorations are given in Fig. 1. It is noticed that the clay was tempered with some vegetable substance like pounded grass or palmetto fiber which has entirely disappeared leaving the mass quite vesicular. A somewhat analogous effect sometimes results from the burning out or decay of pulverized shell. The use of shell was exceptional in the valley of St. John. In cases a coating of fine clay applied to the surface, a common device, has reduced the porosity of the walls.

The ornamentation of this ware is generally of archaic type, consisting of incised lines and indentations arranged in simple rudely executed patterns. The specimens illustrated in Figs. 9 to 12 ("Naturalist," July, 1893) convey an excellent notion of the character of this pottery.

The shapes, the treatment of the rims and some features of the decoration are repeated in the prevailing Floridian wares, and one piece of excellent quality found at a depth of seven feet is neatly incised and has the lip turned out at one point; and it therefore seems possible as already suggested that these shell-bank wares may have been constructed on temporary resorts for purely culinary uses by peoples making better pottery for other purposes elsewhere. The point could be determined by a detailed and extended study of the association, or lack of it, of these wares with other varieties of pottery.

Ginn's Grove Mound.—The few pieces from this mound belong to the highest type of Florida pottery, the variety which connects directly along the Gulf coast to the lower Mississippi in an unbroken chain, the links of the chain varying somewhat with the regions. In Fig. 4, Pl. XV, we have illustrated a fragment, the head of a bird, perhaps an eagle, well rounded and treated in a conventional yet remarkable manner. The hooked bill is seen in profile, and the eye, modeled in low relief, is surrounded by a peculiar figure colored white and outlined in a broad smoothly incised line, the color of the head being red. The incised line of the outline is continued down the curved beak to indicate the mouth. The outlining in a smooth incised line and the use of the angular indentations seen above and behind the
FLORIDA.

125

eye are Floridian ceramic features, while the coloring and the general shape are more typically western. The head has been broken, no doubt, from the rim of a bowl which was probably a handsome specimen of southern ceramic art. The fragment shown in Fig. 5, is of the same style of ware and probably belonged to the same or to a similar bowl. Fig. 6, represents a rudely modeled bird’s head broken from the rim of a bowl on which it was placed to face inward. It belongs to the same general type as the preceding.

Figs. 13 and 14. Pottery of fine paste from the shell heap.

_Thursby Sand Mound._—From the Thursby mound on the St. John’s River near Lake Beresford, Volusia County, Mr. Moore secured a unique collection of upwards of three hundred articles of clay comprising vessels and vessel-like objects, animal figurines and vegetal and conventional forms. Nearly all are of the extemporized variety and extremely rude in execution. The clay was hastily thrown into shape with the fingers almost without attempt at refinement of form or surface finish. The rudeness and newness are so marked that at first I was inclined to question their aboriginal origin and antiquity, but their manner of occurrence, as described by Mr. Moore, their practical identity with other specimens found in association with original burials in a number of mounds, and their relations technically with some of the ordinary varieties of earthenware seem to sufficiently establish their status as an integral part of the native art of Florida. They were confined to a deposit occupying a considerable area on the side of the mound, but none were at a greater depth than 12 inches beneath the surface. Nothing was found in association with them, but a little higher on the mound at a corresponding depth was an ornament of sheet gold and near this a similar object of sheet silver. In another part of the mound and near the surface were found in association an iron axe and a stone hatchet. This evidence together with that furnished by the shallowness of burial and the fresh appearance of the articles furnish conclusive proof of a comparatively recent origin.
Fig. 15. Ladel-like form, possibly intended to represent a bivalve mollusk.

Fig. 16. Rude cup imitating a conch-shell.

Fig. 17. Animal shape.

Fig. 18. Turkey.
The vessels and vessel-like objects number about seventy-five and are generally of small size, the cup-like forms ranging from 2 to 6 inches in diameter. With few exceptions they are quite shallow and all but two were made perforate. Four are slightly and rudely decorated with incised marks and indentations. Their description is rendered difficult by the variety of shape and feature. The ample illustrations presented in Mr. Moore's report serve to convey a vivid idea of their peculiar characteristics. All are decidedly mere "sports" rather than serious or legitimate art. Some of the shallow cups have handle-like projections and others have modeled within the cup, forms which suggest the body of a mollusk such as a clam or oyster with a tongue-like appendage projecting over the rim of the vessel. Fig. 15. Others are noded and spined or supplied with appendages suggesting the extremities of animals, Fig. 16.

The animal figures, some fifty in number and varying from 2 to 7 inches in length, include a wide range of forms, but so rude is the work that it is difficult to determine the originals with certainty. The forms most clearly suggested are the panther, bear, cat, squirrel, turkey, turtle and fish. The otter and beaver are suggested and in the mouth of one of these forms is held what appears to be a stick. In other sections of the country as along the gulf, in the Mississippi Valley and on the northwest coast, the animal thus treated is identified as the beaver, the stick held in the mouth being suggestive of the building operations of that creature. Characteristic examples are presented in Figs. 17 and 18. The former representing perhaps a dog or wolf and the latter apparently a turkey.

Vegetal forms are here seen for the first time, in the ceramic art of the eastern United States, save as embodied in the shapes of actual vessels. The acorn is represented a number of times and an ear of corn and a bud-like form appear in two or three cases.

![Fig. 20. Bead with spiral grooves.](image1)

![Fig. 21. Spool-shaped specimen.](image2)

There are a number of formal shapes, some resembling beads, Fig. 20, one with rudely excavated spiral grooves; others are spool-like, pear-shaped and top-shaped.

The occurrence of this menagerie-like collection of rudely-modeled objects of clay is wholly unique in primitive art. If we explain the existence and use of such articles as a phase of mortuary practices developed in the region, we still fail to sug-
gest any tenable theory for their presence as a superficial deposit or cache in the side of a mound unassociated with human remains.

Orange Mound.—Orange mound is a somewhat crescent-shaped mass of shells and sand in the centre of which several bodies were inhumed.¹ Pottery of the porous variety, stamped and plain, occurs on the surface and in the superficial loam to a foot in depth. From one foot in depth to a depth of about five feet pottery of a distinct type, the midden ware, occurs imbedded in Ampullaria shells and associated with beds of ashes. The remaining 10 feet of deposits were without pottery. This midden ware is rudely made and coarse in texture. It was tempered with vegetable fiber which has now entirely disappeared leaving the mass quite porous. The vessels are of medium size, in shape deep bowls or shallow pots, the walls thick, reaching in cases nearly ¼ of an inch, and the surfaces roughly rubbed down and decorated very generally with archaic patterns of rudely incised lines. In cases the decoration extends over the upper margin of the squarish lip. Typical specimens

Figs. 21 and 22. Fiber tempered ware with archaic decorations.

¹ American Naturalist, July, 1898.
CERTAIN SAND MOUNDS OF THE ST. JOHN'S RIVER, FLORIDA.

By CLARENCE B. MOORE.

PART II.

Preface.

Since the preparation of Part I of this report, seven additional months of continuous work, with a large body of assistants, in a flat-bottomed boat with steam motive power, have been devoted to the sand mounds of the St. John's. The river has now been many times carefully covered by us from Lake Washington to the sea—practically from its source to its outlet—with a boat of so light a draft that almost no contiguous lagoon or tributary creek has been left unvisited, and the employment of native guides and printed promises of reward widely distributed have, we believe, brought to our notice every mound of any importance bordering the river. Where these mounds have not been leveled to the base, the fault has not been ours.

Many mounds of little general interest, we fear, are detailed in this part of our report, but as the St. John's can never again furnish such material for any extended scientific notice, and as archaeologists coming after us will require the fullest records for their work, everything has been included. Nor have we confined ourselves to references to articles characterized by rarity or unusual workmanship, which, taken alone, would give an incorrect and exaggerated idea of the general possessions and state of advancement of the builders of the mounds, but we have endeavored carefully to enumerate all objects found in these relics of the past.

Sincere thanks for kind assistance are extended to Andrew E. Douglass, Esq., to Professor James Douglas, to Professor Cope, to Dr. E. Goldsmith, to Professor Putnam, and to General Gates P. Thruston. Indebtedness is again acknowledged to Dr. M. G. Miller for valuable aid during all our field work and in the preparation of this report.

C. B. M.

AUGUST, 1894.
Sand Mounds of the St. John’s River, Florida, Considered in Part II of this Report.

Mounds Suppementarily Investigated.

Mt. Royal.
Duval’s, Blue Creek.
Hitchen’s Creek.
Tick Island.
Thursby Mound.
Ginn’s Grove.
Thornhill Lake (2).

Mounds North of Palatka.

East Palatka.
Rice Creek.
Deep Creek.
Racey Point.
Picolata.
St. Augustine Road.
Clark’s Creek.
Harris Mound.
Bayard Point.
Orangedale.
Geiger Mound.
Near Peter’s Creek.
Magnolia.
Near Hibernia.
Switzerland (4).
Fruit Cove (2).
Julington Creek.
Mandarin Point (3).

Mounds South of Palatka, Not Included in Part I.

Brown’s Landing.
St. John’s Landing (4).
Near Bear Island, Ocklawaha River.
Davenport, Ocklawaha River.
Near Silver Spring, Lake George (2).
Juniper Creek.
Astor.

Mounds Suppementarily Investigated.

Mt. Royal, Putnam County.

Although a fairly searching investigation of Mt. Royal had been made by us the previous year, as detailed in Part I of this report, so varied and so interesting had been the results that at the suggestion of the owner of the mound, David Wright, Esq., of Auburn, N. Y., who desired a more complete investigation, we willingly devoted to the work twenty-two days of March and April, 1894, with an average force of over thirty men. In all, over two-thirds of the base of the great
Map of St. John's River, Florida.
From the Atlantic to East Palatka.
Revised 1894.
X indicates sand mound.
• indicates shell-heap.
Scale in miles.

- Atlantic Ocean
- Duval
- Jacksonville
- Orange Park
- Mandarin Point
- Julington Creek
- Trust Lake
- Black Creek
- Julington Creek
- Magnolia
- Green Cove Springs
- Bayard Pk
- Harris Mound
- Palatka
- East Palatka
- St. Augustine Road

X indicates sand mound.
• indicates shell-heap.
Scale in miles.
Map of St. John's River, Florida.
From Lake Monroe to Lake Washington.
Revised 1884.

x indicates sand mound.
* indicates shell-heap.

Scale in miles.

[Map showing geographical features such as lakes, rivers, and landmarks in Florida, with notations for sand mounds and shell-heap locations.]
mound have now been laid bare, while the remaining portion has been dug into to a depth of 7 feet. Subsequently, the mound was restored, that so great and historical a land mark should not pass from sight. The results of the last investigation were mainly cumulative, for though a goodly tribute was levied in objects of stone, copper, and earthenware, no new feature of importance was added to the results of the preceding season.

During the second investigation, our experience as to the locality of objects was repeated, since on the base their occurrence was comparatively infrequent, while between the base and the upper seven feet of the mound almost nothing was met with, the superficial seven feet containing nearly the entire collection made by us, though all classes of objects, whether of copper, of earthenware, or of stone, were represented on or near the base.

In connection with Mt. Royal, it must be borne in mind that the shape of the mound gives evidence of a much greater height in former times, and the plough in recent years has contributed its share to the diminution of the altitude. Nothing, then, found in Mt. Royal may be considered as of other than original deposit.

**HUMAN REMAINS.**

Human remains, as before, were found in the last stage of decay, and, with the exception of a few teeth, were not preserved.

**STONE.**

*Spade-shaped Implement.*—Six feet from the surface in the S. E. slope of the mound, at a point about four feet from the base, lay an adult human skull in the last stage of decay, and apparently unassociated with the remainder of the skeleton. A few inches distant lay a beautifully polished hatchet of stone, a spade-shaped implement of stone, a tubular bead of sheet copper and an ornament of the same material. With the copper, and dyed a bright green by contact with it, were a number of deciduous molars and incisors plainly having no connection with the adjacent cranium which, moreover, had its dental complement.

The implement, a modification of the type known as spade-shaped, was six inches in length and, unlike the two found by us in Mt. Royal the preceding season, did not have the handle tapering to a blunt point, while the nicks, or tally marks, were wanting (Fig. 1).

This type of implement, though found so far north as Ohio, is of more frequent occurrence in the Southern States. Its discovery in Florida, so far as reported, has been confined to Mt. Royal.

*Polished hatchets.*—During the investigation seventy polished hatchets and chisels—"celts" so called—were taken from the mound, which, with the sixty-seven found by us the previous year, make a total yield exceeding that from any one mound of which we have knowledge.
None exceeded ten inches in length, while some were not over three or four inches long. Nearly all forms were represented, including one much hollowed out on one side like a gouge. A number were split and broken at the cutting edge, showing rough usage. In one case marks of encircling thongs or cords were plainly visible (Fig. 2).

_Arrow and Lance Points._—Nineteen arrow and lance points, all of chert or of kindred material, rewarded our search. No novel types nor unusual sizes were represented.

_Miscellaneous._—At various depths during the investigation, were a fragment of a boat-shaped ceremonial (Fig. 3), several "sinkers," or pendent ornaments, one gracefully fashioned from polished trap rock (Fig. 4), and a number of small sheets of mica; also the enamel covering of the tooth of a man-eating shark. The bony portion, which may have contained a perforation for suspension, was missing. It is not unlikely that such teeth served to tip projectile weapons.

In different portions of the mound were bits of galena, sometimes several in association, the largest being perhaps two-thirds the size of a closed fist. On the base, at that point about thirteen feet below the surface, were two lumps of the lead sulphide and a cube of the same material about \( \frac{7}{10} \) of an inch in diameter, perforated for use as a bead—a bright and attractive ornament when uncorroded. In no other mound of the St. John’s have we seen galena utilized as an ornament.

A number of perforated pearls were met with in association with small shell beads in various portions of the mound.

_COPPER._

_Note._—The chemists who made analyses given on pages 34 and 39 of Part I of this report now state that lead was present in the sulphuric acid used by them. These analyses are, therefore, valueless and are withdrawn, as are remarks on copper on page 35.
The yield of copper during this second investigation was somewhat disappointing, for while a considerable number of ornaments and implements rewarded our search, but little was found differing to any extent from those met with during our first visit.

Eleven and one-half feet from the surface was an oblong ornament of sheet copper 2.8 by 3.7 inches. A central perforation was surrounded by a circle of projections on one side, indentations on the other. A line of similar design extended from the circle to each corner. Upon one side were remains of a woven vegetable material well represented in Fig. 5. With it lay a circular boss of copper 1.6 inches in diameter (Fig. 6).

It is worthy of remark how widespread is the envelopment in bark or vegetable fabrics of copper in the graves and mounds where its presence has been noted. We see it of frequent occurrence in Florida; it has been described in Georgia, in
Fig. 5. Ornament of sheet copper with vegetable fabric adhering, Mt. Royal. (About one and one-quarter size.)

Fig. 6. Ornament of sheet copper, Mt. Royal. (Full size.)

Fig. 7. Ornament of sheet copper, Mt. Royal. (Full size.)

Fig. 8. Copper effigy of serpent, Mt. Royal. (Full size.)
THE ST. JOHN'S RIVER, FLORIDA.

Fig. 9. Ornament of sheet copper, Mt. Royal. (Full size.)

Fig. 10. Ornament of sheet copper, Mt. Royal. (Full size.)

Fig. 11. Ornament of sheet copper, Mt. Royal. (Full size.)

Fig. 12. Bead of sheet copper, Mt. Royal. (Full size.)

Fig. 13. Bead of sheet copper, Mt. Royal. (Full size.)

Fig. 14. Ornament of sheet copper, Mt. Royal. (Full size.)
CERTAIN SAND MOUNDS OF

Tennessee, in Ohio, and we read of copper implements sometimes found in Canada wrapped in the skin of the beaver.1

Figure 7 represents an ornament of sheet copper with concavo-convex central boss surrounded with beaded ornamentation.

On the base of the mound, apparently unassociated, was an object of copper, in our opinion a serpent effigy. The curves are somewhat more graceful than shown in Fig. 8.

An interesting specimen was an oblong sheet of copper 4·5 by 3·2 inches. A centrally perforated boss about 1·75 inches in diameter was equidistant from the corners, upon three of which were raised elliptical ornamentations. The fourth corner was missing through breakage (Fig. 9).

Figure 10 represents an oval ornament of sheet copper with central oval boss surrounded by double lines of beaded ornamentation.

About 4·5 feet from the surface with fragmentary human remains was an oval copper boss about 1·7 by 2 inches (Fig. 11). Through the usual central perforation ran two cords of vegetable material terminating in a knot on the outer, or convex, side and with free ends on the inner, or concave portion. These cords doubtless served as means of attachment. Adhering to the copper were remains of some vegetable material, probably bark, in which it had been wrapped. In association were a few small beads of shell.

About four feet from the surface, near fragmentary human remains, with a polished hatchet of stone, was an elliptical bead of sheet copper about 2·7 inches in length and 1·1 inches maximum diameter (Fig. 12). With it were several small copper beads and a tubular bead of bone 1 inch in length and 2 of an inch in diameter.

This large elliptical bead and a smaller one of the same pattern from another portion of the mound (Fig. 13) were made each of a single sheet of copper bent or hammered until the edges overlapped, a more difficult process than the method prevalent in Ohio, where, Professor Putnam informs us, similarly shaped beads are made of two sections, one fitting into the other.

In Fig. 14 we have a small concavo-convex boss of sheet copper resembling several found in Mt. Royal.

In caved sand and broken into many pieces by the fall was an object of wood, possibly a pin, beautifully carved with a twisted design, copper-coated (Fig. 15). Unfortunately, no restoration was possible, little more remaining than the fragments given and the metal.

Eleven feet from the surface was a piercing implement of copper pointed at either end. Its length was 19 inches of which 9 inches have been taken by us for purposes of analysis. Its maximum diameter is 2 of an inch. As is so com-

1 Fourth Annual Report, Canadian Institute, page 62.
mously the case with copper in Mt. Royal, the implement had been wrapped in bark or some vegetable fabric, traces of which, in the last stage of decay, remained.

Results of analyses of portions of this implement will be found in our note on copper.

About seven feet from the surface in a pocket of deep red sand were three hatchets of polished stone, a bead of calcite with incomplete perforation, and a copper piercing implement 11-2 inches in length, similar in shape to the one just described. The usual decaying vegetable matter was present.

During the investigation a number of small copper beads of various patterns were met with, and a number of sheet copper ornaments of somewhat similar pattern to those already described. Not any of the objects of copper found during our investigation are exact duplicates in size and design as would surely be the case had they been manufactured in numbers by Europeans for the purpose of sale or barter.

**EARTHENWARE.**

During our second investigation a number of new and interesting types in earthenware rewarded our labors, though no vessels of any considerable size were represented. All but two had been perforated as to the base, either before or after baking, and with but two or three exceptions, all were strictly of the mortuary type so prevalent in Mt. Royal, though not of such fantastic designs as were noted in other localities.

In the western slope of the mound, six feet from the surface, lying above two polished hatchets, were nine vessels of earthenware of which eight were intact and in actual contact. Above them were the fragments of a bowl of earthenware with stamped decoration. The entire bottom and portions of the side of this bowl were wanting. We shall describe these vessels in order.

1. A vessel resembling an inverted truncated cone with a height of 3-5 inches; a maximum diameter of 2-5 inches; diameter of aperture, 2 inches. The rim is beveled (Plate XVII, Fig. 1).

2. A vessel somewhat similar in shape, save as to the brim which extends laterally. Height about 3 inches. Diameter at aperture, from which a rim extends 3 of an inch, is 2-7 inches. The base diameter is 1-2 inches (Plate XVII, Fig. 2).

3. A dipper-shaped vessel, perforated for suspension near the extremity of the handle. Length of bowl with handle, 5-5 inches. Depth of bowl about 1-5 inches. Maximum width, 3-2 inches (Plate XVII, Fig. 3).

4. A curious vessel consisting of two hemispherical cups united as shown in Plate XVII, Fig. 4, each having a diameter at aperture of about 2-8 inches, and a height of about 1-5 inches. Below the margin of the outer side of each is a perforation for suspension. This novel type, unfamiliar to experts to whom it has been submitted, to a certain extent suggests the double shell form of vessel figured by General Thruston,¹ who states in a personal communication that, while several of that kind

¹ Antiquities of Tennessee, page 312.
have come to his notice, the form figured by us, to his knowledge, is unrepresented in the pottery of Tennessee.

We believe this specimen to be unique.

5. A graceful urn of classical type, with a height of 3-7 inches, a maximum diameter of 2-7 inches, and a diameter at aperture of 1-5 inches. It is perforated for suspension (Plate XVIII, Fig. 1).

6. A semi-ovoid vessel having a height of 2-3 inches, with a maximum diameter of 2-5 inches. The margin of the mouth presents three equidistant projections which, continuing down the sides in the form of ridges with incised lines, meet at the base. The mouth is surrounded by raised and incised decoration as shown in Plate XVIII, Fig. 2.

7. A bowl with contracted rim, resembling in shape Figure 3, Plate VI, of Part I, though somewhat larger. Its decoration of parallel lines as shown in that figure has, in addition, parallel rows of punctate markings at intervals between these lines. Double perforations for suspension are on either side of the rim.

8. An earthenware pot, similar in type to Plate VII, Fig. 1, Part I, though differing somewhat in size. Single perforations are on either side of the upper margin.

All these vessels of earthenware show perforation as to the base, made previous to baking.

In different portions of the mound, respectively four and five feet from the surface, were two tubes of earthenware of about equal dimensions, flaring from the centre out and encircled at the middle by a raised band. Length, 5-1 inches; diameter at extremity, 1-7 inches (Plate XVIII, Fig. 3).

Hour-glass shaped tubes of this pattern in stone are not uncommon. They are figured by C. C. Jones as from Georgia, by Thruston as from Tennessee, and by Holmes, who shows a strikingly similar specimen 5-5 inches in length.

We believe the occurrence of this type in earthenware to be hitherto unreported. Fragments of another tube of earthenware, differing somewhat from the preceding, were discovered elsewhere in the mound. The restoration is figured, Plate XVIII, Fig. 4.

A curious curved tube of earthenware, having a nearly square section, was discovered in caved sand (Fig. 16).

Figure 17 represents an unidentified wedge-shaped object of earthenware.

Five feet from the surface was a dish, with perforation made subsequent to baking. Length, 6 inches; maximum breadth, 4 inches (Plate XIX, Fig. 1).

Figure 2, Plate XIX, represents a round imperforate bowl with the ordinary stamped decoration. The material is of fairly good quality differing from the flimsy structure of the mortuary pottery, to which class this vessel evidently does not belong. Diameter, about 6 inches; height, about 2 6 inches. It came from a depth of 14 feet.

Not far from the base was an imperforate vessel having a length of about 3.5 inches, and 2.25 inches in breadth. Its depth was 1 5 inches (Plate XIX, Fig. 3).

As shown in Plate XX, Fig. 1, we have a specimen of mortuary pottery, with base perforation made previous to baking, having a height of 3.25 inches, and a diameter across projecting rim of 3.5 inches. Its diameter at base is 2.2 inches.

Plate XX, Fig. 2, is a rudely made pear-shaped vessel, with a height of about 4 inches, and a maximum diameter of 2.5 inches. Its base contains a perforation contemporary with its manufacture.

The largest vessel found during our second investigation was an almost cylindrical jar. It is of dark material upon which considerable polish has been conferred. At opposite sides below the rim are perforations for suspension. The bottom is entirely wanting. Height, 7.5 inches; diameter at mouth, 4 inches; diameter at base, 4.5 inches. It lay near the centre of the mound, 10 feet from the surface (Plate XX, Fig. 3).

Plate XX, Fig. 4, represents a small mortuary vessel with base perforation made previous to baking. Height, about 3 inches; maximum diameter, about 2 inches.

Fifteen feet from the surface was a bowl with small handle projecting laterally. The base perforation had resulted from a blow subsequent to manufacture. Height, about 2.75 inches; diameter, 3 inches (Plate XXI, Fig. 1).

Plate XXI, Fig. 2, represents a bowl with projecting handle, having base perforation made after completion. The dimensions of this vessel, which was found 12 feet from the surface, are 3.75 inches by 3.25 inches, with a depth of about 1.5 inches.

A number of additional vessels, presenting no points of especial interest, found during our second investigation, will not be particularly described.

CONCLUSIONS.

In Part I of this report, after a fairly thorough investigation of Mt. Royal, we still hesitated to give our conclusions as to the period of its construction, though at the time we were in a position to speak with tolerable certainty.
It will be remembered that we have historical record of Mt. Royal nearly one and one-quarter centuries ago, and at that period live oaks three feet in diameter grew upon it. While we know that testimony as to age deduced from oaks is less reliable than that derived from the family of firs, yet few will deny that live oaks of this size point to a considerable number of years for development, possibly to a time previous to the Spanish and Huguenot occupation.

We have, however, stronger evidence of antiquity than this. At the present writing (1894) but a fractional portion of the mound remains untouched, while the greater portion has been handled twice, and in part four times by men so thoroughly trained and stimulated to such vigilance that, in the rebuilding of the mound, no objects were met with beyond two arrow heads and the handle of a vase.

In all these weeks of work during which, as we have seen, hundreds of objects were discovered, not one was brought to light in any way indicating a knowledge of Europeans. It is simply out of the question to suppose that the rich tribe that piled up Mt. Royal possessed the knives, the bows, the hawk-bells, and brass-ware of Europe without placing them in the burial mound with the dead; and, without hesitation, we positively assert that Mt. Royal and all its contents date from a period prior to the landing of the Whites.

**Sand Mound Near Duval's, Lake County.**

This mound, two or three hundred yards back of Duval's Landing, on Blue Creek, was partially investigated by us last year. It must not be confounded with the mound in the pine woods two miles west, the demolition of which is described in Part I.

With a considerable force of men the mound at Duval's was attacked on all sides during portions of three days, and dug through at a level somewhat below the base.

As before, numerous skulls and long bones filled with roots were met with, and in addition, at a depth to insure originality of deposit, were two polished hatchets of stone found separately, and in association with each other an arrow head and a drill.

The feature of this mound was the earthenware.

About two feet below the surface was a small undecorated bowl with base perforation conferred by fracture subsequent to baking.

Three feet from the surface in the southern slope of the mound and at that point not far distant from the base, near an isolated cranium, lay an imperforate vessel 1·5 inches high, with a maximum diameter of 3·2 inches. From one side of the margin projected an animal's head, to serve as a handle (Plate XXI, Fig. 3).

This type, so well known in Missouri and Arkansas, where the ware is superior to that of Florida, is also a familiar pattern in the stone graves of Tennessee, where the material is still better. The type, though not unknown in Florida, is of infrequent occurrence, and serves to illustrate the curious medley met with in the Peninsula—this pocket of the United States.
In another portion of the mound was a small bowl in fragments, showing base perforation made previous to completion of the vessel.

Two and one-half feet down, and undoubtedly of original deposit, a matter of easy determination in this mound since, it will be remembered, a layer of sand tinged pink with hematite ran through the mound at a point not far below the surface, was a simply indescribable object of earthenware, for an idea of which we must refer the reader to Plate XXII. Its height is about 5.25 inches; its maximum diameter, excluding handles, 5 inches; its base diameter 1.1 inches. Two curious claws that had projected from the margin were unfortunately severed by the blow of a spade, and the portion intervening between them and the rim received so comminuted a fracture that certain restoration was impossible. We are, therefore, uncertain whether this curious claw-like handle projected vertically or laterally; and whether, in its original position, it was everted from or turned over the vessel. We have endeavored in the restoration, which is indicated by broken lines, to suggest the most likely position.

Of all the mortuary vessels of earthenware of fantastic design, to which no possible domestic use can be assigned, and to which we have given the name of "freak" earthenware, this vessel is easily the most curious. It is almost needless to say to those familiar with this type that a base perforation, made previous to baking, is present, or rather that the funnel-shaped body is minus a base.

Beneath the layer of cherry-colored sand was a curious bird effigy of earthenware, with spread tail. Length, 6.7 inches; height of body, 2.5 inches; diameter of body, 2.7 inches (Plate XXIII, Fig. 1). At a depth to indicate original deposit was a vase of globular shape with projecting rim. A flat base, with perforation made previous to baking, enabled the vessel to maintain an upright position. Height, 3.8 inches; diameter across rim, 5.8 inches; diameter of body, 1.8 inches (Plate XXIII, Fig. 2).

From another portion of the mound came an extremely rude imperforate vessel, thick and undecorated, with inverted rim. Height, 2.5 inches; diameter, 2.4 inches; diameter of aperture, 1.2 inches (Plate XXIV, Fig. 1).

Several vessels of earthenware, presenting no new features as to size, shape, or decoration, were met with in various parts of the mound, and with the others illustrated the rule that all customs have exceptions, since certain vessels from Duval's showed base perforation made previous to, and others after, baking; while others again were imperforate.

CONCLUSIONS.

Although we looked vainly for copper in this mound, we think the effigies of earthenware, the "freak" pottery, and the pink-tinged sand connect it with the mound in the pine woods two miles distant. In neither of these mounds were any objects discovered indicating a knowledge of Europeans. We are, therefore, of the opinion that both were abandoned at a period prior to the Conquest.
CERTAIN SAND MOUNDS OF

SAND MOUND NEAR HITCHEN'S CREEK, VOLUSIA COUNTY.

This low mound, with disproportionately large base diameter, is referred to in Part I.

Having acquired by purchase the small frame house that stood in the way the previous season, we completely demolished the mound, a work of no small difficulty since matted roots of the scrub palmetto impeded investigation.

The form of burial was of the bunched variety, and neither human remains nor implements lay at a depth from the surface greater than two feet, or somewhat over one foot above the base. As a rule, unassociated with, but occasionally accompanying human remains, were seven hatchets of polished stone; a handsomely wrought "sinker" or pendent ornament of the same material, 2-75 inches in length, rimmed for suspension on one end and having a central encircling grooved line (Fig. 18); a scraper, so called, of chipped chert, 3 inches in length and a chisel wrought from the lip of a marine univalve, probably Strombus, about 3'5 inches in length, with a maximum breadth of 2-75 inches. This chisel, with a median longitudinal groove on one side, is the only ornamented implement of the kind we have met with on the river, and with those from the Tick Island mound, to which reference will be made later, is the only occurrence of this implement in the sand mounds of the river so far as our investigations extend. We have occasionally met with scrapers wrought from Fulgar in the mounds, but the discovery of the shell chisel, in our experience, has been limited to the surface of the shell-heaps, and to the body of the shell-heap at Mulberry Mound.

The mound was almost destitute of pottery, a few small fragments, plain and stamped, alone rewarded our search.

One cranium from this mound (Academy of Natural Sciences' Catalogue, No. 1789) will be described by Dr. Allen in his paper accompanying this Part of our report.

TICK ISLAND, VOLUSIA COUNTY.

The large mound on Tick Island had been investigated by us upon so many occasions, as detailed in Part I, that farther exploration was impossible without disturbance to the score of large bearing orange trees, and to dozens of the smaller sweet and sour varieties of the same species growing upon it. Finally, after considerable negotiation, permission was obtained, and the mound, surrounded on all sides by a party of twenty-two men to dig, with the usual overlookers and searchers, was completely levelled during five days of March, 1894.

We have described in Part I the structure of this interesting mound. Upon
several occasions small pockets of pinkish sand were found in association with products of aboriginal art. In the sand mounds of the St. John's it is a rule without exception, and the only one of which we know, that when in a mound pockets or layers of sand artificially colored by the aid of red oxide of iron are met with, in that mound surely are burials and relics of the handiwork of the aborigines.

**HUMAN REMAINS.**

As in our previous investigations, human remains were met with in great numbers in the upper or brown sand layer, on the shell base in the white sand and in the base to a depth of one foot. Extended search showed none at a greater depth.

_Crania._—Two calvarias from the base under unbroken strata where the mound had almost its maximum height were recovered in fairly good condition. (Academy of Natural Sciences' Catalogue, Nos. 1794 and 1796.)

_Teeth._—In two molars from separate jaws coming from on or near the base were traces of extensive decay. With the exception of a decayed tooth, discovered by us in the Thursby mound at a depth to guarantee original deposit, we recall no dental caries met with by us in the mounds of the St. John's, save in several cases of superficial interment where the period of burial and even the race of the deceased were in question.

_Pathological Specimens._—Throughout the mound were a number of pathological specimens showing to a notable degree ostitis and periostitis, and in some cases a marked curvature.

_Humeri._—No effort was made looking to the preservation of humeri other than those on or in proximity to the base, which, beyond all periladventure, were contemporary with the mound.

Of 186 humeri, 73 showed perforation, a percentage of 39.2.

In one well-marked case the opening in the septum between the fossae had a diameter of 13 mm., the greatest we have ever met with or seen reported.

**SIDE AND SEX.**

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**SIZE OF PERFORATION.**

*Measurements in mm.*

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Of 73 perforations, 41 are from the right side and 32 from the left. The excess of percentage of perforation in female humeri, originally remarked by Broca, holds good in this case as in Thursby Mound, to which reference will be made later. In that mound, however, humeri in the uncertain class show perforations exceeding the imperforate in number, which is not the case here.

**STONE.**

*Arrow and Lance Points.*—Five arrow and lance points were met with during the last investigation. Of these, four were found separately on the base, and one 8 feet from the surface in the lower, or white sand layer.

*Implements of Polished Stone.*—At different points on the shell base were seven hatchets or chisels of stone, “celts” so called, from two to four inches in length, the smallest being roughened on three sides. In caved sand from the upper layer was a “celt” 5.5 inches in length. The majority of these implements were of a ruder type, less smooth, with cutting edge less truly ground than specimens from many mounds of the river.

On the shell base was found an implement of polished stone somewhat resembling a hammer, rounded and roughened at either end (Fig. 19).

This style of implement, the common type of the pueblos, has not been met with elsewhere by us in the river mounds.

Near by lay two polished “celts,” one in a fragmentary condition.
THE ST. JOHN'S RIVER, FLORIDA.

On the base, in association with human remains, as in fact were all relics from the bottom of the mound, was a highly polished and carefully made "sinker" or pendent ornament, rimmed at either end for suspension, having a length of about 2.5 inches and a maximum diameter of 1.3 inches (Fig. 20).

About 15 inches from the surface, grooved on one side as by the sharpening of pointed tools, was a mass of stone, green in color, weighing 5.25 pounds. A por-

![Fig. 21](image1)

![Fig. 22](image2)

![Fig. 23](image3)

"Sinker" of shell, Tick Island. (Full size.)

tion of this specimen submitted to Dr. E. Goldsmith, of the Academy of Natural Sciences, was determined as follows: "I have to report that it is a fragmental rock, and has nothing in common with green-stone or serpentine. This green rock has frequently been termed jasper, merely on account of its hardness and finely granular texture; but, in reality, it is a felsitic tuff cemented together by silica (when in solution) which afterwards took, by metamorphic change, a crystalline structure,"

SHELL.

In no mound of the St. John's have we found aboriginal art in shell so numerousy represented as in the sand mound at Tick Island. In immediate association, ten feet from the surface, on the shell base, were four "celts" of shell ranging in length from 2.3 to 3.8 inches. A portion of the largest was missing. With these
were three spindle-shaped "sinkers" rimmed at the end for suspension, and four beads of shell from 1 to 1.3 inches in length.

Separately on the base were five "celts" of shell from 2.5 to 6 inches long; five shell "sinkers" from 3 to 4.5 inches in length; one shell bead with a maximum diameter of 1.5 inches, and the columella of a marine univalve worked at the extremities and smoothed at the junction of the whorls (Fig. 24).

![Image](image-url)

**Fig. 24.** Columella of marine univalve, Tick Island. (Full size.)

In association on the base, in one of the rare pockets of red sand met with in the mound, were five shell beads ranging in maximum diameter from about 3 to .75 of an inch.

Three feet from the surface was a gouge wrought from the shell of *Fulgur*.

Five drinking cups made from *Fulgur perversum* were met with during the investigation. One, imperforate, lay five feet from the surface; the others, from or near the base, showed the usual perforation below the shoulder opposite the aperture. One of these cups lay within a larger specimen.

An elliptical ornament of shell 3.5 inches in length was found on the base, and a shell gouge was exhumed 3 feet from the surface.

For fuller details as to many of these interesting types, the reader is referred to Professor Holmes' exhaustive paper "Art in Shell," Report of Bureau of Ethnology, 1880-1881.

**Bone.**

On the base of the mound was an implement of bone, pointed at one end, having the articular portion at the other.

**Copper.**

The discovery of copper in the Tick Island Mound was a matter of surprise and congratulation, after much repeated and unsuccessful search.

Six inches from the surface, with human remains, was a centrally perforated disc of copper 3.2 inches in diameter, encircled near the margin by a series of small indentations forming projections on the other side.

This ornament is shown in Fig. 25 with section removed for analysis, the result of which will be found included in the Note on copper in the latter part of this Report.
In caved sand was a tubular copper bead with overlapping edge, 1 2 inches in length.

At the base of the eastern slope of the mound, at a point about four feet from the surface, was a part of a lower jaw of an unidentified mammal, copper-coated on one side, represented by the ramus and a portion of the body showing the sockets of two molars. The work was neatly done, and at one place showed piecing on of extra copper where the original sheet had failed to afford sufficient material. A part of the copper sheathing extending beyond the bone, indicated a loss of the enclosed material through the ravages of decay. Figs. 26 and 27 show

20 JOURN. A. N. S. PHILA., VOL. X.
both sides of this curious object, which will recall to the reader the copper-coated jaw and portion of the skull of a gray fox found in Mt. Royal, in which case, however, the bone and teeth were entirely included by the metal.

Almost in the immediate center of the base of the mound, on the shell, 12 feet from the surface, in association with a "celt" of shell and human remains, was an object of copper, closely resembling, in shape, the carapace of a small turtle. Its length was 2'8 inches, its maximum diameter 2'2 inches, its height 1'2 inches (Fig. 28). Adherent were remains of some vegetable fabric. This ornament, for such it undoubtedly was, had been constructed by placing, one above the other, two sheets of copper of similar shape, which shape had probably been conferred by hammering or pressing them over the upper shell of a turtle. At all events, such is believed to have been the method in Ohio, where the scales and minor features of
the shell are found in relief on the copper. In this case, excessive deposit of carbonate prevents exact determination. That these turtle shells of copper, in this instance, together formed one ornament was shown by the fact that double perforations at the sides and ends were coincident, which would not be the case had the piercing in each object been accomplished prior to their union. On the outer surface of two of these perforations were knots of vegetable material, which had doubtless served, in connection with cords, for purposes of attachment or suspension.

When we recall the area covered by the Tick Island mound in connection with its height, the discovery of but three objects of copper other than superficially would indicate a high degree of rarity for this metal at the period of construction of the mound.

**TOBACCO PIPES.**

In caved sand from the upper stratum, at that point many feet in thickness, from the same portion of the mound, though not in immediate association, were two tobacco pipes of gritty ware of high specific gravity (Fig. 29 and 30). This type in earthenware is well known in the West. We have seen an almost exact fac-simile from Indiana.

The great rarity of tobacco pipes in the mounds of the St. John's has been commented upon before. Considering the intimate relations between the smoker and his pipe, relations which would undoubtedly be expected to continue in another world, we are at a loss to account for the scarcity of tobacco pipes in the river mounds or, for that matter, in the State of Florida.

**CORAL.**

During previous investigations several masses of coral were met with in the mound. One piece found by us evidently formed part of a pin, used, doubtless, for ornamental purposes. The head, about 1.9 inches in length and 1.25 inches in breadth, remained. Attached to it was a small portion of the shank (Fig. 31).

Professor Putnam informs us that this is the first example of worked coral to come under his notice.

**EARthenWARE.**

As during previous excavations, few vessels of earthenware were encountered. As before, fragments of earthenware, to many of which the outline of projectile points had been given, lay with the bodies. It is worthy of note that arrow
heads described as of sheet copper (probably brass) are found in the graves of post-Columbian Canadian Indians.\(^1\) This thin and flexible material could have served no practical purpose, and was doubtless put in as a makeshift, as were the earthenware arrow heads of some of the river mounds.

It is our belief, based upon careful supervision of ourself and a number of experienced assistants, that during the demolition of the mound no sherd of stamped decoration were met with below the immediately superficial portion.

In the upper stratum were several bowls, perforated as to the base subsequent to completion, presenting no features of interest.

On the base were various sherds, two showing decoration with crimson pigment. The bottoms of two small vessels were met with, also on the shell, each with four small knobs to serve as a means of support, enabling the vessel to maintain an upright position. This unusual addition to mound earthenware was met with during our earlier investigations at Tick Island, and will again be referred to in connection with the mound at Racey Point.

In the white sand layer, 8 feet from the surface, was a boat-shaped imperforate vessel. Unlike all pottery found upon the base, it was apparently unassociated with human remains. Approximate measurements are, length 5\(\frac{1}{2}\) inches, maximum width 2\(\frac{1}{2}\) inches, depth 1\(\frac{1}{3}\) inches (Plate XXIV, Fig. 2).

On the base of the northern slope of the mound, 6 feet from the surface, with human remains, was a rudely made but spirited earthenware effigy of a duck—probably a male wood-duck, a variety found in the neighborhood. The length of this curious effigy, from end of bill to tip of tail, is 9 inches, its breadth 3\(\frac{1}{2}\) inches (Plate XXIV, Fig. 3).

Imbedded in the base of shell, 10\(\frac{1}{2}\) feet from the surface, was a vase with six upright flutings around the body. The bottom, which had been knocked out, lay with it, and is included in the restoration given in Plate XXV, Fig. 1. Height 4\(\frac{1}{2}\) inches; diameter at mouth, including flaring rim, 4\(\frac{1}{4}\) inches.

Three and one-half feet down was an imperforate vessel resembling the bowl of a spoon, with perpendicularly projecting handle, terminating in an effigy of an animal head. Length about 3 inches; breadth about 2 inches; height, exclusive of handle, 8 of an inch (Plate XXV, Fig. 2).

Two globular vessels lay in association 10 feet from the surface. Both showed base perforation subsequent to completion. They were undecorated. Approximate measurements of the larger are, maximum diameter 7\(\frac{1}{2}\) inches; diameter of apex—

\(^1\) "These arrow-heads are rudely and carelessly cut from portions of European copper kettles. They must have been quite useless for shooting, and seem to have been made simply as substitutes for flint for burial purposes. The large number of European articles found in some of the graves renders it tolerably clear that although those who made the graves retained the old custom of depositing objects of various kinds with the bodies, they had lost the art of making chipped arrow points. Here we seem to have an overlapping of the old and the new order of things, as in many other places where specimens of white manufacture are buried in accordance with the traditional customs of the Indians. In this case arrows were probably regarded as a necessity, and the ghosts of these thin copper specimens were thought sufficient for spiritual uses."—Report Canadian Institute, Session 1891, page 51.
tare 5.5 inches; height 4.2 inches; of the smaller, maximum diameter 5.5 inches; diameter of aperture 4.5 inches; height 2.7 inches.

Near the base was a portion of a bird effigy of earthenware representing the forepart of the body with the head and neck extending vertically. The intended likeness is not apparent.

It will be noted that no “freak” pottery was met with in the Tick Island mound, nor, with one exception—a small fragmentary vessel found superficially—was any perforation discovered made previous to baking.

One point of great interest in connection with the earthenware of the Tick Island mound must be noticed here. As we have stated, the mound of sand is constructed upon a base of shell. Whether this shell base was a shell-heap pre-existing at this place, utilized for the construction of the mound, as was the case at Thursby Mound, at Ginn's Grove, at Thornhill Lake, and at the Indian Fields, we are unable to decide, though indications point to a negative conclusion, based upon the facts that the shell does not extend beyond the mound, as is the case at other localities, and that a long causeway of shell running through swampy ground connects the shell base with higher territory farther back. In any event, this mass of shell, which at the centre of the mound attained a height of five feet, whether a pre-existing shell-heap on the spot or a mass of shell-heap material brought from elsewhere, preceded the period of the construction of the sand mound. In the shell was fibre-tempered ware, totally dissimilar from sherds found in the sandy portion of the mound, or in any sand mound of the river, though its presence is noted in the neighboring shell ridges. We shall allude to this again in Notes and Conclusions.

CANINE REMAINS.

The researches of Professor Wyman failed to discover canine remains in the shell heaps of the St. John's. The jaw of a dog found by us in a shell heap of the upper river is figured and described by Professor Cope in our paper in the Naturalist for July 1893. Subsequently, another canine jaw of undetermined variety was exhumed by us from another shell-heap.

In the shell base of the Tick Island mound were skeletal remains as to which Professor Cope writes: “The bones you send are those of a dog, but of what species I am not sure. It is not wolf nor coyote, but differs from ordinary breeds of domestic dogs. Nevertheless, it may be some form domesticated by the Indians with which I am not familiar.”

MISCELLANEOUS.

On the central portion of the base, in immediate association, were two flat pieces of coquina, a pebble hammer, a portion of a columella of a large marine univalve, rounded at either end, and the tooth of a shark, perforated at the base as for suspension (Fig. 32).
CONCLUSIONS.

Of all the important mounds bordering the St. John's or its tributary streams, that on Tick Island was most surely free from all previous investigation, inspired either by scientific motives or by hope of treasure. In swampy ground, hidden by towering palmettos, on an island usually uninhabited and miles from every line of travel, the existence of the mound was known to few. With trivial exceptions, in all probability, the entire contents of this tumulus are in the cases of the Peabody Museum and of the Academy of Natural Sciences. Among all the objects on display there is not one in any way indicating or suggesting European influence.

We know Florida to have been the first portion of the United States to experience European contact, and that Cape Canaveral and other points of its eastern coast saw many wrecks of vessels bound from the New World to Spain. Indeed, we are told by the Huguenot Laudonnière that, in his time (1564), the Indians acquired various possessions from vessels cast away, and even at this early period, doubtless, many products of European art had a fairly wide distribution in the Peninsula. Tick Island is scarcely ten leagues from the sea and to a certainty, in our opinion, had the mound been in process of construction in post-Columbian times, such objects would, at least to a limited extent, have found their way into the common burial place of the island.

It is, therefore, our belief that the mound at Tick Island was no longer in use as a place of interment when white influence was first felt in Florida.

THURSBY MOUND, VOLUSIA COUNTY.

Wishing to learn the entire contents of a mound which, superficially, had yielded such rich returns on former visits, and having again obtained the cordial permission of Mrs. L. P. Thursby, of Blue Spring, the owner, we devoted nine days of January, 1894, with a force of fourteen men to handle the spades and our usual complement of five to direct and oversee the work.

The mound was completely demolished.

Thursby Mound, it will be remembered, was situate on an arm of land between Lake Beresford and the river. Extensive shell deposits on the eastern side of the river where the mound lay, and the great shell bluff, mounds and ridges of Huntoon Island immediately opposite, testify to a numerous Indian population in former times.

The mound, as our previous work indicated, was largely composed of white sand with thin local layers of shell of considerable extent and occasional pockets of shell, sometimes from one to two feet in thickness. But three or four pockets of sand, artificially colored red, were met with, thus calling to mind the mound at Tick Island, which Thursby Mound greatly resembled in nearly every respect.

HUMAN REMAINS.

In the south, southeast, and southwest portions of the mound, beginning at the
margin of the base and continuing through the central portion, human remains were constantly met with on and in the shell base. In certain cases, determination of the form of burial was impossible, owing to the ravages of decay and to the intermingled condition of the bones, but in the case of the greater number the form of burial was shown to be in anatomical order, though in various degrees of flexion. In the white sand, somewhat above the base, but at depths to indicate original burial, bunched interments were met with. Superficial burials were all in anatomical order.

_Crania._—Though the bones in Thursby mound, owing to assimilation of lime salts from the shell, were in a better condition than those from the down river mounds, but two crania were saved in a comparatively unbroken condition. (Academy of Natural Sciences Catalogue, Nos. 1781 and 1782.)

_Humeri._—Of 264 humeri from original burials on or near the base, 132, or exactly 50 per cent., showed perforation.

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<th>Male</th>
<th>Female</th>
<th>Uncertain</th>
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<tr>
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<td>40</td>
<td>25</td>
</tr>
<tr>
<td>Lefts</td>
<td>22</td>
<td>38</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>41</td>
<td>78</td>
<td>37</td>
</tr>
</tbody>
</table>

_Size of Perforation._

Measurements in mm.

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<tr>
<th></th>
<th>Perforated</th>
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<th>Minimum Diameter</th>
<th>Maximum Diameter</th>
<th>Oscillation Exponent</th>
</tr>
</thead>
<tbody>
<tr>
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<td>5</td>
<td>9-5</td>
<td>2-19</td>
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<td>37</td>
<td>6-7</td>
<td>2-5</td>
<td>11-5</td>
<td>1-32</td>
</tr>
<tr>
<td>Uncertain</td>
<td>54</td>
<td>6-4</td>
<td>2</td>
<td>10-5</td>
<td>2-1</td>
</tr>
</tbody>
</table>

From the above tables it will be seen that of 132 perforations, 64 are from the right side and 68 from the left. The excessive percentage of perforations in the case of female humeri and in those of uncertain sex, which are doubtless mainly of females of masculine build, is worthy of note. In these two classes also, the size of the perforation considerably exceeds that noted in male humeri.

Seven superficial humeri contained 3 perforations.

In caved sand, and therefore of undetermined depth, 15 humeri were found. Of these all but 3 showed perforation, a percentage of 80.

Of 14 humeri of children between one and twelve years of age, not included in foregoing data, 3 showing perforation were noted; one from a child of about twelve years of age, with an opening 5 mm. in diameter; and 2 from children about six years of age, with perforation respectively 5 mm. and 1 mm. in diameter.
CERTAIN SAND MOUNDS OF STONE.

Ten "celts" of polished stone were met with, the majority on the base in the vicinity of human remains. One rude chipped implement of chert also was found, while a number of arrow heads of chert, chert breccia and of chalcedony were singly, as a rule, on the base of the mound.

A fragment that had formed part of a large vessel of steatite was obtained at a depth denoting original deposit. No vessel, or fragment of a vessel, of stone has before been found by us in the river mounds, though a piece of considerable size was taken from the river, not far from Thursby mound.

Near the base, in the southern slope of the mound, was a lance head of chert 5'35 inches in length, with a maximum breadth of 2'5 inches (Fig. 33).

The unusual scarcity of lance heads in the river mounds is worthy of remark. During all our mound investigations but five have been met with exceeding 4 inches in length.

In caved sand, and therefore of undetermined depth, was a highly polished bead of red jasper with lateral perforation. Its length was 1'1 inches, its width 1 inch, its maximum thickness .65 of an inch. To those familiar with the character of jasper, upon whose surface steel fails to make an impression, the even perforation of this bead will be a matter of surprise. Its accomplishment was probably rendered possible by the aid of a revolving reed with sand and water.

SHELL.

Two and one-half feet from the surface, with human bones, was a drinking cup wrought from Fulgur perversum. A similar one was met with in caved sand. Both had suffered the usual mutilation by intentional perforation of the base.

Curiously enough, and in marked contrast with other large river mounds, no shell beads were met with in Thursby mound, except with superficial interments.
EARTHENWARE.

At the margin of that portion of the mound where the remarkable deposit of earthenware effigies and pots was found by us the preceding season, a number of similar objects—ten or a dozen—were met with, presenting, however, no new types.

About 18 inches from the surface, in the eastern slope of the mound, not far from the margin of the base, with human remains, was a small animal effigy, similar in type to those previously found, which, it will be remembered, were on the southern slope. With this exception, none of these curious effigies were met with in any other portion of the mound.

Sherds were infrequent, and all, with possibly one or two exceptions, were undecorated, save in some cases by the use of red pigment.

Under the summit plateau, from 7 to 10 feet from the surface, were a number of earthenware bowls and vessels of large size, one having a diameter of 21 inches. They were not in immediate association, and none, even excluding a portion knocked from the bottom, which was common to all, was complete. The missing portions were not found in association, and it was evident that the canny builders of the mound had utilized broken vessels for mortuary purposes. Certain ones, in fact, were so fragmentary that, presenting no decoration, their retention was deemed needless.

Among the earthenware vessels from this portion of the mound was a curious fragment, having a height of about 5 inches and an approximate diameter of 8\(\frac{1}{2}\) inches (Plate XXV, Fig. 3).

A circular flaring bowl, having traces of red pigment inside and out, had a diameter at mouth of 15 inches (Plate XXVI, Fig. 1), and a globular vessel decorated around the margin, shown half size in Plate XXVII, Fig. 3, lay not far distant.

Still another vessel, bell-shaped, had major and minor diameters of 10 and 4 inches, respectively. As both margins exhibit broken surfaces, its original shape cannot be determined.

In the eastern slope, 2 feet from the surface, with human remains, was somewhat over half of a vessel entirely new in our experience on the St. John's (Plate XXVI, Fig. 2). Length of fragment, 8 inches; maximum breadth, 8 inches; height at aperture, 4\(\frac{1}{2}\) inches. The material is of superior quality, thin and thoroughly baked; the punctate decoration carefully stamped. The shape of the entire vessel must have been ellipsoidal, though with pointed extremities. Through the upper portion of the remaining end are two perforations, made previous to baking. While the one below the margin is easily explainable as for purposes of suspension, it is hard to account for the other situated not far above the base towards the end of the slope. The care exhibited in the manufacture of this vessel, its superior quality and conscientious decoration, separate it from the class of mortuary "freaks," though, on the other hand, the lower perforation made the retention of liquids an impossibility, and would seem to unfit it for domestic purposes.

Ten feet from the surface, with human remains, was a curious oblong article
of earthenware of undetermined attribution. Four legs, two of which are somewhat imperfect, furnish means of support. The upper surface, having a decoration of incised lines, is 5 by 3.5 inches. An oval depression, about 2 by 2.5 inches, surrounded by a raised margin, was intended, apparently, as a receptacle of some sort. One end of this puzzle for archaologists had, apparently, been trimmed down as for the removal of a broken portion, possibly a handle (Plate XXVII, Figs. 1 and 2).

When discovered, this object was covered with a fine white powder resembling wood ashes, wholly unlike the sand of the mound. At places the depressed circle on the upper surface seems to show traces of fire. We have seen in Japan, articles suggesting this one, supporting a live ember, around which sat a company of smokers making use of the fire from time to time to ignite the contents of their pipes. This suggestion may be taken for what it is worth.

In different portions of the mound, at depths to guarantee original deposit, were the headless body of a duck of solid earthenware, 10 inches in length, and two heads, one of which is shown in Fig. 34, evidently belonging to some member of the duck family. Unfortunately, neither head corresponds to the trunk. They are of coarse manufacture, and recall to a certain extent the earthenware heads figured by Mr. S. T. Walker (Smithsonian Report, 1883, page 67) as coming from northwestern Florida.

In caved sand was a tube of earthenware 2.75 inches in length.

Several pots and bowls, undecorated, of medium size were found superficially.

**METAL.**

Several "celts" of iron or of steel were found superficially.
While implements of iron, which certainly, and an ornament of gold and one of silver,1 which possibly, show European contact were found in the vicinity of the surface, nothing at any depth indicated a knowledge of the arts of the white man. In our opinion, Thursby Mound belonged to a period prior to the Discovery.

Ginn's Grove, Orange County.

This mound has twice before been examined by us. It was again visited with a force of eight men to dig, and a careful investigation made, with the kind permission of J. N. Whitner, Esq., the owner. As before, superficial burials were found and abundance of human remains along the base. Two crania (Academy Catalogue, Nos. 1784 and 1788) partly imbedded in the shell base were saved in fairly good condition.

As on former occasions, relics were conspicuous by their absence, and our hopes to find additional earthenware of the superior quality formerly yielded by the mound, were doomed to disappointment.

On the base, with the skeleton of a child, was a bead of shell about one inch in diameter.

Beneath the western slope of the mound, on the base, at that point about 2-5 feet from the surface, was a portion of a molar of a mammoth (Elephas primigenius Americanus). This fossil tooth was probably prized by the Indians as a stone. Fossil remains have been found by us in Florida, bordering the river and in the neighboring clay. We have seen remains said to have been brought up in seines. Teeth of the mastodon and of the mammoth have been found in the mounds of Ohio.

Two feet down was an undecorated bowl about 6 inches in diameter, in fragments.

The mound at Ginn's Grove is the one to which Dr. Brinton assigns a comparatively modern origin. During the many days of work included in our three visits, with many trained assistants in addition to those handling the spades, we have discovered nothing in any way indicating contact with the whites, nor have we noticed marks of disturbance on the base, and we are therefore of the opinion that Dr. Brinton's conclusions may be dismissed as based upon superficial and insufficient evidence.

Thornhill Lake, Volusia County.

Reference is made in Part I to two mounds at this point. Eight days of January, 1894, were devoted, with a large party of men, to the total demolition of the larger mound and the excavation of the central portion of the smaller one, in which part alone burials were met with in that mound.

1 See Part I.
As during our first visit, human remains were found in anatomical order in the large mound, no case of the bunched burial being discovered. Including the skeletons found during our previous visit, somewhat over fifty were noted throughout the mound, lying from a depth of 10 feet to within a short distance of the surface. No crania were saved. Indeed, so great was the pressure of the sand and of the material from the shell-heaps, which lay between and above the sand strata, that even long bones were crushed, and one cranium had suffered so greatly that the opposite sides were in contact, giving it somewhat the shape of a tureen.

**IMPLEMENTS, ORNAMENTS, ETC.**

Superficially, was a beautifully wrought arrow head. Two fragments of projectile points were met with during the excavation.

Occasionally, with the bodies were small beads of shell, and with several a few tubular beads of the same material, one inch in length and over.

Five feet from the surface, unassociated, was a portion of a ceremonial object or gorget. The material was limestone; length about 2'5 inches; breadth 2 inches. On one side it presented a flat surface, on the other a convex one. It was perforated longitudinally (Fig. 35).

In the northern slope, in the shell-heap debris surrounding the sandy portion of the mound, 4 feet from the surface, lay the skeleton of a man, presumably a person of rank. Great quantities of small shell beads lay along the forearms from wrist to elbow. With them were occasional beads of a polished rock, which Dr. E. Goldsmith has pronounced *Catlinite.* At either wrist was a miniature example of the double-bladed axe in stone, variously termed gorgets, ceremonials or banner stones. Between the blades was the usual perforation for suspension. These little gems were each 1'3 inches in length, with respective maximum breadth of blade of '8 and '9 of an inch (Figs. 36 and 37).

On the breast of the same skeleton with many beads of *Catlinite* and of shell, including some of the latter material tubular in form and over one inch in length, and discoidal beads of shell having a diameter of '7 of an inch, was a double-bladed axe of stone shown in Fig. 38.

Near the neck of the skeleton, with beads in great profusion, were the disintegrated remains of a small stone ceremonial. With them lay a pendent orna-
Fig. 36. Ornament of stone with sections, Thornhill Lake. (Full size.)

Fig. 37. Ornament of stone with sections, Thornhill Lake. (Full size.)

Fig. 38. Ceremonial axe of stone, Thornhill Lake. (Full size.)

Fig. 39. Pendent ornament of stone, Thornhill Lake. (Full size.)

Fig. 40. Tooth of shark, Thornhill Lake. (Full size.)
ment of polished stone, perforated at either corner of one side, while the opposite margin curved slightly upward and inward, as seen in Fig. 39.

Andrew E. Douglass, Esq., has called our attention to the fact that this curious ornament is made from the blade of a double-bladed ceremonial, doubtless rendered useless through fracture. He informs us that a similar ornament was found by him in a mound on Tomoka Creek, near the east coast, about 36 miles in a straight line north of Thornhill Lake.

Among the beads on this skeleton was the tooth of a shark with double perforation at the base, for suspension (Fig. 40).

With the bones were fragments of charcoal.

In the light sand layer, 6 feet from the surface, lay a skeleton badly crushed. Upon the sternum, with a few small shell beads, was a pendent ornament of stone, similar to the one described, though somewhat smaller. As the type is so unusual, we represent this one also in Fig. 41.

Tubular beads of Catlinite, never exceeding five in number, lay with several skeletons.

The discovery of this stone, whose source of supply is Minnesota, in a Florida mound showing absolutely no contact with the Whites, is of considerable interest, since this rock is believed by some to have come into use only in recent times. We believe the larger mound at Thornhill Lake, in common with all the more important mounds of the St. John's, to have been completed in pre-Columbian times, and are, therefore, of the opinion that Catlinite was in use at a period earlier than has been supposed.

In the central portion of the smaller mound were seven bodies in anatomical order. Upon the breasts of three, with shell beads, lay gorgets representing a form of the double-bladed axe, differing from that found in the larger mound. Two of these, about the same size, were of phosphate rock, much the worse for age; the other, probably a soft serpentine, also was in a crumbling condition from the lapse of time (Figs. 42 and 43).

REMARKS.

In certain respects, the mounds at Thornhill Lake stand alone. In no other of the river mounds has the double-bladed ceremonial been met with by us, and in no mound of the State, we believe, has it been reported accompanying human remains. Andrew E. Douglass, Esq., had the good fortune to find in the mound

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1 It is found also in Wisconsin and in Dakota. The reader is referred to an interesting article, "Catlinite," by Edwin A. Barber, American Naturalist, Vol. XVII, page 754.
near Tomoka Creek, to which reference has been made, eight beautiful ceremonial implements of this type, some of which he has figured and described.\footnote{Proceedings of the American Association for the Advancement of Science, Vol. XXXI, Montreal Meeting, Aug. 1882.}

Another feature, worthy of remark, is the absence in these mounds of other implements of stone. One would at least expect hatchets and projectile points.

The most noteworthy point of the entire investigation was the total absence of vessels of earthenware, whole or fragmentary, and the virtual absence of sherds. During our first investigation of the larger mound at Thornhill Lake, though each spadeful of material was closely watched, not one sherd was encountered, save superficially. During the demolition of the mound the question of presence or absence of earthenware was carefully kept in mind. About four feet from the surface were two sherds with the ordinary stamped decoration. We were present at their discovery, and are convinced as to their position as stated. They were doubtless of accidental introduction, since the entire mound yielded no other earthenware.

In the smaller mound no pottery was met with.

This almost total absence of sherds and earthenware, fragmentary or otherwise, is entirely novel in our investigation of Indian mounds devoted to purposes of sepulture, and it is evident that, with the makers of the mounds at Thornhill Lake, the custom of interring earthenware with the dead did not obtain—an unlooked for departure.
CERTAIN SAND MOUNDS OF

MOUNDS SOUTH OF PALATKA, NOT INCLUDED IN PART I.

NEAR BROWN'S LANDING, PUTNAM COUNTY.

In thick undergrowth, about one-half mile from the river, and about five miles south of Palatka, is a mound of yellowish sand without stratification. Its height is 6 feet, its base diameter 47 feet. It had undergone considerable previous investigation. About three-quarters of the mound were demolished by us with entirely negative results.

FOUR MOUNDS NEAR ST. JOHN'S LANDING, PUTNAM COUNTY.

In an arm of land formed by the union of Dunn's Creek with the river, is a wooded territory, thick with trailing vines and scrub palmetto, forming a portion of the Acosta grant, dating from Spanish occupation.

The mounds, several hundred yards apart, about equidistant, are possibly one mile from St. John's Landing on the river and Westonia on Dunn's Creek.

MOUND 1.

The measured height of this mound, which was totally destroyed, was 9 feet 7 inches, but as it formed the centre of a depression from which its material probably came, its actual height was about two feet less. At a level to justify this supposition, a layer of sand 3 to 6 inches in thickness, showing the effects of fire and mingled with charcoal, extended through the mound.

The base diameter was 62 feet.

A previous investigator had dug through the summit plateau to the base.

With the exception of a few fragmentary superficial bones, human remains, represented by two isolated crania, were met with in but two places, at a depth of 5 and 6 feet respectively.

Three arrow heads and a small sheet of mica represented the total yield of objects of stone.

Sherds were numerous, and of good quality, near the margin of the mound, some having the complicated stamped decoration of Georgia and Carolina. This is the farthest point south on the river where its occurrence has been noted.

Near the eastern margin of the mound, on the base, which at this point was 2-5 feet from the surface, unassociated, was a globular bowl of earthenware, bearing traces of red pigment, with the usual base mutilation. Height, 6 inches; maximum diameter, 9-25 inches.

Three unadorned bowls of ordinary pattern and of poor material were found separately in pockets of sand whitened by fire and containing fragments of charcoal.

MOUND 2.

This mound, with a height of 5-5 feet, and a base diameter of 45 feet, was virtually demolished. With the exception of a few fragments of human bones and
a small number of sherds, plain or decorated with pigment, our search was unrewarded.

**Mound 3.**

This mound, somewhat oblong in shape, had a base diameter of 35 by 45 feet. Its height was 5 feet. The mound was entirely leveled. With the exception of the usual charcoal and two or three sherds, absolutely nothing was encountered.

**Mound 4.**

The shape of this mound, and the fact that it had undergone no previous investigation, inspired us with hope, especially as it was evident that the roots of trees had protected its summit against the ravages of time. Its height was 7½ feet, its base diameter 95 feet. Twenty-one men working five days leveled it to the base. There was no stratification. Charcoal was found in places, usually on the base, and occasionally bones of deer in association. In the body of the mound were no human remains, though two human skeletons were met with superficially. Sherds were very infrequent. On the base, separately, were five rude arrow heads and an unfinished implement of chert. In caved sand was a polished hatchet of stone, and two feet from

![Fig. 44. Object of Steatite, Mound 4. (Full size.)](image)

the surface was an object of *Steatite*, 3 inches in length, with cross-hatched decoration on upper surface (Fig. 44).

The disproportionate area of the summit plateau gave to the mound the appearance of a platform rather than of the usual cone, truncated near the apex. In view of the possible accidental introduction of the arrow heads and the absence of human remains and relics other than superficial, we may consider this mound to have been erected possibly for domiciliary purposes.

**Mound Near Bear Island, Putnam County.**

On the mainland near Bear Island on the Ocklawaha, about 8 miles from the mouth, was a small mound of white sand demolished by us with entirely negative results.

**Davenport, Putnam County.**

This interesting little mound, on a bluff of the Ocklawaha at Davenport, about 12 miles by water from the St. John's, was composed of yellow sand with consider-
able quantity of pinkish sand towards the margin. Its height was 3.5 feet, its base diameter 35 feet. It was razed to the ground.

Human remains were few and very fragmentary, the bunched form of burial being indicated. In all, 6 polished hatchets of stone were found, one at a depth of 5 feet, a point considerably below the level of the surrounding territory. At depths to indicate original deposit were a pebble hammer 1.75 inches in length; three rudely worked or incomplete implements of chert and one fragment showing cleavage. In addition were shell beads in small quantities, a columnella wrought from the axis of a marine univalve and a piercing implement of shell.

The feature of the mound was the earthenware which was of the "freak" variety, and met with at depths to indicate original deposit.

A curious object to a certain extent resembling a spool in form, recalls a somewhat similar piece figured in Part I, from the mound in the pine woods near Duval's. In that case, however, portions from either end are missing, rendering impossible a determination as to original shape. This spool-shaped object from Davenport, with longitudinal central perforation, has a height of about 4 inches. One end has a diameter of 3 inches, that of the other is somewhat in excess (Plate XXVIII, Fig. 1).

In Plate XXVIII, Fig. 2, we have a fragment of an undetermined object of earthenware, probably belonging to the "freak" variety.

A vessel about 3 inches in height, with laterally projecting rim, having with mouth aperture a diameter of about 6.5 inches, was found in a somewhat fragmentary condition. On either side, below the rim, are double perforations for suspension (Plate XXVIII, Fig. 3).

Two curious objects of earthenware, resembling in shape the ear-plugs known to have been worn by the aborigines, were discovered in different portions of the mound. The maximum diameter of the smaller, which is shown Plate XXVIII, Fig. 4, is 2.6 inches; its height 1.8 inches. The height of the larger is 2 inches; its maximum diameter 2.8 inches. A perforation runs longitudinally through each.

Several additional vessels of the usual mound type were discovered during the investigation.

Nothing in the mound at Davenport indicated a knowledge of the Whites by its makers.

Two Mounds on Western Shore of Lake George, Marion County.

On the property of Mr. John Purdy, who kindly granted permission to investigate, about one mile north of Spring Run, was a mound about 2 feet in height, with a base diameter of 35 feet. It was totally demolished. Charcoal and Pulpines were found at various points. A few sherds were met with, but no other evidence of man's handiwork. No trace of human remains was apparent.

On the property of Mr. Greenleaf, at Silver Spring, was a mound a trifle larger than the preceding one. It was virtually dug through. Three fragmentary crania,
THE ST. JOHN'S RIVER, FLORIDA.

and several long bones were exhumed, but no sherds other than superficially, and no other relics were met with.

JUNIPER CREEK, LAKE COUNTY.

Juniper Creek enters Lake George about 2.5 miles west of Volusia Bar. About 1.5 miles above the mouth of the Creek, on the left hand side going up, is a small shell deposit described by Professor Wyman. A southwestern course for a quarter of a mile was followed to reach the mound which was concealed by a thick growth of scrub and trees. Its height was 5.5 feet, its base diameter 40 feet. It was completely demolished. There was no stratification. Fragmentary human remains were met with in one place superficially. In another portion of the mound were two coarse earthenware bowls, just beneath the surface, showing the usual base perforation. With the exception of several fragments of earthenware, lying together at a depth to indicate original deposit, and a number of bits of charcoal throughout the mound, nothing showing the work of man was discovered.

The results obtained by the excavation of one mound, frequently overturn conclusions derived from the demolition of another. Within 8 miles of the rich pottery bearing mounds of Volusia, and hardly 5 miles distant from Duval’s and its interesting neighbor in the pine woods, symmetrical in shape and absolutely intact, the mound near Juniper Creek held out every reason to suppose that a rich reward awaited the archaeologist.

ASTOR, LAKE COUNTY.

About one-quarter of a mile back of Astor was a small symmetrical mound of white sand. Total demolition yielded nothing beyond a lance point on the base, 4 inches in length.

SAND MOUNDS NORTH OF PALATKA.

The division at Palatka in this report of the sand mounds of the St. John’s is not an arbitrary one, since a little north of that place, comes to an abrupt conclusion the great chain of fresh water shell-heaps extending in close succession to the river’s source.¹

It will be observed that, with the exception of the two great mounds not far from the river’s mouth, the mounds of the St. John’s north of Palatka are of a height considerably inferior to many of those of the upper river. It must be borne in mind, however, that the territory north of Palatka, often early Spanish grants, has long been under cultivation, and that the continuous use of the plow with the aid of the elements has to a certain extent rounded off the summits. Nevertheless, judging from the base diameter also, the mounds of the upper river must have originally exceeded in size most of those to the north of Palatka.

In this connection it is well to remember that a numerously represented class among the smaller mounds on the St. John’s consisted of those where, to a large

¹ American Naturalist, Nov. 1892, page 919.
extent, irrespective of association with skeletal remains, a comparatively central deposit was made of objects of aboriginal art, often placed in comparative proximity to the surface. It is evident, then, that mounds of this class on the lower river, long under cultivation, have lost a great majority of their mortuary deposits, a point to be kept in mind in considering their comparative poverty.

Another point to be noticed is the almost total absence of incised decoration in the earthenware of the lower river, which in nearly every case was plain or decorated through the medium of the stamp, and that certain stamped ornamentation of complicated design, unknown on the upper river, was not infrequent in the sand mounds within a dozen leagues of the river's mouth.

The absence of skeletal remains in condition for preservation is a marked feature of the mounds of the lower river. Indeed, with the exception of one skull from the mound near Julington Creek, no human remains other than fragmentary were encountered by us.

In many instances, it will be remembered, tumuli of the upper river were built upon shell-heaps, while a certain percentage of shell is often found scattered throughout the sand. It is from such mounds, where lime salts from the shells act as a preservative agent, that human remains may be looked for in comparatively good condition. From the down-river mounds, then, in a region where no shell-heaps are found, but little in the way of skeletal remains was to be expected.

East Palatka, Putnam County.

This mound, on the river's edge in a bearing orange grove, has long been under cultivation. Its present height is 5 feet 7 inches; its present base diameter, which probably considerably exceeds the original, is 61 feet.

The original mound was dug through by permission of Mr. Hanna, superintendent of the grove, and subsequently refilled.

The mound was not distinctly stratified, though along the base ran a layer of sand with numerous bits of charcoal, having a darker color than the remainder of the mound, which is whitish sand sprinkled throughout with minute pieces of charcoal. Toward the centre of the mound was a dark layer of sand near the base, about one foot in thickness, surmounted by a somewhat similar layer not directly in contact.

Human remains.

Human remains, too fragmentary through decay to determine form of burial, were found in six or seven instances.

Stone.

Two feet from the surface, with human remains, was an unsymmetrical implement with rounded edge, about six inches in length, probably used as a hammer.

Two arrow heads were found separately on the base and four superficially.

\(^1\) We have found one specimen of this pottery, superficially, in a mound about ten miles south of Palatka.
Two and one-half feet from the surface was a discoidal bead of Steatite, '8 of an inch in diameter. Human remains were in association.

Comparatively superficial, though doubtless originally at considerable depth from the surface, were three small "celts" of stone, separate and unassociated.

One foot from the surface was a pendent ornament of stone, about 3 inches in length, triangular in shape, grooved for suspension (Fig. 45).

SHELL.

On the base was a pendent ornament from the columella of a marine univalve.

Unassociated, near the surface of the mound, was a drinking cup wrought from Fulgur perversum.

With human remains, near present surface of mound, in association, were a pin of shell about 2-5 inches in length with flat, circular head (Fig. 46); a spherical headed pin of shell about 4-5 inches in length (Fig. 47); another, 5-5 inches long, with two circular cavities in head and two below on shank, which, however, are omitted in the cut (Fig. 48). With these were two portions of the columella of marine univalves, each about one inch in length, resembling beads, though lacking the perforation (Figs. 49 and 50). Shell pins considerably longer than the ones discovered here, are found in the stone graves of Tennessee.

A curious object of shell (Fig. 51) from this mound was probably worn through the lobe of the ear. We are indebted to Professor Putnam for details as to the discovery of similar ones in other localities, lying in close proximity to crania.

EARTHENWARE.

Two feet down, unassociated, was a bowl stamped in places, about 2-5 inches in height; the bottom was wanting.

At the same depth, though not in association, was an unornamented vessel of earthenware, about 5-5 inches in height and 4 inches in diameter at aperture. The bottom was missing through intentional fracture. At different points on the sides, as though still farther to "kill" the vessel, were seven perforations (Plate XXIX, Fig. 1). This is the sole instance of side perforation of earthenware, made subsequent to baking, met with by us on the St. John's.

MISCELLANEOUS.

Scattered throughout the mound were another bead of stone, one of clay and a number of small beads of shell; also pebbles, chippings of chert, and bits of Hematite.
CERTAIN SAND MOUNDS OF REMARKS.

We are informed that a windmill formerly occupied the summit of this mound.

A previous visitor had dug a hole near the summit, about 3 feet in depth, traces of which were plainly apparent. At the bottom were carefully deposited an iron hoop, half a glass bottle, and the base of a brass candlestick. Near them was a "celt" of stone, which the investigator had overlooked or ignored.

Nothing of original deposit in this mound indicated a knowledge of the arts of Europe.
THE ST. JOHN'S RIVER, FLORIDA.

RICE CREEK, PUTNAM COUNTY.

Rice Creek enters the St. John's from the west 5 miles north of Palatka. About 3 miles up the creek, on the left hand side going up, nearly opposite the brick works, is a road about one-quarter of a mile in length, passing through the swamp to the high pine woods. About 40 yards from the edge of the swamp was an unstratified mound of yellow sand, 2 feet 10 inches in height, with a base diameter of 44 feet. It was virtually demolished. Two or three mouldering fragments of human remains were met with, and eight unassociated sherds, mostly of gritty ware.

DEEP CREEK, ST. JOHN’S COUNTY.

Deep Creek enters the St. John's from the east, about two miles north of Federal Point. Following the course of the creek for one mile, and tying to the left bank going up, we found a mound about 50 yards in the swamp. The service of a guide was necessary. The mound, which was entirely demolished, was unstratified, of whitish sand with admixture of some foreign substance, probably clay, rendering it extremely tenacious.

Burials, 28 in number, were of the bunched variety, the entire skeleton upon no occasion being fully represented.

Scattered through the mound, as a rule unassociated, were 8 “celts” of stone, one having a length of 9 inches. In addition, were a wrought pebble, a slab of stone 7-5 by 5-5 inches and one inch in thickness, and one arrow head.

One drinking cup from Fulgur perversum and two others somewhat fragmentary were met with. Two showed base perforation.

A number of sherds scattered throughout the mound were, with one exception, undecorated.

Nothing in this mound gave evidence of contact with the Whites.

RACEY POINT, ST. JOHN’S COUNTY.

This symmetrical mound, in view of the road at Racey Point, had a height of 6 feet, a base diameter of 60 feet. It was totally destroyed. It was composed of brown sand, through which were scattered particles of charcoal. The base was not distinctly marked.
Almost in the centre of the mound, about 4 feet from the surface, was a layer of brownish material, 2 feet long by 1.5 feet broad, and 3 inches in thickness. This material was soluble in bisulphide of carbon, and when burnt upon platinum foil, left a small whitish ash. It was bitumen.

We are indebted to the United States Geological Survey for a paper1 from which we learn that bitumen has a wide distribution, being found, among many other States, in North Carolina, Georgia, and Alabama. It is also present in Cuba. We are informed by chemists that analysis will not determine the locality from which a particular asphalt is derived.

On, and in some cases in, this layer of bitumen were four bits of quartz; one piece of chert; a pebble about 3 inches in length; an oval shell bead with lateral perforation, 1.4 inches in length. This perforation was filled with the material in which the bead lay.

The use of bitumen as a medium of adhesion is not met with on the St. John's as in California, where vessels were repaired and implements hafted through its agency.

HUMAN REMAINS.

Human remains were met with in but four places, and in very fragmentary condition. The bunched burial was indicated.

Six feet from the surface, near fragmentary human remains unaffected by fire, was a pocket containing a considerable number of bits of calcined human bones.

A previous excavation in the summit plateau of this mound may have disturbed certain interments.

STONE.

In caved sand was a polished stone implement with cutting edge, about two inches square. It had probably seen service in a handle as a chisel or scraper.

Two feet from the surface, entirely unassociated, was a lance head of chert, 5 inches in length, of a pattern unknown on the St. John's, or, so far as we can learn, elsewhere. Above the tang, extending '75 of an inch, is a straight edge on either side. Above, well-worked serration extends 1.5 inches to where the weapon begins to taper sharply to a point (Fig. 52).

Four feet from the surface was a small sheet of mica.

EARTHENWARE.

The sherds of this mound, while not numerous, were interesting. Few were stamped. Some of good

1 Asphaltum in 1866, by Clifford Richardson and E. W. Parker.
material were colored with red pigment, while several bore new designs, one apparently representing the stem of a plant with leaves, the whole surrounded by numerous indentations.

In this mound was remarked for the first time in comparatively many sherds and vessels, a curious custom hitherto unnoticed by us on the river (and it is our opinion that its occurrence would have been noted) and unreported elsewhere.

Fragmentary ware, instead of separation by a clean fracture, showed around the margin the work of a pointed tool, through the agency of which the division had
been effected. Vessels bore evidence of similar treatment where portions had been chipped away. This novel and unaccountable proceeding is well illustrated in Figures 53, 54, 55, 56, and 57.

Fig. 56.
Sherds showing marks of pointed tools. (Full size.)

Its occurrence was noted in a number of mounds north of Racey point so far as and including the tumuli at Beauclere, a distance of 30 miles in a straight line.

Fig. 58.
Vessels of earthenware, Racey Point. (Full size.)

Another point of interest in this mound was the absence of base perforation of any description in the earthenware.
Four and one-half feet from the surface was a vessel with flaring rim, without decoration. Four small legs on the curved base had enabled it to maintain an upright position. Part of the upper portion, including about one-half of the margin, was wanting. Approximate height, 4'25 inches; diameter at aperture, about 5 inches (Plate XXX, Fig. 1).

About five feet from the surface were five earthenware vessels practically entire, and two in a somewhat fragmentary condition. The imperfect ones present no features of interest. The largest of the remaining five is a jar with contracted neck and flaring rim, a small portion of which has been removed by a pointed tool in the manner to which reference has been made. Height, about 6'5 inches; maximum diameter, 5'8 inches; diameter at aperture, 3'2 inches (Plate XXIX, Fig. 2).

The other four are undecorated, save in one instance, where a species of fluting runs at intervals about half-way up the sides. All have base supports or legs, and as this feature is of extreme rarity, not on the St. John's alone but in other sections of the United States, these vessels are all shown full size (Figures 58 and 59; Plate XXX, Figs 2 and 3).

In caved sand beneath the summit plateau was a bowl in fragments in association with a vessel of earthenware, 3 inches in height, having a diameter at aperture of 3'1 inches. This vessel had a novel ornamentation conferred by pressure, as shown Plate XXX, Fig. 4.

Two feet down, unassociated, was a portion of an object of earthenware, apparently the bowl of a large tobacco pipe (Fig. 60).

Conclusions.

No object in the mound at Racey Point showed evidence of White contact, and we are, therefore, of the opinion that the mound was completed in pre-Columbian times.

Usina Mound, St. John's County.

This mound, which was totally demolished by us, lay one-half mile south of Picolata on the river's edge. It was the property of M. P. Usina, Esq., to whom we are indebted for permission to investigate. Its height was 3 feet 7 inches; its base diameter 38 feet. Previous investigators had rendered almost useless the work of exploration. With the exception of a few arrow points, nothing of interest rewarded our search.
Mound Near St. Augustine Road, St. John’s County.

This mound lay a short distance north of the St. Augustine road, about 6.5 miles from Picolata. It presented a somewhat unsymmetrical appearance through previous superficial examination. Its height was about 5 feet; its base diameter 37 feet. With the exception of the marginal portion, believed to have been largely washed or thrown from the summit and sides, the mound was totally destroyed. It was unstratified and contained the usual admixture of charcoal. The form of burial was the bunched variety, the bones being in the last stages of decay. Two polished hatchets were found, while 4.5 feet from the surface, in pinkish sand, with human remains, was a thin sheet of copper, about 3.5 inches by .5 of an inch, with a thick backing of wood greatly decayed. Sherds were infrequent. Nothing indicating a knowledge of the Whites was discovered.

Mound Near Clark’s Creek, Clay County.

This mound, near the southern bank of Clark’s Creek, about one mile from the St. John’s, had an approximate height of 6 feet, with a base diameter of 70 feet. It was unsymmetrical in shape, showing considerable wash from heavy rains. It was virtually demolished. Its composition was yellowish sand, containing occasional particles of charcoal.

Total results were three or four small fragments of human bone at various points; several arrow heads; one hammer stone; one small polished hatchet, and a few sherds, showing separation by pointed implements.

Nothing to indicate a post-Columbian origin for the mound was discovered.

Harris Mound, St. John’s County.

This mound, in the midst of a grove of bearing orange trees, on the river’s edge, about three miles north of Picolata, was the property of Dr. L. H. Harris, of Pittsburgh, Pa., to which gentleman we are indebted for active assistance, and for permission to investigate various sites bordering the St. John’s, belonging to him.

The mound, the usual truncated cone, had a height of 6.5 feet, with a base diameter of 64 feet. Upon it grew forest trees, hickory, water-oak, and the slow growing live-oak, one of the latter having a circumference of 10 feet measured 5 feet from the ground. The mound was destroyed.

Stratification was marked. Extending from the surface to a depth of 2 feet was a layer of sand pinkish through admixture of Hematite. Below the upper layer was the yellow sand of the surrounding territory reaching to the base, the line of which was marked by a dark band about 2 inches in width, sprinkled with charcoal and showing at places marks of fire.

Upon the base of the mound, including the central portion, was a flooring of split plank in the last stages of decay, about 13 feet square. Its thickness was 2 inches. A portion of this wood submitted to Professor J. T. Rothrock was kindly
THE ST. JOHN'S RIVER, FLORIDA.

187

identified by him as red cedar. No evidence in the mound tended to show the former existence of a house or pen, as is sometimes seen in Ohio. Upon the planking lay a long stone "celt" in three fragments. Whether this breakage occurred in process of splitting the wood we can but surmise. Flooring of this character is unique in our experience of Florida mounds.

HUMAN REMAINS.

In all, thirty-four bundles of bones were met with in separate localities, though in no case did a bundle represent an entire skeleton, the smaller bones of which were never included, and even the larger at times were absent. Upon one occasion portions of three skeletons lay under one cranium.

The bones were mainly within three feet of the surface, and as a rule occupied a central position, the marginal portion of the mound being almost destitute of human remains. The bones were in the last stages of decay.

In the eastern slope of the mound, about one foot below the present level of the surrounding territory, was a bunched burial. One yard south of this was a species of pocket containing charcoal in small bits, mingled with numbers of small fragments of human bones, including the head of a radius, a small portion of a jaw, a bit of a cranium, and a part of a vertebra. With these were fragments of bones of lower animals.

Near the surface, with disturbed strata above, lay a skeleton at length in complete anatomical order. The bones of this secondary interment were in good condition.

IMPLEMENTS, ORNAMENTS, ETC.

On the base of the mound was an arrow head of chert showing marks of fire. Beyond this and the fragmentary "celt," to which reference has been made, no implements or ornaments lay along the base.

Never deeper than 3-5 feet from the surface, sometimes with human remains, were twelve hatchets of polished stone, varying from 3-5 to 9 inches in length.

In the eastern slope of the mound, unassociated with human remains, 4-5 feet from the surface, were two pockets containing 29 and 51 chippings of chert, respectively.

Entirely unassociated, 3 feet 8 inches from the surface, not far from the center

Fig. 61. Ornament of polished stone, Harris Mound. (Full size.)

of the mound, was an object, probably an ornament, of highly polished greenish stone, possibly Serpentine. Its length is 2-7 inches; its maximum width 7 of an
CERTAIN SAND MOUNDS OF

inch. It consists of five hemispheres ranged in a line in contact, much like certain bar-pins worn by women at the present time. The central and largest hemisphere has one on either side equalling each other in size, included by two smaller terminal hemispheres, each 4 of an inch in diameter (Fig. 61). This beautiful ornament has been submitted to various high authorities, who in every case have pronounced it probably unique.

Somewhat less than 4 feet down, in mutual contact, but unassociated with human remains, were a lance point of chert; a pendent ornament of stone, 3-5 inches in length, with double perforation, slightly convex on one side, flat on the other (Fig. 62); a pebble, almost spherical, having a diameter of one inch. Through the centre of this pebble, a perforation had been attempted from either side and for some reason abandoned. To one side of this a hole had been drilled, resulting in a fracture of the outer portion of the stone, while on the other side of the attempted perforation the endeavor had been safely carried to completion.

With two bunched burials were respectively 28 and 30 large beads wrought from the columellae of marine univalves. The maximum size of any bead was 1-4 inches and 1-2 inches in its major and minor axes.

With the bones of a child lay a shell drinking cup with perforated base.

No whole pottery was encountered. Sherds were infrequent.

Throughout the mound were fragments of red Hematite.

In the western slope of the mound, above the base, in actual contact, were about a dozen cockle shells (Cardium) and salt water mussels (Modiola plicatula). They were unassociated with human remains.

CONCLUSIONS.

There is no reason to suppose that this mound was constructed subsequent to the Discovery.

MOUND NEAR BAYARD POINT, CLAY COUNTY.

Bayard Point, nearly opposite Picolata, on the western side of the St. John's, is about seven miles south of Green Cove Springs. On the point is a fortification of considerable size, with moat, forming three sides of a square. The river side is unprotected, possibly through erosion by the current. This fortification is said to date from the Spanish occupation, veterans of the Seminole war positively affirming its pre-existence to that war.
About one-half mile in a northerly direction inland was a tumulus 4 feet 9 inches in height, with a base diameter of 45 feet. It was leveled to the ground by the kind permission of John P. Pratt, Esq., manager of the Borden Estate.

The mound was composed of whitish sand with occasional pockets of charcoal. It was unstratified and without clearly marked base.

In the extreme southern margin of the mound, where it was almost level with the surrounding territory, two feet from the surface, lay the skeleton of a man buried at length in anatomical order. The head was toward the west. Parallel to the body was a flint-lock musket or rifle, the muzzle toward the feet. In association were 14 spherical bullets. The bones were in fairly good condition.

In the northern portion of the mound where its full height was attained, 3 feet from the surface, lay the skeleton of a woman, with a layer of superimposed bark. Near the cranium were silver earrings of European pattern and the cervical vertebrae had in association a great quantity of oval white glass beads, and five brass (not copper) finger rings. On the chest were many small round beads of the same color and material as the others. Additional ones were present around the wrist. With the left hand were four bits of glass, the largest, oblong, about 1 by 2 inches. In the bones of the right hand, resting against the upper portion of the femur, was a mass of bright red pigment, dissimilar to the red ochre of other mounds. Chemical tests show this coloring matter to be mercuric sulphide—the cinnabar of commerce.

Somewhat south of the centre of the mound was a male skeleton at length, with head pointed northwest. Alongside lay a flint-lock rifle or musket, muzzle toward the feet. With it were a bone-handled awl and probably the remnants of a powder horn, the base partially studded with brass-headed tacks. In addition, was an object of iron with a gun flint in contact, probably a flint and steel.

Four or five sherds lay in different portions of the mound, none in association with the bodies.

CONCLUSIONS.

The results of this investigation are of deep interest in connection with the river mounds, and from them we may draw the following conclusions:—

1. That at least one low tumulus was built by the Indians of the St. John's in post-Columbian times.

2. That their most valued possessions were buried with them, including brass, not copper, and that articles of European make, when in possession of the Indians, were freely interred, even the easily obtainable red oxide being supplanted by the commercial cinnabar.

Orangedale, St. John's County.

A symmetrical little mound stood about 200 yards from the river, within sight of the road at Orangedale. Its height was 6 feet, its base diameter 36 feet. It

1 The mound was of irregular shape, and not the usual truncated cone.
CERTAIN SAND MOUNDS OF

was entirely dug through. It was composed of light yellow sand, with a slight intermingling of particles of charcoal. Sand of lighter shade indicated the base.

HUMAN REMAINS.

The form of interment was the usual bunched variety, and skeletal remains were comparatively numerous for so small a mound. The usual disregard as to the selection of bones of the same skeleton was well emphasized in this mound, one bundle containing fragments of crania, four femurs, and three tibiae.

In the central portion of the base was a layer of human remains, indiscriminately mixed, a number of square feet in extent, while almost in the exact center of the base was a deposit of fragmentary calcined human bones in sand whitened by the action of fire. In the sand beneath this deposit lay unbroken human remains, unaffected by fire, indicating that the interment took place subsequent to the extinction of the flames.

Several interesting pathological specimens were encountered.

STONE.

Nine "celts" were met with, from 3 to 8½ inches in length, as a rule unassociated with human remains and somewhat superficial, though one was from a depth of 5 feet.

POTTERY.

Sherds were very infrequent. Plain or stamped alone were met with.

CONCLUSIONS.

Nothing indicating White contact was met with in this mound, whose origin may therefore be considered as prior to the Discovery.

GEIGER MOUND, CLAY COUNTY.

This mound, 3½ miles south of Green Cove Springs, was leveled to the base with the consent of Mr. J. F. Geiger, the owner. Its height was 3½ feet; its base diameter 65 feet. It had apparently been under cultivation and had suffered by the wash of rains. A number of fragmentary human remains were found, and in one case a bit of Galena within a lower jaw.

MOULD NEAR PETER'S CREEK, CLAY COUNTY.

This mound, 5 miles northwest of Green Cove, had been considerably leveled by previous investigation. Its height was 4 feet, its base diameter 60 feet. It was leveled to the base. No stratification was noticed. In occasional pockets of pink sand were many shell beads with human remains. Two "celts" of graceful pattern
were found, one roughened for hafting (Fig. 63). Sherds were mainly of the stamped form of decoration.

**MAGNOLIA, CLAY COUNTY.**

Within a few yards of the hotel at this place is at present a very symmetrical mound, 7 feet high and 60 feet through the base. During the past thirty years it has been opened a number of times and restored to a more symmetrical shape. Some years ago, we are informed, two scientific men from the North, unfamiliar with mound work and the appearance of disturbed material, found towards the centre a tomato can and a sardine box—a powerful argument in favor of those advocating the theory of a post-Columbian origin for the mounds.

**MOUND NEAR Hibernia, Clay County.**

This mound on Fleming’s Island lies within a short distance of the road leading from the ferry at Black Creek. Previous investigation has removed so large a portion that no work was attempted.

**Four Mounds Near Switzerland, St. John’s County.**

About one mile south of Switzerland, 75 yards from the river’s bank, were three mounds in a line running north and south, their margins in contact. Beginning with the northernmost their respective heights were 2 feet 7 inches, 2 feet 7 inches, 2 feet 4 inches; their base diameters 47 feet, 32 feet, and 42 feet. They were completely dug through, as was a small mound about 150 yards farther south. Nothing of particular interest was encountered.

**Two Mounds Near Fruit Cove, St. John’s County.**

One mound, 2 feet 8 inches in height, with base diameter of 66 feet, was demolished with the consent of Mr. Joseph Lennig, the owner. It had been under constant cultivation. Bunched burials, charcoal, and sherds were met with much below the level of the surrounding territory. So often has this occurred in our experience that we are of the opinion that an excavation was made in many cases for the first interments over which the mound was subsequently built. Nothing of particular interest was encountered.

The second mound, about 400 yards east of the one on Mr. Lennig’s property,
was leveled to the base by the kind permission of its owner, J. C. Greely, Esq. Its height was 4 feet 9 inches. Its shape was somewhat elongated and, exclusive of material washed down after cultivation, its length was 75 feet. A few fragmentary human remains were found at different depths, and a great variety of sherds, the majority showing separation by pointed tools, as described in the case of the mound at Racey Point. No features of especial interest were noted.

_Julington Creek, Duval County._

About 3 miles up Julington Creek on the south side, one mile west of Tar Landing, on the edge of the swamp was a mound 6 feet in height, with base diameter of 46 feet. At its southern margin was a trench several feet in depth, from which at least a portion of the material for the mound had been obtained. The summit plateau had been superficially examined previous to our visit.

With a force of ten men to dig, the mound was completely demolished within four days.

It was composed of gray sand with an upper stratum of irregular thickness, somewhat the color of terra-cotta, which analysis showed to be from oxide of iron modified in shade by vegetable matter.

_Human Remains._

The usual bunched method of burial prevailed exclusively, or rather interment after exposure, since in some cases the usual heaps were somewhat modified, the bones being deposited at length, though not in anatomical order.

Five feet from the surface were human remains with long bones end to end for a space of several feet; the cranium lay upon a tibia.

In all, 27 separate deposits of bones were observed (though some escaped us in caved sand), consisting sometimes of but a single cranium unassociated; of a few long bones without the skull; of the usual bunched burial; of the long bones at length, of which mention has been made; and again of masses of bones of many individuals.

A little east of the center, about 4 feet from the surface, was a large bundle of bones with four crania, while an isolated skull was one foot above.

Nearly at the center of the base of the mound was a matted mass of bones, having a maximum thickness of 16 inches. The length of this deposit was 5'5 feet, its greatest breadth 4 feet. Bones of all ages and sexes were piled together indiscriminately.

The almost universal use of fire in connection with the construction of mounds of the St John's was well illustrated in the case of the mound on Julington Creek. In addition to the usual sprinkling of charcoal throughout the sand, there were at least four fireplaces immediately over deposits of human remains, and these remains gave no evidence of contact with the flames, save in one instance where a tibia slanted upward through the sand into the fireplace.
A number of human bones lay 6 feet from the surface, near the center of the base, with two crania in contact. All were unaffected by heat, though the remains of a fire, 4 feet in length, were plainly apparent in the sand about one foot above. Among the extinct embers lay considerable portions of a human tibia, a fragment of lower jaw, and other human remains thoroughly charred.

In various portions of the mound human remains similarly treated were met with.

Four and one-half feet down, in the western slope, was a pocket of fragments of human bones, unaffected by fire. With them were small pieces of calcined bone, some of undetermined identity, others of lower animals.

The reader is referred, in connection with the treatment of human remains in this mound, to "Aboriginal Remains of the Piedmont and Valley Region of Virginia" by Mr. Gerard Fowke.¹

One cranium (Academy Catalogue, No. 1783) was secured from near the base in fairly good condition.

STONE, SHELL, AND EARTHENWARE.

A few bits of Hematite were scattered throughout the mound. On the base, unassociated, were two "celts" of stone, some distance apart.

¹ American Anthropologist, October, 1893.
Three feet from the surface, unassociated, was an implement of stone, about 4 inches in length, departing somewhat in shape from the ordinary “celt,” and more resembling the modern idea of the hatchet (Fig. 64).

Of undetermined depth, in caved sand, was a flat implement of polished stone, with cutting edge at one extremity. Its length is 3.5 inches; breadth 2.4 inches; maximum thickness about .6 of an inch. We have not met with this type elsewhere on the river (Fig. 65).

Upon two occasions, small shell beads were found with crania.

A number of sherds were met with at all depths, plain, stamped, and in two instances, otherwise decorated. On the base was a portion of an undecorated bowl, represented by hardly more than a few inches below the margin of the aperture. Its diameter is 12 inches.

Conclusions.

There is no reason to assign to the mound on Julington Creek an origin other than pre-Columbian.

Three Mounds on Mandarin Point, Duval County.

Mandarin Point makes into the St. John’s, just north of Julington Creek. It is now covered with a heavy growth of oak and pine, though the tract, an old Spanish grant, plainly shows marks of previous cultivation.

The northernmost mound had lost considerably in height during civilized times. Its altitude was 4 feet, its base diameter 55 feet. The work of a former investigator was apparent. It was levelled to the base by us. Little of interest was discovered beyond very fragmentary human remains, a few arrow heads, and many sherds on which the work of pointed implements, to which we have already made reference, was noticeable.

About one-quarter of a mile in an easterly direction from this mound was another 3 feet 7 inches in height and 58 feet through the base. This disproportionate base diameter is a probable indication of a diminution in height through cultivation in civilized times. The mound was totally demolished. Absolutely no human remains were met with.

Three feet from the surface, near a deposit of charcoal, was a vessel 7 inches in height and 7.5 inches in diameter. Its condition was somewhat fragmentary though allowing restoration. Its ornamentation consists of a series of short intersecting lines, formed by pressure of a twisted cord into the wet clay (Plate XXXI, Fig. 1).

The southernmost mound on Mandarin Point lay about 50 yards from the river’s bank, though hidden from view. Its height was 5 feet, its base diameter 47 feet. A large central excavation had previously been made by the owner of the mound, and we are of the opinion, judging from results obtained by us, that a report as to the discovery of numerous articles during the first investigation is correct. The remaining portion of the mound was virtually demolished.
THE ST. JOHN'S RIVER, FLORIDA.

The line of the base was considerably below the level of the surrounding territory. Upon it was a layer of sand from one to two feet in thickness, blackened by fire and filled with charcoal. In this layer lay many oyster shells and several bones of the lower animals, among which were remarked part of the shell of a turtle, the lower portion of the femur of a deer, etc. A slight sprinkling of charcoal was apparent throughout the mound. Above the dark layer was sand of a yellowish hue to the thickness of about one foot, and this was surmounted by a stratum 4 feet in thickness at the center of the mound, pink in color, and even at times a bright cherry, through admixture of Hematite.

Human remains were of infrequent occurrence.

Five celts were met with separately, apparently unassociated with human remains, from one to two feet from the surface. One was buried in a pocket of scarlet sand; another, very symmetrical, has a length of 10.75 inches, the longest from Florida to come under our notice, though implements of this character 13 and 14 inches in length are reported from other sections.

Unassociated, about one foot from the surface, was a tobacco pipe of coquina with original fracture of the bowl. It was additionally injured by the blow of a spade (Fig. 66).

Nothing in this mound in any way pointed to White contact.

DOCTOR'S LAKE, CLAY COUNTY.

Near the northwestern extremity of Doctor's Lake, at a settlement named Peoria, is a low mound of yellow sand, the property of a native called Silcox, whose
charge for the privilege of excavation is disproportionately great considering the unimportance of the mound.

**Two Mounds at Orange Park, Clay County.**

In the town of Orange Park are two mounds which have been dug into to such an extent that farther investigation was deemed inadvisable.

**Smaller Mound Near Beauclic, Duval County.**

This mound, on property controlled by W. D. White, Esq., of Mandarin, was courteously placed at our disposition by him.

The mound, about one-half mile east of Beauclic, has been under continuous cultivation and its height, 5 feet 7 inches, was no indication of its altitude in former times. Its base diameter was 68 feet.

The mound was completely demolished.

It was composed of brownish sand. On one portion of the summit was sand of a terra-cotta shade similar to the upper stratum of the mound at Julington Creek. Probably the remainder of this layer was wanting through the agency of the plough.

The base of the mound, somewhat below the surrounding level, had been one vast fireplace. On it at one point, covering a number of square feet, were scattered fragments of human bones and of bones of lower animals charred and calcined by fire. Immediately above these, occupying a central position on the base, was a solid mass of human bones in the last stage of decay. These bones, owing to advanced state of decomposition and pressure from the sand above, had virtually lost their distinctive shapes, and lying in a compact mass, closely resembled a rotten plank. They were unaccompanied by relics of any sort and showed no marks of fire, proving that, previous to burial, the flames that charred the bones below, had been allowed to cool. Local fireplaces were in various portions of the mound. Rising from the base in the form of a cone beneath the yellow sand was a mass of sand darkened by admixture of charcoal. Its exterior was marked by a black line indicating the base of another fireplace. Toward the center of the mound the apex of this cone was within one foot of the surface. In various portions of the mound were fragmentary burials, representing portions of the skeleton, while upon two or three occasions, not far from the surface, were skeletons in anatomical order. One of these, the bones of which fully retained their organic matter, presented a rather gruesome appearance, and doubtless belonged to a colored man who, we are informed, had been interred there some ten years previously.

An occasional *Fulgar (carica)* lay on the base, where also, at different points, were found a small arrow head and two oval pebble-hammers.

One lance point and three "celts" were found separately from two to three feet from the surface.

Sherds plain or stamped were abundant.
LARGER MOUND, BEAUCERC, DUVAL COUNTY.

This mound, about one-quarter of a mile east of the smaller one, was of unusual shape as shown by diagram (Fig. 67). Its height, at the time of our visit, was somewhat over 6 feet, though continuous cultivation had doubtless transferred masses of sand from the upper portion to the margin of the mound. A small circular elevation, E, having a height of about 18 inches, contained nothing beyond scattered sherds.

We were indebted, as in the case of the smaller mound one-quarter mile distant, to W. D. White, Esq., for permission to investigate.

Seventeen men to dig and four to direct the work, levelled the mound to the base within six days.

It was composed of yellowish sand with the usual sprinkling of charcoal, though no fireplace marked the base which was of yellow sand of brighter shade. At the highest portion of the mound, a little over six feet above the surrounding
level, charcoal was mingled with the sand to a depth of 8 feet. Locally throughout the mound were fireplaces occasionally containing small fragments of bones, human and of the lower animals.

**HUMAN REMAINS.**

Skeletal remains were found at every depth, though very widely separated.

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**Fig. 68.** Implement of chert, larger mound, Beaucere. (Full size.)

**Fig. 69.** Section of same.

The form of burial was the bunched variety, and the bones were in the last stage of decay, at times represented by fragments only.
EIGHTEEN inches from the surface was a chipped implement of chert, about 6·5 inches in length, pointed at one end, with a cutting edge at the other. We have found nothing of this type previously in the river mounds (Fig. 68).

A number of pebbles and eight arrow points were found separately and unassociated at various depths.

Five feet from the surface were twelve small chippings of chert with no other object in association.

Two small masses found together in this mound were chemically determined, through the kindness of Dr. E. Goldsmith, to be "an intimate mixture of carbonate and phosphate of calcium and some aluminous matter"—of common occurrence in Florida.

**Earthenware.**

In caved sand, and therefore of undetermined depth, was a heart-shaped earthenware vessel. Exteriorly and interiorly are traces of red coloring matter. A portion of the margin shows chipping from pointed tools, as does the vessel next to be described, and the great majority of sherds in this mound which, the reader will recall, is the northernmost limit of the prevalence of this curious custom so far as our observation extended. The height of this heart-shaped vessel is 1·5 inches; its maximum diameter about 2·5 inches. It was apparently unassociated (Plate XXXI, Fig. 2).

One and one-half feet from the surface was a small pot marked with red pigment inside and out. Small handles or indications of them are on either side of the aperture, the diameter of which is 2 by 2·5 inches. Height about 2·5 inches. This vessel (Plate XXXI, Fig. 3) is of high specific gravity, and like all the whole vessels, and most of the sherds, seems to be of gritty ware.

Two and one-half feet down, lying bottom up, unassociated, was an undecorated bowl, 4·5 inches in height and 10·5 inches maximum diameter. It was of superior manufacture with carefully bevelled edge. An accidental blow from an axe, causing a certain base mutilation, showed the material to contain small fragments of chert (Plate XXXI, Fig. 4).

In another portion of the mound was a small bowl undecorated and of poor material.

In caved sand was a neatly made vessel with six encircling parallel rows of punctate decoration, extending laterally about two-thirds down the body from the aperture, which is contracted to a diameter of about 1·75 inches; maximum diameter 8 inches; height about 2·5 inches (Plate XXXIII, Fig. 2).

Four and one-half feet from the surface were fragments of a large vessel with stamped decoration of complex pattern resembling that of Georgia and of Carolina. The rim is doubled over. The material is filled with fragments of chert, at times the size of a pea. Fragments of this vessel were many feet apart, as though strewn upon the mound in course of construction (Plate XXXIII, Fig. 1).
Many other sherds of types of decoration uncommon on the St. John's were found at various depths (Plate XXXII, Figs. 1 and 2). Attention is called to the fact that no earthenware in this mound showed base perforation of any sort, as was the case at Racey Point.

CONCLUSIONS.

So continued had been the cultivation of the two mounds at Beauclerc that objects superficial when found, had unquestionably originally been placed at a much greater distance from the surface. It is our opinion that nothing in these mounds was of secondary introduction, and that the mounds, through absence of all evidence tending to connect them with White occupation, were abandoned prior to the coming of Europeans.

**Grant Mound, Duval County.**

The Grant Mound, on a high bluff overlooking the southern bank of the river, at a point about 2 miles west of Mill Cove, has a base diameter of 216 feet. Its height above the level of the bluff is 26 feet 8 inches; its shape, the usual truncated cone, so symmetrical in this case that the diameter of the summit plateau is but 24 feet.

The owner of the mound, James B. Grant, Esq., to whom with his family we are indebted for many courtesies, gave cordial permission to investigate, though a natural desire on the part of the owner to preserve so notable a landmark prevented an attempt to demolish the mound. Unfortunately, unless a change of channel occurs, this great aboriginal work will fall a prey to the river into which fully one-third of its material has already gone, furnishing to neighboring residents a rich harvest of aboriginal relics.

Six days, with a force of 16 men in all were devoted to the mound. Its composition, judging from the parts exposed by us and section laid bare by the water, is of yellow sand with a base blackened by fire, containing a heavy percentage of charcoal. Charcoal to a much less extent is sprinkled throughout the mound, while small local layers and pockets of gray sand and of white sand, both of natural hue, and of red, of pink, and of cherry sand colored by *Hematite*, abound, usually in connection with human remains and aboriginal relics. Near the surface beneath the summit plateau were masses of oyster shells, while single shells are scattered throughout the mound.

**Human Remains.**

The form of burial was that of bundles of bones piled without reference to anatomical order. In no case was the entire skeleton represented, and frequently but small portions were found. One bundle of bones was made up of six femurs and two humeri belonging to at least four different individuals. All bones were in the last stage of decay, making impossible any successful attempt at preservation.
STONE.

In all, nine polished hatchets, or "celts," were met with during the investigation, with one exception lying within a few feet of one another as to area, though some were in caved sand, and others from 4 to 7 feet in depth. As a rule no bones were found in association.

Three and one-half feet from the surface, with human remains, was a flattened tube of sandstone 2'6 inches in length, with a maximum diameter of 1'5 inches.

Another tube of about the same proportions, rough on the outside, has somewhat the appearance of a natural formation.

GALENA.

A piece of Galena, somewhat over a cubic inch in size, lay unassociated at a depth of 1'5 feet beneath the summit plateau.

SHELL.

Small beads of shell were found in great abundance, always in association with human remains.

Several unimportant objects of shell were met with during the investigation, including a drinking cup wrought from Fulgur perversum.

COPPER.

The presence of copper of aboriginal design, at depths to denote original introduction, was a feature of peculiar interest in the Grant Mound.

In caved sand was a nearly spherical bead of sheet copper, 7 of an inch in diameter (Fig. 70).
Five feet from the surface, in sand rendered bright cherry by admixture of Hematite, with fragmentary human remains and large numbers of small shell beads, were three tubular beads of thin sheet copper, with overlapping edges. Of these, the two largest were each one inch in length with a diameter of 3 of an inch; the smallest, about one-half these dimensions.

In another portion of the mound, 5 feet from the surface, was one tubular bead of copper, similar to the largest above described.

In caved sand was an oblong sheet of copper 3·7 by 2·6 inches, with a central oval boss having the usual perforation for attachment or suspension. At the three remaining corners was repoussé decoration as shown in Fig. 71, which, by the way, correct in other respects, is too long by 3 of an inch.

Seven feet below the surface, apparently unassociated, was a large oval bead of sheet copper about 2 2 inches in length, with a maximum diameter of 1·2 inches (Fig. 72). This bead, almost similar in shape and size to that described as coming from Mt. Royal, differed in that the edges met without overlapping. Like the Mt. Royal specimen it was made of a single sheet of copper hammered over, differing from Ohio specimens, which, as we have stated, are made of two sections fitted together.

Earthenware.

Sherds were comparatively of infrequent occurrence and were almost universally undecorated or stamped in squares.

Five feet from the surface, in a pocket of gray sand and charcoal, was a tureen-shaped vessel of earthenware, 5 inches long, 3 inches broad, and about 1·3 inches in height. Through the bottom a small hole had been knocked subsequent to baking.

At a depth of five feet, in another portion of the mound, was a curious object of earthenware. The body, from which the base had been intentionally omitted in manufacture, resembles in shape an inverted truncated cone. The laterally projecting rim, including aperture, has a maximum diameter of 4·7 inches. The maximum diameter of the body is about 2·5 inches, its base diameter about one inch less (Plate XXXIII, Fig. 3). We found in Mt. Royal an object of earthenware similar to this in size and shape.
THE ST. JOHN'S RIVER, FLORIDA.

In the talus at the foot of the bluff was found a small semiovoid vessel with base perforation made previous to baking.

OBJECTS FOUND BY OTHERS IN THE GRANT MOUND.

The reader has probably remarked by this time that hearsay testimony as to mounds and objects discovered in them has not occupied a prominent position in this report. This has not been through lack of abundant supply, but while much of this information is probably correct, much more is confused or not based upon fact.

During the score of years that the mound has gradually succumbed to the wash of the river, according to those living in the vicinity many curious objects have been gathered by those keeping a watchful eye on the talus, especially after storms. We have seen in the possession of reliable persons living near the mound, masses of Galena, the largest about the size of a closed fist; various vessels of earthenware; a discoidal stone, carefully dressed; several polished hatchets of stone; a crystal of quartz about 3 inches in length and 1-5 inches in diameter, grooved for suspension at the base. Laudonnière refers to "deux pierres de fin cristal" as gifts from southern Indians.

Mrs. Martha A. Millspaugh, residing not far distant from the foot of the Grant Mound, has an interesting collection of objects, all of which, we are informed, were obtained from the sand on the exposed side of the mound. We are indebted to her for a piercing implement of copper, and a portion of another of great interest, since the section at the point of fracture shows it to be formed of numerous thicknesses of thin sheet copper beaten into close contact. These specimens, used for analysis, will be particularly referred to in our Note on Copper.

CONCLUSIONS.

Although we are told by the Huguenot chronicle1 that various paracous, or kings, were in control along the borders of the St. John's, Satonrion, near Fort Caroline (several miles below the Grant Mound), and Outina at a point up the river, which archaeologists have considered to be at or near Mt. Royal, there can be no question that tribes having identical mortuary customs, built the two great mounds to which reference has just been made.

The unusual size of the mounds, the layers and pockets of brightly colored

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1 The graphic story of Laudonnière detailing the ill-fated Huguenot expedition to the new world should be in the hands of all making a specialty of the archaeology of Florida, including as it does minutest particulars of the manners and customs of the aborigines.

While the Brevis Narratio, containing the story in Latin, with plates by Le Moyne de Morgues, a survivor, published by de Bry (Frankfort a M., 1591), or the first French edition of this "Histoire Naturelle de la Floride" (Paris, 1586), or Hakluyt's quaint rendering into English of the same, may not be within easy access to all, the Paris edition of 1583 is readily obtainable, as is the English translation in "Historical Collections of Louisiana and Florida," New York, 1889. We are informed that an English translation with photographic reproductions of Le Moyne's plates was published in Boston some years ago. We have been unable to obtain a copy.
CERTAIN SAND MOUNDS OF

sand, the presence of copper, the occurrence of identical forms of "freak" earthenware, taken with a similar form of burial establish this beyond reasonable doubt.

Unfortunately, the investigation of the Grant Mound has not been so extensive as that of Mt. Royal, but nevertheless no mean amount of work was accomplished.

In this mound we have found no more traces of the iron distributed by the Huguenots than were apparent in Mt. Royal, to whose king, we are distinctly informed, such objects were sent, and it is our opinion that the Grant Mound, like Mt. Royal, was a monument of the past when the Whites first set foot in Florida.

MOUND NEAR MILL COVE, DUVAL COUNTY.

About one mile west of Mill Cove, some 150 yards from the river, on high rolling ground sweeping the St. John's for miles, is an Indian earthwork of great size, and of a form entirely novel for mounds of the St. John's. In shape, it resembles a circular platform, having a base diameter of 214 feet, with a circular summit plateau 108 feet across. On the side facing the river, an approach carefully graded, 126 feet in length and 88 feet in breadth, leads to the upper level. Such approaches are not found elsewhere on the St. John's, though somewhat irregular causeways of shell were noted, as the reader will recall, at Tick Island and at Thursby Mound.

So regular and symmetrical in every way is this great earthwork that its origin was universally attributed to the Huguenot French by those living in the neighborhood. It is not likely, however, that the ill-fated founders of Fort Caroline (probably at St. John's Bluff, a few miles below) had time or disposition to pile up great masses of sand, while works of defence are not approached by broad avenues of easy grade. Moreover, Le Moyne, an eye-witness, has left us in Plate X a representation of Fort Caroline showing no earthworks in connection with it.

There can be no doubt, as the reader will presently see, that the mound near Mill Cove is of aboriginal origin.

The owner, a foreigner, alleging superstitious terrors on the part of his family, would consent to no extended investigation, though influence and inducements were brought to bear.

A number of trenches were dug from the surface of the summit plateau, none exceeding 6 feet in depth. These excavations were subsequently carefully refilled.

So far as our observation extended, the mound is of yellow sand with the usual sprinkling of charcoal. Local layers of red sand near the surface, some several feet in thickness, were encountered. In but one excavation, which happened to be on the edge of the summit plateau, were human remains. These remains, the

1 *Brevis Narratio.*

2 While the drawings made by Le Moyne, or from his descriptions, are not exact in detail, as, for instance, the use of bows of Chinese type by the Indians, and the obliging manner in which alligators allow great stakes, propelled by half a dozen men, to be forced down their throats, yet we know bows to have been in use, and doublet-shoulder spears, thrust into the jaws of alligators which were by no means timid on the St. John's at even a much later period, as we are told by the traveller Bartram. It is unlikely, therefore, that features of importance, such as the appearance of Fort Caroline, would be misrepresented.
usual bunched form of burial, lay beneath a layer of sand colored red by admixture of Hematite, and showed no evidence of previous disturbance.

The only objects of aboriginal workmanship met with in the mound were 5 arrow points and a tureen-shaped pendent ornament or toy of earthenware, with perforation at end for suspension. Length 2 inches; breadth, 1 3 inches (Fig. 73).

A house, now destroyed by fire, at one time occupied the summit of the mound. It is not probable that the mound was in any way levelled for its reception, since examination of the steep and symmetrical sides showed no appearance of deposit from above.

It is to be hoped that at some future time a change of ownership may permit farther investigation.

**Fulton, Duval County.**

About one-half mile southwest of Fulton, a settlement just south of St. John's Bluff, is a mound in a light grove of oak and pine. The mound and surrounding territory give evidence of previous cultivation. The height, which has evidently suffered considerable diminution, is at present 7 feet, the base diameter 90 feet. About one-third of the area of the mound was levelled by kind permission of H. J. Hole, Esq.

Locally were layers of oyster shells from one to several feet in thickness, with occasionally in association fragments of bones of lower animals and vertebrae of fish. Sherdts were infrequent.

Superficially was a fragment of human radius, but beyond this no signs of human remains were met with, nor any implements whatever.

**St. John’s Bluff, Duval County.**

St. John’s Bluff, by some supposed to be the site of the ill-fated Fort Caroline, towers high above the water on the south bank of the river, about six miles from the sea. At the point of union of the St. John’s and a small creek, the bluff forms a right angle, having a side parallel to each, the northern side overlooking the river, the eastern rising above the creek and adjacent marsh.

Along the edge of this eastern side is a line of curious elevations, some oblong, some conical, all very symmetrical. A few were utilized as batteries during the late war by the removal of central portions.

The most symmetrical of these eminences, almost a perfect cone, had a height of 9 feet and a base diameter of 47 feet. About one-half of this mound was dug away by us, removing a number of feet from the summit, and exposing a portion of the base. Absolutely nothing indicating human agency was met with, even the heretofore, ever-present, charcoal being wanting. We are in doubt as to the origin of these mounds.
CERTAIN SAND MOUNDS OF

NOTES AND CONCLUSIONS.

PERIOD OF CONSTRUCTION OF THE MOUNDS OF THE ST. JOHN’S.

That the reader may be placed on an equal footing with ourselves in considering the probable age of the sand mounds of the St. John’s River, we will give a brief résumé of the results of all our investigations. During the years devoted by us to mound exploration on the river, we have seriously investigated about seventy-five sand mounds, the majority of which we have levelled to the base, while the remainder have received far from superficial attention.

In a number of these mounds, possibly half a dozen, we have found, superficially, articles of iron, glass, etc., buried with later Indians, presumably in pre-existing mounds, since, with other burials in the body of these mounds, articles of a like nature were not encountered. Thursby Mound was a good example of this, where, it will be remembered, iron implements lay near the surface, while at greater depth none but objects of aboriginal manufacture were met with, though the mound was completely demolished.

At Raulerson’s, burials had been made at a late period on a pre-existing shell heap, and covered with a foot or two of sand.

But one mound on the St. John’s has shown human remains, other than superficial, associated with objects of European manufacture, namely, the low mound at Bayard Point.

The reader, turning to our description of this mound, will find that muskets, tools of iron, bullets, bits of glass, and beads of the same material, with a red paint of commerce, cinnabar, lay in association with the dead, and it is our opinion that the discovery of this small mound, with its profusion of articles obtained from the Whites, serves clearly to illustrate the tendency of the Indians to inter such possessions with the departed, and emphasizes the character of the mound.

In considering the question of the period of the construction of the mounds of the St. John’s, having no data as to their existence at the time of the Discovery, though others are reported in regions not far removed, we are compelled to rely mainly on negative evidence.

Now negative evidence, while not absolutely final, is generally accepted where a sufficient amount is confronted by none of a positive character, and many things universally admitted as facts are established by negative evidence alone. In this dearth of positive information the story of the mounds must be told by the character of their contents, and inferred from what they do not contain.

We know it to have been a common custom to inter with the dead, possessions in general use. With superficial burials we find a great variety of articles furnished by the Whites, and highly prized by the aborigines.

We think then, it must be admitted that on the St. John’s, as elsewhere, what the Indians had they interred with the departed, and that when in an entire mound no articles of European manufacture are met with, an explanation must be sought
under the hypothesis that such articles were wanting among them, and that the
makers of the mounds lived at a period when such objects were unobtainable, a
period prior to or bordering on the Conquest.

To one who has carefully read the reports of the two investigations of the
great mound at Mt. Royal, and noted the hundreds of objects discovered therein,
seemingly the product of aboriginal art, and the absence of so much as one bead
of glass or one implement of iron in the great mass of sand moved by us, the
conviction must be assured that a people so comparatively rich, and so devoted to
its dead, would surely have possessed and taken pride in interring with the departed
the many objects of gift and of barter, which Indians always acquire in intercourse
with Europeans, had the mound been in process of construction in post-Columbian
times.

In this connection it may be well to notice a suggestion made by Professor
Holmes in his able and interesting paper on the earthenware of the St. John’s (page
109); published with the first part of this report, that the practice of perforating
the base of mortuary pottery arose in post-Columbian times, through a desire to
render less attractive to the Spaniards the contents of the mounds.

In the preparation of his paper, Professor Holmes labored under a certain dis-
advantage in that, through our absence in Florida, he was unable to have clearly
set before him certain points in relation to depth and association of objects discov-
ered in the mounds, and it was with no small wonder, upon reading his paper, we
became aware how clearly in nearly every respect, from our somewhat imperfect
communications, he had grasped the subject.

However, such a hypothesis relating to the base perforation of mortuary pot-
tery, involving as it does so late an origin for the mounds, since this pottery is found
upon the base of many of them, seems to us entirely untenable. In the first place,
no European objects have been found in association with pottery of this class. And,
secondly, it is hardly to be supposed that aborigines interring only rude and com-
paratively useless earthenware through fear of subsequent loss by pillage should
place in immediate association unbroken ornaments of copper, entire implements of
polished stone, pearls, and other possessions dearest to the native heart.

We are then of the opinion that the manufacture of flimsy forms and mutila-
tion prior or subsequent to baking was practised in pre-Columbian times in deference
to some religious rite or established custom, and not at a later period through fear
of plunder by the Whites.

While we are not in a position to make a positive statement, it is our firm
conviction that at least all the larger mounds of Florida are of pre-Columbian origin. It
is but recently that thorough mound investigation has been practised, and it is
to be regretted that too frequently conclusions have been drawn by strangers to the
mounds, whence the material was derived, and who were, therefore, not in a position
to consider the situation from every point of view.

To box the contents of a mound, the superficial with the base deposits, and to
label the whole “From a mound, Florida,” is worse than useless—it is misleading—

26 JOURN. A. N. S. PHILA., VOL. X.
since the iron axe, the beads of glass, the pewter, and the lead from the superficial burial are not distinguished from the deposits from the base, and too frequently are factors in the attribution of the age of the mound.

The mounds of the west coast, of the lake country, and of the prairie lands of the northernmost portions of the State have received but superficial attention. The Bureau of Ethnology, Report 1883-1884, page xxi, contains the statement that but few of the Florida mounds were built for burial purposes, from which statement the thoroughness of the work may be inferred. On the other hand, Mr. Andrew E. Douglass, who has given serious attention to forty mounds of the east coast, informs us that upon not one single occasion has he found in these mounds other than superficially, objects connecting them with the civilization of the Whites.

In conclusion, we are firmly of the opinion that all the larger mounds of the St. John’s, and, with trifling exceptions, the smaller ones, date from a period prior to the coming of Europeans.

ARE THE SAND MOUNDS OF THE RIVER CONTEMPORARY WITH ITS SHELL-HEAPS?

During the four seasons covering our researches on the St. John’s River, we have given special attention to the question of the contemporaneity of the sand mounds and of the shell-heaps of the St. John’s, carefully weighing reasons for and against, and especially directing our researches with a view to elucidate certain points previously clothed in uncertainty, questions which the lamented Wyman, pioneer investigator of the archaeology of the river, doubtless would have taken up.1

Unfortunately, the results of our researches have not put us in a position to make a positive statement. But it is our opinion that what we believe to be the earlier of the sand mounds, as for instance that at Tick Island and the Thursby Mound, were contemporary with what we consider the later shell-heaps; but whether sand mounds were constructed contemporaneously with presumably the older shell-heaps, and whether the period of the shell-heaps had not come to a close when what are probably the comparatively later sand mounds, as typified by Mt. Royal, were constructed, we are unable to say.

Before presenting in detail the reasons upon which this opinion is based, we shall give a brief summary of the principal features of the shell-heaps of the St. John’s, founded upon our work of two seasons with steam-notive power and an adequate force of men, virtually covering every known fresh-water shell-heap on the river.2

1 Professor Wyman says: “We leave out of consideration the burial mounds, which may possibly be as old as the shell-heaps, because they have not thus far been satisfactorily examined and proved to be so. Nearly all the explorations of them have been confined to the superficial portions where there are mixed burials of an earlier, though perhaps not of the earliest, and the later inhabitants. The only mound which we have had an opportunity to examine quite to its base had only recent burials on the top, but none whatever lower down. In its general appearance it exactly resembled the others.”—Fresh Water Shell Mounds of the St. John’s River, Florida, page 47 (foot-note).

2 Partial results of these investigations are given in the American Naturalist, November, 1892, January, February, July, August, 1893, January, 1894.
Bordering the St. John's and its tributary streams, beginning at a point a little north of Palatka, and extending to the river's source, are heaps mainly composed of fresh-water shells, with a small percentage of bones of lower animals, and occasionally of man. Many of these shell-heaps, including some of the largest, have no burial mounds of sand in association; at all events, above the surface. At all depths in every shell-heap, without exception, are the remains of ancient fireplaces, bearing certain testimony to the artificial origin of these heaps of shell which, formed from kitchen refuse, gradually increased in size during the lapse of years.

In certain of these shell-heaps persistent search on our part has failed to reveal a single fragment of earthenware which we know to be so abundant in other of the river shell-heaps, and this negative result was also reported by Professor Wyman. This absence of earthenware was attributed by him to the lack of its possession by the makers of such heaps, and we see no reason to differ from that conclusion.

It has been asserted that the absence of fragmentary earthenware can be accounted for under the hypothesis that aborigines residing on the shell-heaps made their pottery elsewhere; or, even admitting its introduction, that the rude earthenware of these people was subject to decay. To these suggestions we would reply that no people habitually using earthenware, though made elsewhere, could form and occupy great masses of shell without leaving behind numerous fragments of their fragile vessels, as they have done in the other heaps; and that as we have never in Florida met with aboriginal earthenware showing partial decay, we are not inclined to the belief that the absence of pottery can be accounted for by this agency. Moreover, in shell-heaps where pottery is discovered to a certain depth, the lowest sherd-bearing stratum shows its earthenware to be, so far as decay is concerned, in a condition equally as good as that of fragments from the upper portions of the heap. There is absolutely no transition from strata devoid of earthenware through others containing it in a crumbling condition, to layers of shell holding the solid sherds, and this we say after seasons of work conducted under our personal supervision, in our immediate presence at the excavation, with a corps of trained assistants to examine every object brought to light, and to submit the same to us, and in not one single instance have our conclusions been arrived at from the reports of others as to discoveries made during our absence.

In comparatively recent times races have been met with to whom the manufacture of pottery was an unknown art, and we see no inherent reason why to the early savages of the Peninsula we should not attribute an equal ignorance.

We do not assert that the art of manufacture of earthenware was self-taught to the makers of the shell-heaps, acquired by the slow process of evolution, since we are in possession of no data for or against; but we do say, and we are fully convinced, that there was a time when the men of the earlier shell-heaps did not include earthenware among their possessions. It seems not unlikely that the art of pottery making was brought by a more advanced people, and that the abundant sherds of certain shell-heaps prove such heaps of a later date.

In refuse heaps fragmentary objects alone can be expected, though from time
to time articles of value, doubtless through accident, found their way into the heaps of debris, and it is fair to suppose that long-continued and persistent investigation, involving the careful removal of great masses of shell, should yield a representative collection of objects, many, of course, fragmentary, formerly possessed by the makers of the shell-heaps. Beyond a very occasional arrow head, shell-heaps devoid of pottery are virtually barren of relics of aboriginal art, nor in the heaps containing earthenware is the search of the investigator as a rule much more richly rewarded. Possibly an awl of bone or a gouge of shell may be brought to light, but articles of luxury and of adornment are conspicuous by their absence.

To this there is one marked exception, Mulberry Mound, an island shell-heap near Lake Poinsett, on the southern border of Orange County, rising sixteen feet from the level of the river. This heap, which since our report in the "Naturalist," has again been thoroughly investigated by us during a number of days of April, 1894, when an excavation 16 by 24 by 10:5 feet deep was made, furnished a bewildering list of objects hitherto undiscovered in the river heaps, including gracefully shaped arrow heads; sherds decorated with crimson pigment; implements of bone, including long pins with head decoration; a fragment of a gorget of shell; shell chisels and drinking cups; a rude hatchet of polished stone; the human figure scratched upon earthenware; a graceful tobacco pipe; and other objects occasionally found in the sand mounds and on the surface of the shell-heaps.

We believe, therefore, that a considerable divergence of time marks the period of the construction of the shell-heaps. As we have stated, we are unable to determine whether the makers of the earliest shell-heaps interred their dead in mounds of sand.

It may be suggested by a close reader of this report that certain sand mounds have contained no pottery, and that these mounds may have been the work of the men of presumably the earliest shell-heaps. To this we would reply that, save with burials, no incentive existed for the inhumation of pottery, whole or in sherds, in the sand mounds, and that even in the burial mounds it was simply a matter of custom, almost universally followed, it is true, but still not without exceptions. We have seen how, in the large mound near Thornhill Lake, but two sherds were encountered, evidently of accidental introduction, but undoubtedly of original deposit. The absence of earthenware in a sand mound is no proof that the makers did not possess it.

It is true we have discovered in Persimmon Mound, a shell-heap, burials on sand in anatomical order, and in Orange Mound, another shell-heap, beneath three feet of shell, a small stratified sand mound containing skeletons, and in neither of these cases were sherds or other objects in association, though in Orange Mound fragmentary pottery is found with the shell to a certain depth below the surface. We cannot, however, determine these shell-heaps as positively belonging to the oldest shell-heaps of the river.

1 This unique object is figured and described in the Naturalist, August, 1893.
2 American Naturalist, July, 1894.
That certain shell-heaps were in process of construction at a time when some of the river mounds were built, we believe to be undoubtedly the case. Certain varieties of earthenware are common to various mounds and shell-heaps, while objects similar to all those discovered in Mulberry Mound, with the exception of the unique incised effigy on pottery, are present in sand mounds. And furthermore, immediately adjacent to Mulberry Mound was a small burial mound of sand which, as the nearest land is almost two miles distant, we think must be attributed to the makers of the shell-heap, especially as the earthenware, including fragments of tobacco pipes of similar pattern, was common to the mound and to the shell-heap.

It must not, however, be assumed from this that neighboring sand mounds and shell-heaps on the mainland are of necessity of the same period. We have seen how in the shell base beneath the Tick Island Mound, was discovered a piece of porous fiber-tempered pottery of a kind not present in the mound itself and never found by us in any sand mound of the river. Yet, after a certain depth, in the shell ridges of Tick Island this pottery is abundant.

Thus, having shown the connection between the shell-heap at Mulberry Mound and some of the sand mounds, through objects common to them, we believe ourselves in a position to trace relationship between Mulberry Mound and a class of presumably older shell-heaps by means of this species of earthenware.

This porous pottery, which Professor Holmes calls fiber-tempered ware, consists of clay originally reinforced by vegetable fiber, the destruction of which by exposure to fire in course of manufacture has left small canals. This variety of ware, as we have stated, is never present in the sand mounds, nor is it found by any means in all the sherd-bearing shell deposits of the river. We have met with it notably at Huntington's, near Cook's Ferry; in Orange Mound, where it begins about one
foot below the surface, continuing from three to four feet down, after which, in the central portion of the mound, no pottery has been discovered during many careful excavations; and in the great shell ridges of Tick Island where, beginning at three feet below the surface, its continuance has been observed through six intervening feet to the base. This fiber-tempered ware is frequently marked by archaic decoration not found on the pottery of the sand mounds, nor seen on the earthenware of many of the shell-heaps. Professor Holmes in his interesting paper has pointed out that this rude ware may have been constructed for shell-heap use alone, and has suggested that curved decorations frequently found upon it are not characteristic of earliest types. While admitting the probability of this, we are still inclined to the belief that the presence of this pottery marks the earlier shell-heaps, though not the earliest which are characterized by an absence of pottery, the latest class holding sherds similar to the commoner varieties met with in the sand mounds.

At a depth of about thirteen feet from the surface in Mulberry Mound fragments of this fiber-tempered ware are met with at intervals through the three remaining feet to the base, indicating, we believe, the abandonment of one class of ware for another of considerably better material; and thus, as we started to show, connecting the inception of Mulberry Mound with, let us say, the middle period of the shell-heaps, a point to which additional probability is lent by the paucity of relics other than sherds characterizing the lower six feet of Mulberry Mound.

In the shell-heaps of the river we have discovered nothing of necessity connecting them with the sand mounds of which Mt. Royal is a type. The beautifully polished and tapering hatchets, the pottery of erratic design, ornaments and ceremonial objects of stone have in no instance rewarded our search in the shell-heaps, and we are compelled, therefore, to consider the question of the contemporaneity of this class of mounds with any of the shell-heaps an open one, possibly to be settled by the results of future investigation.

In this connection we would point out, since Mt. Royal and kindred sand mounds are in close proximity to shell-heaps, that the proximity of sand mounds to shell-heaps on that portion of the river where shell-heaps are met with may arise from the fact that these heaps of shell mark the choicest sites which a later people would settle upon in selecting places of abode long after the abandonment of the shell-heaps.

It will be well to bear in mind, moreover, in considering the contemporary origin of sand mounds and shell-heaps, that the presence of layers and pockets of shell in many mounds is not conclusive as to the use of shell-fish as food by the makers of the mounds, since adjacent shell-heap material might readily be, and doubtless sometimes was, used for purposes of stratification at a period subsequent to the abandonment of the heaps.

Taking all these facts into consideration, we have arrived at the conclusions given at the outset of this note, which, for emphasis, we repeat here:—

1. That no evidence so far discovered connects the oldest shell-heaps with the sand mounds.
2. That while we found no fiber-tempered ware in the sand mounds, the presence of burials in sand in Orange Mound beneath strata containing this ware indicates at least a beginning of the mound form of burial.

3. That certain shell-heaps probably, and Mulberry Mound certainly, were contemporary with some of the sand mounds.

4. That absolutely nothing so far discovered indicates a connection between any shell-heaps and the class of mounds characterized by layers of artificially colored sand, abundance of finely wrought polished hatchets and mortuary earthenware of fanciful pattern.

As to Copper from the Mounds of the St. John’s.¹

Note.—The chemists, who made analyses given on pages 34 and 39 of Part I, now state that lead was present in the sulphuric acid used by them. These analyses are therefore valueless, and are withdrawn, as are remarks on copper on page 35 of Part I.

Before proceeding to discuss the copper found in various mounds of the St. John’s, we wish clearly to define certain terms as they will be used by us during the course of this inquiry.

Native Copper.—Native copper is metallic copper found in nature, often containing other elements such as silver, iron, etc.

Copper Ore.—When copper is found in chemical combination with other elements it forms an ore, as for instance, the oxide, the carbonate, the sulphide, etc.

Melting and smelting.—To melt is to reduce to a liquid state through the agency of heat.

To smelt is to recover the metal from the ore by the aid of heat, at times the employment of certain fluxes and the use of carbon in the case of copper. Thus, it is clear that to aborigines conversant with the melting of copper, the art of smelting might be unknown.

For the sake of clearness, we shall take up, under different headings, the copper of the river mounds, its workmanship, its composition, and its origin.

Copper Objects of European Design.

With one possible exception, a hawk-bell, a favorite gift and medium of barter from the time of Columbus, found with iron and glass near the surface of the mound.

¹ Sincere thanks for valuable assistance are returned to Alexander Agassiz, Esq.; to James R. Cooper Esq., Superintendent of the Lake Superior Smelting Company; to Professor Frank Hamilton Cushing; to J. B. Eckfelft, Esq., Chief Assayer U. S. Mint, Philadelphia; to Dr. Persifor Frazer; to Dr. Harry F. Keller; to A. R. Ledoux, M.S., Ph. D.; to G. W. Lehmann, Ph. D.; to Dr. Edward D. Peters, Jr.; to Professor J. W. Spencer, State Geologist of Georgia; to A. L. Walker, Esq., Consulting Engineer, Old Dominion Copper Co., Baltimore.

To Professor James Douglas, President of the Copper Queen Mining Company, of Arizona, we are especially indebted for continuous advice and assistance in the preparation of this paper, and for the loan of many books and pamphlets otherwise inaccessible.

It is only fair to state that no one of the above-named gentlemen is responsible for all our statements and conclusions as to copper.
at Dunn's Creek, no article of copper distinctly of European workmanship has been met with by us in the mounds of the St. John's. Articles of brass, of whose origin no doubt can exist, are of course not under consideration.

**Copper Objects of Aboriginal Design.**

Before proceeding to discuss objects of copper discovered by us in the mounds of the St. John’s, which, it is strongly our belief, are of aboriginal design, we wish earnestly to call the reader’s attention to the admirable paper\(^1\) by Professor Cush- ing, which we regret our space forbids us to quote at length.

In this paper it is clearly shown how the most complicated designs in sheet copper hitherto brought to the attention of archaeologists can be reproduced with purely aboriginal tools, and how the sheets can be beaten from native copper with the aid of annealing. As to annealing we shall speak in another portion of this paper.

The reader of the two parts of our report will recall that from five mounds\(^2\) of the St. John’s, whose contents gave no evidence of necessity connecting them with a period subsequent to the Conquest, numerous objects of copper were taken by us, including ornaments of sheet copper with various repoussé designs, beads of sheet copper and beads of wood, shell and limestone copper-coated, jaws of mammals encased in sheet copper, copper effigies of the serpent and of the turtle, and piercing implements of hammered sheet copper. These piercing implements, of which the longest measured 19 inches, seemed upon superficial examination to be wrought of solid copper. A careful inspection, however, showed them to be made in at least two different ways; some from strips of thick sheet-copper hammered over on itself and rounded by hammering, others of many thicknesses of copper in thin encircling sheets beaten into very close contact.

Now this class of objects, deriving its material from sheet copper of various thicknesses, represents about all the work in copper so far met with on the St. John’s. We shall, therefore, confine ourselves to it, and not include in this inquiry articles found in other sections, wrought from masses of solid copper, such as “celts,” bracelets, heavy breast-pieces, and the like, whose material and manufacture by cold hammering, so far as we know, is believed by none to be other than aboriginal. In fact, Professor Putnam informs us that such implements and ornaments have been reproduced under his direction without the intervention of heat.

The copper work of the St. John’s is characterized by the following features:

1. The invariable lack of uniformity in size. If the reader will examine the representations of objects from Mt. Royal and other mounds, it will become apparent that no two articles coincide exactly as to dimensions.

2. The great diversity of shape and ornamentation. In all our mound work we have discovered no two objects exactly alike. It is quite evident that had a

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\(^1\) Primitive Copper Working, American Anthropologist, January, 1894.

\(^2\) Grant Mound, Mound on St. Augustine Road, Mound on Tick Island, Mt. Royal, and Mound in pine woods west of Duval’s.
Fig. 75. Ornament of sheet copper, repoussé decoration, Mt. Royal. (Full size.)

Fig. 76. Piercing implement showing manufacture from sheet copper, Mt. Royal. (Full size.)

Fig. 74. Piercing implement of copper, Mt. Royal. (Full size.)
supply of staple sizes for commercial purposes been stamped from sheet metal by
the Whites, exact duplicates must necessarily occur in the mounds.

3. Striae in depressed surfaces, giving evidence of the conferring of the design
by pressure and motion as shown in the paper of Professor Cushing.
We are, therefore, of the opinion that aboriginal workmanship on the copper
of the river mounds may be conceded.

Sheet Copper of Aboriginal Production.

But here we are brought face to face with another question. It has been
alleged by some that, granting aboriginal work on copper, the sheets of metal may
have been obtained through White contact, a suggestion too plausible to be dismissed
without serious consideration.

We shall first consider the mechanical evidence of aboriginal work.
The sheet-copper ornaments do not present a uniform thickness, as would be
the case had the metal been rolled or hammered by European artisans and stamped,
the same specimen sometimes decreasing in thickness to almost a cutting edge on
one side. Moreover, a number of plates give evidence of a species of patchwork
where smaller sheets are joined together to furnish one of the requisite size.
While present in a number of cases, this curious aboriginal custom is especially
emphasized in the case of the copper breast-plate found by us at Mt. Royal.

This breast-plate, it will be recalled, was exhumed from the great Mt. Royal
mound at a depth to guarantee original deposit.

We have requested Dr. M. G. Miller, who was present at the discovery of
all the copper met with by us, carefully to examine and to describe the two copper
plates constituting the breast-piece, one of which was figured as frontispiece of
Part I, while the representation of the other occupies a similar position in this
volume.

"The two plates of copper composing the chest-piece were each about 10-5
inches square, and when found were separated by a woven vegetable fabric.

"The anterior plate, restored in the frontispiece of Part I, unfortunately, is
now in such a fragmentary condition that a complete description of its structure is
impossible. Moreover, a thick coating of carbonate upon the surface of the frag-
ments adds to the difficulty. On certain pieces this coating presents a delicate hair-
like structure, suggesting the idea that the surface had been in contact with the
skin of some animal, but inspection under the microscope shows it at present to
consist of capilliform crystals.

"The decoration is impressed and is regular and well defined. It consists of
seven concentric circles surrounding a central perforation, and a conventional
aboriginal bird's head occupying the space between the circumference of the outer
circle and each corner. Between each head and its neighbor is a diagonally placed
elliptical figure. The edges of the decoration are slightly rounded and not sharply
cut as represented in the frontispiece. The impression varies somewhat in depth,
its maximum being about 2 mm.
"Owing to chemical changes, it is impossible to state the original thickness of the plate, but it is decidedly thinner than its companion. Variations in thickness are evident in different fragments, but taken as a whole they represent a sheet of remarkable uniformity.

"At certain points, during the process of working, the plate had been beaten or ground through, and here an interesting feature presents itself. To render the plate fit for use it was necessary of course thoroughly to repair such a defect. Accordingly the margin of the opening was worked to a fine edge, against the surface of the plate was then applied a thin sheet of copper of size sufficient to cover the hole, and copper rivets were driven through from .25 to .5 of an inch apart to hold it firmly in place. The rivets were placed not only along the margin of the patch but through the body also to fix solidly the superimposed portion of the plate. The task was finished by pressing the margin of the hole as closely as possible against the patch beneath, and by working off the rivet ends projecting on that surface. The delicacy of the work may be judged by the fact that even at the present day, after long exposure to the action of the elements, it requires the closest scrutiny, after cleaning the surface with acid, to determine the location of the rivets and the line of repair. This of course refers to the exposed surface of the plate, the rivets and patch being clearly evident on the opposite side. The patch was not cut to fit closely the part repaired but extends well beyond, and presents a rough, irregular, unworked margin as though the piece had been hammered from a small lump of metal.

"That this work was done before the completion of the plate, and not to repair holes made during subsequent use, is shown by the way in which the patches participate in the decoration.

"But this process was resorted to not only for the repair of such defects, but for the extension of the sheet as well. Along one side of the plate a strip over an inch wide and several inches long has been attached by riveting along the inner edge while the marginal portion has been turned upon itself and closely pressed against the other surface.

"The posterior plate, about twice as thick as its companion, is from 1 to 1.5 mm. in thickness; weighs 15 ounces avoirdupois, and, thanks to its greater strength, is comparatively well preserved.

"The decoration, shown in the frontispiece of this report, is remarkable for the symmetry of the work. It consists of a central perforation1 surrounded by seven concentric circles, while the space between the outermost circle and each corner is occupied by an hour-glass arrangement of bars with five parallel bars upon one side (Fig. 77).

"Certain irregularities, however, are evident. The central elevation (M) of the figure in the lower right hand corner is oblong, while the corresponding portion of the other figures is square in outline. The first bar to the left of M is much narrower than the others. The inner half of the hour-glass in the upper figures is

1 Omitted in the illustration.
CERTAIN SAND MOUNDS OF

composed of seven bars, while in the lower figures there are eight in the corresponding space.

"On this plate also the carbonate forms a thick coating, and interferes with a thorough examination. However, a close scrutiny shows the plate to be made of two sheets overlapping along the margin. The larger sheet had been split to the depth of about half an inch near the middle of one edge, and into this slit had been inserted the edge of the smaller sheet, so that one-half of the margin of each sheet

overlapped on one surface and the other half on the opposite surface. In this position they were riveted together.

"The arrangement is indicated on Fig. 77, in which the line A, B, represents the margin of the smaller sheet inserted into the split edge of the larger sheet at C. The heavy portion of the line, A, C, indicates the free margin of the smaller sheet on the presenting surface of the plate, while the dotted portion, B, C, is the con-

Fig. 77. Lower plate, copper breast-piece, showing use of rivets, Mt. Royal. (Half size.)
THE ST. JOHN'S RIVER, FLORIDA. 219

tinuation of the same margin on the opposite surface. The line, D, C, represents
the margin of the larger sheet in the same plane as A, C, while E; G, is the con-
tinuation of the edge on the other surface. At X are the rivets which have been
driven through to hold the sheets together. Those represented are such as could
be detected by a close inspection of the surface, and were subsequently determined
positively by the use of acid. Undoubtedly a thorough cleaning of the surface
would bring others to light.

"Here we have an excellent illustration of the production of a plate of desired
size by the process of joining by rivets two smaller sheets, the larger of which con-
stitutes about two-thirds of the finished plate. The same procedure has been fol-
lowed in the production of several of the smaller ornaments in the collection, while
in no instance is there evidence of either soldering or brazing, methods which one
would certainly expect to note were the articles of European origin.

"At several points on the surface, H, K, L, where a tendency to exfoliation was
evident, rivets were used to hold the loosened edges in place. This is especially
marked near the margins and in the corners. The letters indicate only the most
evident of the rivets, many others undoubtedly being hidden under the coating of
carbonate.

"The exfoliation, it will be observed, arose not after long exposure in the
mound, but during the process of construction of the sheet as evidenced by the
rivets. This condition is frequently observed in hammered masses of copper, and
in copper ornaments and implements obtained from mounds, and may aid in deter-
mining such articles as of aboriginal origin.

"At several points on the depressed surface of the ornamentation may be seen
striae, which have probably come from the rubbing of some implement used to force
the copper into corresponding depressions of a mold.

"In finish, this plate does not equal its companion, though both surfaces had
received a certain amount of attention. The line of union of the two sheets can
be readily followed throughout the greater part of its course; the conjoined edges
are irregular, and were not so carefully pressed into the underly sheet."

From this description we are of the opinion that these plates, with their
ingenious system of repair and extension\(^1\) by the aid of rivets, may not under any
circumstances be attributed to the handiwork of artisans of Europe.

MOUND COPPER ARCHAEOLOGICALLY CONSIDERED.

In estimating the epoch of construction of mounds, the mounds themselves
are the most reliable witnesses, and any class of objects found therein is best known
by the company it keeps. By consulting the detailed descriptions of the copper-
bearing mounds of the St. John's given in this report, it will be seen that the objects
of copper were from the base and the body of the mound, associated with products
distinctly of aboriginal art, such as polished hatchets of stone, vessels of earthen-

\(^1\) Professor Putnam has referred to the use of rivets for repair, and recently has discovered the ex-
ware, and ornaments of shell, but never with articles indicating a knowledge of Europeans as exemplified by implements of iron, beads of glass, brass, pewter, and glazed pottery. It is, indeed, a hypothesis not to be entertained that later Indians in possession of these products of the Whites, through gift, barter, or plunder, in these mounds interred European copper alone, and sedulously refrained from placing with the dead, iron axes, glass beads, or the paint of commerce, and many kindred articles, all of which they so highly prized, and all of which are found on the St. John's with the superficial burials.

As we have pointed out in our note on the probable comparative age of the river mounds, archaeologists are agreed that when in a class of mounds no article of European manufacture is met with other than superficially, these mounds may be classed as of a period antedating the coming of the Whites, and Professor Putnam has so clearly expressed this view that we quote here a portion of a personal letter from him.

"Just after I wrote my little paper on copper in the Museum as the beginning of a series of papers on the use of metals, copper began to come in from our Ohio explorations in a wonderful manner, until we now have copper in such abundance that a paper on the subject would be a volume. We have it hammered and cut into all manner of shapes—implements and ornaments—and with it have come several lots of ornaments made of meteoric iron—implements and ornaments—and also considerable silver (ornaments) and a little of gold. All these metals are hammered and cut, and we have the copper in all stages from the rough nuggets, through those partly hammered to the sheets and the objects cut from them. To consider this the work of Europeans is an absurd perversion of the facts before us; and yet just because the facts do not agree with the theories of some who would have all facts drop into their theories, or else throw them out of consideration, these objects are spoken of as unquestionably of European origin, traded to our old mound building people of the Ohio valley by Whites since the settlement of the country.

"I am confident that you are right in your conclusion, when, after the careful examination you made at Mt. Royal, you did not find anything derived from the white man, such as glass beads, brass, etc., that all the work was native, the copper plates included.

"I have explored several sites (villages and burial) which were known historically, and I have always found glass beads, brass kettles, pewter mugs and plates, brass buttons and iron knives and axes, etc., etc., in the graves or in the refuse piles and hearths of the wigwams, mixed with native objects, and when, after a thorough and extensive exploration of any place such objects of European origin are not found, we have no right to doubt as native what we do find, no matter what peculiar things may occur."

THE COPPER FROM A CHEMICAL STANDPOINT.

We are, however, not compelled to base our conclusions as to the origin of the copper solely upon the testimony we have adduced. In the investigation of copper
found within the limits of the United States, for some reason, analysis has been hitherto entirely overlooked, and we shall now endeavor to throw some light upon copper from a chemical point of view.

Comparative Purity of Copper.—Before proceeding to discuss the copper of the mounds, early post-Columbian copper and native copper, it will be necessary for the reader to have a clear idea of the percentage of pure copper usually found in these commodities, that he may definitely draw his conclusions.

Unfortunately, so far as the presentation of a striking case is concerned, the difference between the purest of smelted copper and the most impure is relatively small, its range not greatly exceeding two per cent., thus each tenth of one per cent. is of marked importance.

At the present time, with the most approved methods of smelting, a copper 99 per cent. pure1 is considered of inferior grade, good commercial copper averaging, let us say, 99.5 per cent. pure.

On the other hand, opinions of many experts, backed by results of analysis, lead us to conclude that in early post-Columbian times commercial copper of a much higher degree of purity than 99 per cent. was not produced in Europe. As we shall see, lead was at that period intentionally introduced during treatment, while arsenic and silver, loath to part company with copper, were not successfully treated by the processes of those days. In fact, it is asserted that in recent years old German copper coins have been profitably remelted for their silver, and yet it was in Germany that smelting processes were best understood during early times.

It is evident, then, that a copper purer than the average of that produced under modern methods of smelting cannot have been derived from Europe during the sixteenth or seventeenth centuries.

The reader must bear in mind that analyses of copper from native metal, as given in works on metallurgy and the like, are not results obtained from specimens of mass copper prior to melting, but analyses made from ingots of cast metal which may have lost proportions of certain elements during treatment, or received others through accidental or intentional introduction. We have been unable in any work to find the result of a single analysis of native copper made prior to the ingot state, and have therefore submitted to various chemists a considerable number of authentic specimens from different sections:2 The percentage of pure copper in the native state previous to treatment is from 99.65 to 99.994.

The Copper of the Mounds.—So great a period of time has elapsed since the deposit of copper in the mounds that many of the sheets are carbonated and oxidized through and through, rendering absolute determination as to purity impossible. Where, however, a part of the metal remained we have been able to arrive at definite results.

1 At the present time "India sheets" and "brazier sheets," of a very low grade of copper, are shipped from England to India and China.
2 Since writing, our attention has been called to a statement by Rammeisberg (Mineralchemie, page 5) as to the impurities in Lake Superior copper. He reports iron 0.31 per cent. and silver entirely absent.
A portion of a piercing implement of hammered sheet copper from Mt. Royal, Florida, was submitted for analysis to Booth, Garrett and Blair, with the following result:—

"Copper ..... 99.897 per cent.
Lead ..... None.
Bismuth ..... None.
Iron ..... 0.0057 "
Gold ..... None.
Silver ..... 0.0012 "

99.039 "

They state that the sample was much corroded and although cleared with acid before analysis there was probably a little oxide remaining which they did not attempt to determine.

A second and smaller fragment of the same implement was submitted to A. R. Ledoux, M. S., Ph. D., whose determination was as follows:—

"This sample consisted of a pure copper core coated with a film of oxide and carbonate. We removed the film by dissolving in dilute acid until only the unoxidized core remained. This was analyzed and showed:—

"Copper ..... 99.85 per cent.
Silver ..... Trace.
Iron ..... Trace.

"No arsenic, antimony, lead, tin, zinc, nickel or cobalt is present. This is a very pure copper indeed."

The reader's attention is especially called to the great purity of this copper and to the absence of arsenic and antimony; and in this connection we introduce a portion of a letter from Dr. A. R. Ledoux, who has had the widest experience in such matters: "I now authorize you, if you wish, to quote me for publication to the effect that in my opinion the smelting processes of two or more centuries ago could not have turned out as pure an article as this from copper ores, and that in my opinion the piercing instrument was made from native copper of exceptional purity as is found in some of the Lake Superior mines and at a few other points."

A number of fragments of various ornaments of sheet copper from all parts of Mt. Royal mound were analyzed as a whole by Ledoux and Company, with the following result:—

"Arsenic ..... 0.038
Iron ..... 0.170
Nickel and cobalt ..... 0.030
Silver ..... Trace.

"Note: The sample contains very little metallic copper—not sufficient to make a satisfactory determination—consisting practically of a crust of carbonate and oxides of copper."
THE ST. JOHN'S RIVER, FLORIDA.

"The sample was specially examined for antimony, tin, lead, bismuth, and zinc, none of which was found present.

"The above figures are on the basis of the sample as received."

The metal used in this analysis was so altered that we must not regard the result as quantitative in relation to the copper as it originally existed. It is submitted as a qualitative analysis to show presence or absence of certain elements.

We have referred in another portion of this report to the discovery of articles of copper in the great Grant Mound, near Mill Cove, Duval Co., Florida. These objects, all in good state of preservation, were unwilling to sacrifice for purposes of analysis, and are, therefore, doubly grateful to Mrs. Martha A. Millspaugh, whose residence is near the foot of the mound, for a piercing implement of copper, 8:25 inches long and .12 of an inch in thickness, apparently made from a strip of thick sheet copper, and a fragment of another piercing implement 4 inches in length, with a thickness of .2 of an inch, made, as the reader will recall, from numerous thin sheets of copper closely hammered together. These objects were taken from the mound by a relative of Mrs. Millspaugh.

According to the analyses of Ledoux and Company the metal of these objects had the following composition:

"Fragment of piercing implement of sheet copper. Grant Mound, Florida. [The larger specimen.]

<table>
<thead>
<tr>
<th>Metal</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>99.730</td>
</tr>
<tr>
<td>Iron</td>
<td>0.034</td>
</tr>
<tr>
<td>Silver</td>
<td>0.023</td>
</tr>
</tbody>
</table>

"Note: The sample was examined for lead, bismuth, arsenic, antimony, nickel, cobalt, none of which was present.

"The sample also contains some oxygen, as it was impossible to entirely remove the oxide of copper from the surface of the sample. This oxygen is due to superficial oxidation, and is not an essential ingredient of the metal."

"Fragment of smaller piercing implement from Grant Mound, Florida.

<table>
<thead>
<tr>
<th>Metal</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>99.720</td>
</tr>
<tr>
<td>Iron</td>
<td>0.044</td>
</tr>
<tr>
<td>Silver</td>
<td>0.015</td>
</tr>
</tbody>
</table>

"Note: The sample was examined for lead, bismuth, arsenic, antimony, nickel, cobalt, none of which was present.

"The sample also contained some oxygen, as it was impossible to entirely remove the oxide of copper from the surface of the sample. This oxygen is due to superficial oxidation, and is not an essential ingredient of the metal."

We have thought it well to include with these analyses, for comparison, results obtained from copper from mounds other than of Florida.

We are indebted to Thomas Wilson, Esq., of the National Museum, for a number of fragments of sheet copper "from grave A, Little Etowah Mound, Georgia."
These fragments, submitted to Booth, Garrett and Blair, were reported as follows:—

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold</td>
<td></td>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Silver</td>
<td></td>
<td></td>
<td>0.013 per cent.</td>
</tr>
<tr>
<td>Lead</td>
<td></td>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Copper</td>
<td></td>
<td></td>
<td>75.050 per cent.</td>
</tr>
<tr>
<td>Silicious matter</td>
<td></td>
<td></td>
<td>0.480</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>75.543</td>
</tr>
</tbody>
</table>

“This sample contained but a very little amount of copper in the form of metal, the great mass being either oxide or carbonate.

"Since we found no other metal present" in the sample than those given above, we feel justified in saying that the original metal was nearly pure copper, over 99 per cent."

To those who have examined or have read of the wonderful deposit of copper ornaments, etc., in the Hopewell Mound, Ohio, the results of thorough analysis will be of peculiar interest. We are indebted to Professor Putnam for “a fragment of a ‘breast-plate’ hammered and cut, a fair representative of the copper of the mound.”

This specimen was exhaustively examined by Ledoux and Company, who write as follows:—

“The piece of ornament from mound in Ohio submitted to us for analysis contains:—

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td></td>
<td></td>
<td>96.3100 per cent.</td>
</tr>
<tr>
<td>Antimony</td>
<td></td>
<td></td>
<td>0.0070</td>
</tr>
<tr>
<td>Silver</td>
<td></td>
<td></td>
<td>0.0450</td>
</tr>
<tr>
<td>Nickel and cobalt</td>
<td></td>
<td></td>
<td>0.0060</td>
</tr>
</tbody>
</table>

Note: The sample was carefully examined for arsenic, tin, lead, bismuth, and zinc, none of which is present. This analysis was made by removing adhering oxides and carbonates as far as possible, but the sample contained sand adhering to it and penetrating it to such an extent that it was impossible to remove it all. This accounts for the low percentage of copper; the metal would have undoubtedly run over 99 per cent. if freed from mechanical impurities and oxygen.”

Warren K. Moorehead, Esq., has kindly furnished us with an implement of copper from an Ohio mound which yielded to a partial analysis by Booth, Garrett and Blair:—

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold</td>
<td></td>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Silver</td>
<td></td>
<td></td>
<td>0.011 per cent.</td>
</tr>
<tr>
<td>Lead</td>
<td></td>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Bismuth</td>
<td></td>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Copper</td>
<td></td>
<td></td>
<td>99.678 per cent.</td>
</tr>
</tbody>
</table>

In this case no search was made for other elements.

1 The italics are ours.
2 The italics are ours.
During the present summer (1894) Gerard Fowke, Esq., has obligingly conducted for us investigations in a "double mound" on the farm of Mr. J. M. Van Meter, three miles south of Piketon, Pike County, Ohio.

With human remains, below the base, in a central position in the mound, were five sheets of copper averaging in size about 3 5 by 2 5 inches. One of these sheets, forwarded to Ledoux and Company, was reported upon as follows:

"Copper . . . . . . 99:9130 per cent.
Silver . . . . . . 0:0198 "
Arsenic . . . . . . 0:0026 "
Antimony . . . . Trace.
Iron . . . . . . 0:0233 "
Nickel and cobalt . . . . 0:0080 "

"Note: The above analysis was made after removing the superimposed film of oxides and carbonate from the sample. Special examination for lead, bismuth and zinc shows that none of these is present."

From these analyses of copper from the mounds we note the very high percentage of copper, the constant occurrence of silver and iron, the total absence of lead, the occasional presence in minute quantities of arsenic, of antimony, and of nickel and cobalt. In no case, however, does the amount of any impurity present, with the exception of silver and iron, greatly exceed a trace.

Copper after White Contact.—It is a noteworthy fact that in a great majority of cases where the discovery of copper with articles giving evidence of White contact is reported, the metal is in reality brass.

During all our researches on the St. John's in but one case have we found copper (and this was possibly bronze) in association with glass, iron and other products of Europe.

In the mound at Bayard Point, where alone on the river we have found, other than superficially, articles distinctly European, brass was met with, but no copper.

Professor Putnam, with the collections of the Peabody Museum to draw upon and with the warmest desire to aid us, has been able to furnish us brass alone from post-Columbian Indian village sites and graves.

From a post-Columbian Onondaga village site, Rev. W. M. Beauchamp, the well-known authority, kindly forwarded us a number of ornaments, etc., all of which were likewise of brass. We have it from this gentleman and from other sources that the copper arrow heads, so called, are of the same material, as also are the kettles usually spoken of as copper.

"Wood, in his 'New England Prospect,' published in 1634 (page 90), distinctly states that the Indians obtained brass from the English for their ornaments and arrow heads."1 We see, then, that much that has heretofore been considered copper is in reality brass, and that brass and not copper was as a rule furnished the Indians by the Whites, the natives being quick to take advantage of the superior character of the alloyed metal.

1 Squier, Aboriginal Monuments of the State of New York, page 188, et seq.
There is little doubt that we must look to Europe as the source of supply of such copper as came to this country during the possible post-Columbian mound building period.

Now the sulphide ores of copper are universally distributed throughout the world, supplying more than four-fifths of the copper in demand, while Europe has no great available district of wholly native copper as is found in the Lake Superior region of this country.

Of the ores of copper, the sulphide most stubbornly resists treatment, and in association with it are almost invariably certain elements, arsenic, antimony, and sometimes bismuth, whose absolute elimination even at this day it is impossible to accomplish by any process of smelting. In fact, the comparatively recent electrolytic process does not appear to entirely eliminate these elements when present.1

Even in the more amenable oxide ores from certain districts, a trace of arsenic, after refining, still remains, not sufficient, it is true, to interfere with the drawing, the rolling and the stamping of the metal, but nevertheless distinctly recognizable, and this we mention to disabuse the reader of the idea, prevalent in certain quarters, that oxide ores are necessarily non-arsenical. It is evident then that early European copper for commercial purposes must have contained ponderable quantities of arsenic or antimony or of both, with occasional presence of bismuth, if at the present day, with improved methods, these elements are to a certain extent present in the metal.

At the time of the discovery of America, the extraction of copper in Europe was practised by the Germans and the Italians, whose supplies were almost exclusively sulphide ores. Later the German processes were established in Wales.

Professor James Douglas, of New York, whose unceasing kind offices have so materially aided us in this paper, has placed in our hands a work2 containing much original and curious information relative to the introduction of smelting processes in Great Britain.

From this work we learn that the smelting of copper in the Swansea district (where fully nine-tenths of the copper of Great Britain is said to be reduced from the ore) was begun at Neath, in the year 1584; at Swansea, 1717-1720; at Taibach, 1727, etc.

On page 25 et seq. of the same work we find a curious communication regarding the earliest English smelting, containing references to the presence of sulphur, showing the ores to be sulphide, and allusions to the roasting of ore, which is not practised in the case of oxides.

As to antimony and arsenic we shall quote the quaint wording of the original: "And that water doth not only drawe the vitriall and coppris from the ure, but also divers other hurtfull humors, being by nature enemies to the Copper; as arsenick,

2 The Smelting of Copper in the Swansea District of South Wales, from the Time of Elizabeth to the Present Day; by Col. Grant-Francis, F. S. A. Second edition. London and Manchester, 1881.
sulpher, antimony, allome, and ironn." And again, "The ij corrupt humor is Arsineque, by nature a kinde of poysom, being in like manner a minerall substance, wilbe consumed w'th fire in to Smoke, w'ch is a vrey daungerous ayer or savor, and by his force maketh the copper white and brether then the sulpher doeth. This Arsineque is not onely in great quantitie in our copper ures, but is by nature so forceable of it self, that it is Lorde and Ruller over all the rest, and consumes both ye sulphur, and antimony, so y't thei ar not to be scene."

We have devoted considerable time during the preparation of this paper to the investigation of the range of impurities in the German and English copper of comparatively recent times, since it is evident that all impurities found in this copper at the present time must have existed to a greater extent at an earlier period.

Of many recent analyses of German copper we give three representative examples:—

<table>
<thead>
<tr>
<th></th>
<th>I.</th>
<th>II.</th>
<th>III.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>99·325 per cent.</td>
<td>99·357 per cent.</td>
<td>99·6125 per cent.</td>
</tr>
<tr>
<td>Silver</td>
<td>0·072 &quot;</td>
<td>0·072 &quot;</td>
<td>0·0292 &quot;</td>
</tr>
<tr>
<td>Gold</td>
<td>0·0001 &quot;</td>
<td>0·0001 &quot;</td>
<td>None.</td>
</tr>
<tr>
<td>Arsenic</td>
<td>0·130 &quot;</td>
<td>0·104 &quot;</td>
<td>0·0172 per cent.</td>
</tr>
<tr>
<td>Antimony</td>
<td>0·095 &quot;</td>
<td>0·067 &quot;</td>
<td>0·0023 &quot;</td>
</tr>
<tr>
<td>Bismuth</td>
<td>0·052 &quot;</td>
<td>0·051 &quot;</td>
<td>—</td>
</tr>
<tr>
<td>Lead</td>
<td>0·061 &quot;</td>
<td>0·062 &quot;</td>
<td>0·0200 &quot;</td>
</tr>
<tr>
<td>Iron</td>
<td>0·063 &quot;</td>
<td>0·065 &quot;</td>
<td>0·0039 &quot;</td>
</tr>
<tr>
<td>Cobalt</td>
<td>0·012 &quot;</td>
<td>0·010 &quot;</td>
<td>—</td>
</tr>
<tr>
<td>Nickel</td>
<td>0·064 &quot;</td>
<td>0·079 &quot;</td>
<td>0·2112 &quot;</td>
</tr>
<tr>
<td>Sulphur</td>
<td>0·001 &quot;</td>
<td>0·001 &quot;</td>
<td>0·0024 &quot;</td>
</tr>
<tr>
<td>Oxygen</td>
<td>0·1166 &quot;</td>
<td>0·1574 &quot;</td>
<td>0·0752 &quot;</td>
</tr>
</tbody>
</table>

99·9917

100·0255

99·9739


In Percy's Metallurgy, we have various analyses of modern copper of commerce. In twenty-nine specimens of English tile, best selected, sheet copper, etc., all but two, in which traces are present, contain ponderable quantities of arsenic. Antimony is included in traces in eleven instances and in eight by weight. We find bismuth in twenty-five of these analyses in quantities sufficient for exact determination, and traces in the remaining four.

Copper ores, mainly sulphides, are found in various parts of Italy, though most of the copper used by the Romans was obtained from the Island of Cyprus. According to G. Jervis (I tessori sottoanei dell' Italia, Turin, 1874, Vol. II, page 439), the mines of Monte Catini in the Province of Pisa were worked about

the middle of the fifteenth century. Toward the close of the century, in 1494, they were abandoned, but reopened early in the sixteenth century and operated intermittently. According to Jervis these are among the richest copper mines of Europe. The ores are sulphides.

Another copper mine of importance is that of Ravamonte, near Agordo, in the Venetian Alps, which was operated, according to Jervis (op. cit., Vol. I, page 332), so far back as the fifteenth century. The process employed there for the extraction of copper is described by Haton, Percy, and Rivot.

Percy (Metallurgy, Vol. I, page 439) says: "The process appears to be of comparatively ancient date; but I have not been able to trace its history with certainty. At the present time (1861) it appears to be carried on with great skill at Agordo, where it is stated to have been first introduced in 1692 by a Prussian of the name of Weyberg."

The copper, according to Schnabel's Metallhüttenkunde, contains:—

<table>
<thead>
<tr>
<th>Element</th>
<th>Per cent.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>0.64</td>
</tr>
<tr>
<td>Antimony</td>
<td>0.04</td>
</tr>
<tr>
<td>Lead</td>
<td>0.20</td>
</tr>
<tr>
<td>Silver</td>
<td>0.10</td>
</tr>
<tr>
<td>Sulphur</td>
<td>0.04</td>
</tr>
</tbody>
</table>

We shall not occupy space with farther analyses of Italian copper, the impurities of which, as a product of sulphide ores, the reader is by this time in a position to divine.

Now let us consider results of analyses of copper used by Indians after contact with the Whites.

We are indebted to David Boyle, Esq., of the Canadian Institute, Toronto, for a fragment of copper taken by him from a grave of the Tobacco Hurons, near that place. In these graves are articles unquestionably of European origin.

This fragment submitted to Dr. A. R. Ledoux, was analyzed and reported upon as follows:—

<table>
<thead>
<tr>
<th>Element</th>
<th>Per cent.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>98.970</td>
</tr>
<tr>
<td>Silver</td>
<td>0.084</td>
</tr>
<tr>
<td>Iron</td>
<td>0.057</td>
</tr>
<tr>
<td>Arsenic</td>
<td>0.160</td>
</tr>
<tr>
<td>Antimony</td>
<td>0.150</td>
</tr>
<tr>
<td>Nickel and cobalt</td>
<td>0.070</td>
</tr>
<tr>
<td>Lead</td>
<td>0.300</td>
</tr>
</tbody>
</table>

"The sample contains no bismuth, tin or zinc. The low percentage of copper is partially due to oxygen which it was impossible to remove entirely from such thin samples. This copper is, as you will note, of inferior grade."

The considerable collections of post-Columbian Indian relics of Mr. W. W. Adams, of Cayuga Co., N. Y., largely made on the spot by him, contained no specimens of early post-Columbian copper other than ears of copper on two kettles of brass, and in one instance copper rivets joining together two sheets of brass.
which had probably formed part of one of those kettles which archaeologists usually incorrectly describe as of copper.

The copper ears of a kettle from a Cayuga Iroquois grave, Venice, N. Y., found in association with glass beads and other articles of European manufacture, yielded to the analysis of Ledoux and Company the subjoined result:

<table>
<thead>
<tr>
<th>Element</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>98.520 per cent.</td>
</tr>
<tr>
<td>Lead</td>
<td>0.362</td>
</tr>
<tr>
<td>Silver</td>
<td>0.026</td>
</tr>
<tr>
<td>Antimony</td>
<td>0.136</td>
</tr>
<tr>
<td>Arsenic</td>
<td>0.127</td>
</tr>
<tr>
<td>Iron</td>
<td>0.016</td>
</tr>
<tr>
<td>Nickel and cobalt</td>
<td>0.211</td>
</tr>
<tr>
<td>Bismuth</td>
<td>Trace.</td>
</tr>
</tbody>
</table>

The copper rivets from Iroquois brass kettle, Fleming, N. Y., afforded too small a quantity of material to permit a complete quantitative analysis. Ledoux and Company report upon them as follows:

<table>
<thead>
<tr>
<th>Element</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>97.03 per cent.</td>
</tr>
<tr>
<td>Lead</td>
<td>Present</td>
</tr>
<tr>
<td>Silver</td>
<td>Present</td>
</tr>
<tr>
<td>Iron</td>
<td>Present</td>
</tr>
<tr>
<td>Cobalt</td>
<td>Present</td>
</tr>
<tr>
<td>Nickel</td>
<td>Present</td>
</tr>
<tr>
<td>Arsenic</td>
<td>Present</td>
</tr>
<tr>
<td>Antimony</td>
<td>Present</td>
</tr>
<tr>
<td>Bismuth</td>
<td>None.</td>
</tr>
</tbody>
</table>

Note: This is an exceedingly impure copper. The above elements, while determined only qualitatively, are present in very considerable quantities, apparently greater than in any of the samples we have hitherto examined for you. The lead is especially high.

We regret that, after many months of earnest endeavor, including extended correspondence with those in all parts of the country likely to have it in their power to aid us, we have been unable to secure other specimens of European copper which had seen service with American aborigines, though abundance of brass was obtainable.

We shall now take up the important question of the presence of lead in European copper. The introduction of lead during treatment was included in the German method of smelting and with this method was adopted in England. Especially was lead a feature in sheet and drawn copper.

The translators of Percy’s Metallurgy, in summing up the results of many analyses, inform us that lead constituted an almost invariable element in wire and sheet copper, basing their conclusion on the results of a considerable number of analyses of English sheet and drawn copper, all of which show the presence of lead, and we may add here that all similar works consulted by us, which cover the

1 Loc. cit.
ground to a period, say thirty years back, refer to the union of lead with copper used for the production of sheet copper and wire. Moreover, various experts consulted by us, consider that, while the introduction of lead was not invariable, its absence from any considerable number of specimens is good negative evidence against a European origin in early times. Even at the present day, many analyses of copper show the presence of lead, though sheet copper from certain sections or where the material has been obtained by electrolytic deposit, may give no evidence of it. But such recent copper, of course, is not germane to our subject.

*Lead has never been discovered in copper from the mounds nor is it ever present in native copper.*

We shall now examine results of partial analyses made for us, bearing strongly upon this point.

A number of fragments of sheet copper from various parts of Mt. Royal, submitted to Booth, Garrett and Blair, furnished the following result:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Silver</td>
<td></td>
<td>0.0315 per cent.</td>
</tr>
<tr>
<td>Gold</td>
<td></td>
<td>None.</td>
</tr>
<tr>
<td>Lead</td>
<td></td>
<td>None.</td>
</tr>
</tbody>
</table>

“The remainder is chiefly red oxide of copper.

“Assuming that all the copper is in the form of red oxide, the percentage of silver would be 0.0372 in the copper in the melted state.”

Several fragments of thin sheet copper from the mound west of Duval’s, Lake County, Florida, were submitted to Dr. Ledoux with a view to determination as to lead. The result was negative.

General Gates P. Thruston has kindly forwarded us several small fragments of sheet copper from the stone graves of Tennessee, in 15,000 of which, we are informed, no European object has ever been brought to light. Copper is far from abundant in these graves, and we are especially indebted to General Thruston for the sacrifice of his specimens. Unfortunately, the thin sheet copper was completely oxidized; lead could not be detected by analysis.

Professor Putnam, for whose deep interest in this investigation we must again express our gratitude, has placed at our disposal “a fragment of a copper breast-plate from a Tennessee stone grave.” A partial analysis showed the presence of silver, the absence of lead.

We are indebted to Professor Putnam also for a number of specimens of copper from Ohio, which are reported upon by Booth, Garrett and Blair as follows:

B. Piece broken from nugget of copper found with several others in a mound in Ohio:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Silver</td>
<td></td>
<td>Present.</td>
</tr>
<tr>
<td>Lead</td>
<td></td>
<td>None.</td>
</tr>
</tbody>
</table>

C. Fragment of a copper ornament from a mound in Ohio:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Silver</td>
<td></td>
<td>Present.</td>
</tr>
<tr>
<td>Lead</td>
<td></td>
<td>None.</td>
</tr>
</tbody>
</table>
"D. Fragment of a copper plate (breast-ornament) from a mound in Ohio:"—

"Silver  .  .  .  .  .  .  Present.
Lead  .  .  .  .  .  .  None."

"E. Fragment of a copper ear-ornament from a mound in Ohio:"—

"Copper  .  .  .  .  .  99.77 per cent.
Silver  .  .  .  .  .  .  Present.
Lead  .  .  .  .  .  .  None."

"F. Fragment of copper ear-ornament from mound in Ohio:"—

"Silver  .  .  .  .  .  Large quantity.
Lead  .  .  .  .  .  .  None."

"G. Ear-ornament of copper covered with meteoric iron, from mound in Ohio:"—

"Gold  .  .  .  .  .  .  None.
Lead  .  .  .  .  .  .  None.
Silver  .  .  .  .  .  .  Traces.
Nickel  .  .  .  .  .  .  Considerable amount.
Iron  .  .  .  .  .  .  Large amount.
Copper  .  .  .  .  .  .  Large amount.

"This sample being oxidized through and through, no attempt was made to separate the two layers. The nickel, of course, was present in the iron."

In contrasting the analyses of post-Columbian copper with those of the copper from the mounds we note: (1) The greater percentage of pure copper in the mound specimens. (2) That certain specimens of copper from the mounds have as impurities silver and iron only, while the elements present in European copper are never so restricted in number. (3) That in no case do the impurities present in a specimen of mound copper equal the extended list found in any sample of the early copper of Europe. (4) That when antimony or arsenic is present in mound copper the quantity is minute and at least nineteen and forty-five times less respectively than that in the early post-Columbian copper. (5) The presence of lead in European copper and its invariable absence from the copper of the mounds. (6) That it is evident that we need not look to Europe as a source of supply of the copper from the mounds.

Probable Source of Supply of the Copper of the Mounds.

The reader who has carefully followed the course of this inquiry to the present point has doubtless arrived at the conclusion that native copper alone possesses all the characteristics met with in the copper of the mounds, and we may add that no evidence as to aboriginal smelting within the limits of the United States has yet been adduced.

Before proceeding to consider the probable source of supply of mound copper, it may be well to say a few words as to native copper in general.
Native copper is entirely free from combined oxygen, which is always found in copper which has been in a state of fusion. Unfortunately, the thin sheets of hammered native copper usually met with in the mounds are so greatly oxidized exteriorly that total elimination of extraneous oxygen previous to analysis is a matter of great difficulty, hence percentages of oxygen are frequently reported. Therefore, except in the case of pieces of copper cut from solid implements, the presence or absence of oxygen is not a final test.

All native copper, so far as we have been able to learn, contains a percentage of silver. The metal is finely distributed, and except in the case of occasional masses of copper from Lake Superior, to which reference will be made later, its presence is not visible in copper from North America so far reported.

Crystallized native copper from Lake Superior, which James R. Cooper, Esq., Superintendent of the Lake Superior Smelting Company, kindly has had analyzed, yielded 2.74 ounces of silver per ton (.0093 per cent.), while the average amount of silver in ordinary "Lake" copper is reported by the same high authority to be about 6 ounces to the ton (.0206 per cent.).

Unfortunately for exact determination the presence of silver in copper does not of necessity indicate native copper, unless the silver is visibly present in streaks, seams, or flakes, since silver is very frequently found in the ores of copper, and its elimination, as we have stated elsewhere, is difficult.²

Lead, we believe, has never been discovered in native copper.³ It is true that its presence has occasionally been reported in ingot copper from Lake Superior, but this result is in every case due to the gangue or to impurities in the furnaces. The intentional introduction of lead into drawn copper from the "Lake" was discontinued thirty years ago. As to the absence of lead from "Lake" copper previous to treatment, all experts are absolutely unanimous.

Native copper, owing to absence of oxygen, is of a lighter color than copper when melted and cast or smelted from the ore.

We are indebted to James R. Cooper, Esq., for another method to distinguish native copper from copper which has undergone treatment.

"You can readily determine," he writes, "the fact whether the 'mound' copper is a native metal, or whether it has been smelted.

"Take a piece of the mound copper and hammer it thoroughly to harden it, then bend it double and hammer it down flat. If it is native copper it will stand the test without a show of cracking, but if it is smelted copper it will break short in bending double. * * * The fracture is entirely different. The fracture of native copper is more like that of lead when it is bent back and forth and finally broken."

¹ Practically all "Lake" copper is native.
² Silver is not volatile, as are some other elements, hence the tenacity of its union with copper.
³ A certain writer has reported the discovery of lead in South American native copper. This report lacks confirmation. Moreover, this assertion was made at a time when the chemistry of copper was in its infancy. There is, against the discovery of lead in native copper, the fact that native lead, if found at all, is of extreme rarity. Lead ore may exist in the gangue.
THE ST. JOHN'S RIVER, FLORIDA.

We shall now consider the probable source of supply of the copper of the St. John's.

Mexico.—Of Mexico but little can be said. Native copper is found in various parts of the country, and it is probable that the natives had learned to smelt from superficial carbonates of exceptional purity, the wood of the fire furnishing the carbon.1

We are aware that possible means of communication between Mexico and Florida existed before and at the time of the Discovery. We are told by Herrera2 that Columbus found on the Island of Pine Trees, in the Gulf of Honduras, "an Indian Canoe, as long as a Galley, and eight Foot in Breadth, laden with Western Commodities, which it is likely belong'd to the Province of Yucatan." On board, among various commodities, were "small Hatchets made of Copper to hew Wood, small Bells, and Plates. Crucibles to melt the Copper."

And again we read that the natives of Yucatan made long sea trips,3 while Bernal Diaz describes,4 at the discovery of that province (1517), the approach of canoes with paddles and sails, large enough to hold forty or fifty Indians.

No copper is found on the peninsula of Yucatan, the most probable point of departure, though we read of copper implements met with on the coast to the west not far distant,5 and trinkets, half gold and half copper, on the Island of Cozumel but twelve miles away.6

It is not likely, however, that the sea offered a method of regular communication between Mexico and Florida, a much more feasible journey being afforded by the overland route taken by Cabeça de Vaca on his escape from northwestern Florida to the Spanish settlements in Mexico.7 It is interesting to note, moreover, that on this journey he twice saw articles of copper.

We are of the opinion that a careful investigation of the mounds of Louisiana, Alabama and Georgia will yield other objects such as the copper plates from the famous Etowah mound, whose decoration surely points to Mexico.

We are indebted to Dr. Joseph H. Hunt for a specimen of native copper obtained at El Paso, said to have been brought in by Mexican miners. A partial analysis showed this to contain 0.0621 per cent. of silver, but no lead.

Howard S. Graham, Esq., has kindly presented us with a specimen of crys-

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1 For details as to Mexican copper implements see "Mexican Copper Tools," by Philip J. J. Valentini, Ph.D., Proceedings American Antiquarian Society, Worcester, 1879.


3 Also "Notes on the Copper Objects from North and South America Contained in the Collection of the Peabody Museum," by Professor Putnam, in the XV Annual Report of the Museum.


5 Ibid., Vol. IV, page 183.


8 Ibid., Vol. I, pages 56 and 57.

tallized native copper, found at a considerable depth in his mine in the State of Coahuila, Mexico. An analysis by Dr. Harry F. Keller showed:—

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>99·9521 per cent.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td></td>
<td>Trace.</td>
</tr>
<tr>
<td>Silver</td>
<td></td>
<td>0·0054</td>
</tr>
<tr>
<td>Antimony</td>
<td></td>
<td>0·0149</td>
</tr>
<tr>
<td>Arsenic</td>
<td></td>
<td>0·0168</td>
</tr>
<tr>
<td>Iron</td>
<td></td>
<td>Doubtful reaction.</td>
</tr>
<tr>
<td>Bismuth</td>
<td></td>
<td>99·9892 per cent.</td>
</tr>
</tbody>
</table>

“Gold, lead, tin, nickel, cobalt, selenium and tellurium were tested for with negative result.

“The gangue amounted to 0·0462 per cent. and was deducted before the above percentages were calculated.”

A quantitative analysis of this copper by Ledoux and Company yielded confirmatory results.

Cuba.—Pre-Columbian intercourse between Cuba and the mainland has never yet been conclusively shown by results of mound investigation, owing, perhaps, to our unfamiliarity with prehistoric art-products of the island and to the scanty archaeological work hitherto done on the Peninsula, which has kept within narrow limits the supply of objects on which to base conclusions.

Records as to intercourse before the Discovery are, however, explicit enough.

“It is certain,” writes Herrera,1 “that John Ponce de Leon, besides the main Design of making new Discoveries, as all the Spaniards then aspir’d to do, was intent upon finding out the Spring of Bimini, and a River in Florida, the Indians of Cuba and Hispaniola affirming that old people bathing themselves in them, became young again, and it was certain that many Indians of Cuba, firmly believing that there was such a River, had, not long before the Spaniards discover’d that Island, pass’d over into Florida in Quest of that River, and there built a Town, where the Race of them continues to this Day.”

And again we are told that Ponce de Leon, at the discovery of Florida, found there an Indian familiar with the Spanish tongue,2 conclusive proof of previous intercourse with the islands.

The reader of Part II will recall that in the great mound at Tick Island, Volusia County, totally levelled by us, a disc of copper was found about 6 inches below the surface. This disc, about 3 inches in diameter, was covered with a beautiful coat of polished patina, a sure guarantee of antiquity. In the Tick Island mound, neither superficially nor otherwise, were any objects discovered hinting at White contact, and it is well to bear in mind that while intrusive burials are always superficial, the converse is far from being the case and that many objects of undoubted antiquity are discovered on or near the surface. This disc, which a mar-

original row of indentations showed to be of aboriginal workmanship, while not of necessity contemporary with the mound, we believe to be of considerable antiquity from what we have stated, and from what we shall proceed to show.

We are indebted to Dr. Pulaski F. Hyatt, United States Consul at Santiago de Cuba, for specimens of native copper obtained by him especially for us by means of a messenger sent to the Cobre (copper) mountains, at that point about ten miles distant from Santiago de Cuba and from the sea. The specimens, boxed by Dr. Hyatt, in Cuba, were delivered by that gentleman to us in person.

A portion of this copper was submitted to Dr. A. R. Ledoux for analysis, to whom was also entrusted a section of the copper disc from Tick Island. The reader may draw his own conclusions from the striking results as given below:

<table>
<thead>
<tr>
<th>Metal</th>
<th>Copper Disc, Tick Island</th>
<th>Native Copper, Cuba</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>99.835 per cent.</td>
<td>99.880 per cent.</td>
</tr>
<tr>
<td>Silver</td>
<td>Trace</td>
<td>0.0056</td>
</tr>
<tr>
<td>Arsenic</td>
<td>0.0089 per cent.</td>
<td>0.0087</td>
</tr>
<tr>
<td>Antimony</td>
<td>Trace</td>
<td>Trace</td>
</tr>
<tr>
<td>Iron</td>
<td>0.072 per cent.</td>
<td>0.019 per cent.</td>
</tr>
</tbody>
</table>

The samples were especially tested for bismuth, lead, tin, zinc, nickel, and cobalt with negative result. In each case a certain amount of oxygen was present, doubtless due in the case of the Cuban copper to oxidation extending into irregularities of the metal, which, in fact, was visible under the microscope. In the case of the disc, deep oxidation on either side was doubtless found impossible to eliminate.

Qualitative analyses of another portion of the disc and of the Cobre native copper were made by Professor F. A. Genth, Jr., with confirmatory results, while a qualitative analysis of the Cobre copper by Dr. Harry F. Keller was likewise corroborative.

In view of all this testimony we consider it probable that the Tick Island disc, whose high percentage of purity shows the copper to be native, was derived from Cuba, and shall look with interest for reports of further analyses of copper from the mounds of other sections of Florida.

Southern, Middle, and Eastern States.—The geology of Florida precludes the idea of any deposit of copper within its limits.

The late Colonel C. C. Jones, authority on the archaeology of the Southern Indians, tells us1 "Native copper exists in portions of Cherokee Georgia, Tennessee, North Carolina, and Alabama, but it is generally found in combination with sulphur and not in a malleable form." In this instance, however, this able writer is in error. Copper in union with sulphur becomes the sulphide, an ore and beyond the reach of aboriginal endeavor.

Professor Spencer, State Geologist of Georgia, informs us that native copper, if any, in his State, is too limited in quantity to justify the theory of an aboriginal source of supply.

1 "Antiquities of the Southern Indians," page 228.
While the occurrence of native copper is noted in our Southern, Eastern, and Middle States the quantity is comparatively small, and, as a rule, the metal is not superficial, and it is hardly probable that this scanty supply to any extent filled the needs of the peoples inhabiting these districts, though doubtless a native nugget, when found, was utilized.

New Mexico and Arizona.—It is probable that products of Arizona and New Mexico, to a certain extent at least, reached some of the Southern States, and possibly Florida.

Small quantities of native copper are found superficially in portions of these districts, but the well-known native copper mines of the Santa Rita Mountains, New Mexico, contain the metal beneath oxides and carbonates at a depth too great to have supplied aboriginal demand.

According to Cushing, to whose interesting paper we have already alluded, the melting out of nodules of native copper included in rock was practised by the aborigines of Arizona; though in no part of our country, it must be remembered, have objects of copper cast in molds been discovered.

If in any portion of the territory of the United States reduction from the ore was practised in prehistoric times, it will be found to have occurred in New Mexico and Arizona, where familiarity with the civilization of Mexico may have enabled the natives, with the aid of wood fires, to obtain the metal from very pure carbonate ores.

We are under obligation to James Colquhoun, Esq., General Superintendent of the Arizona Copper Company, of Clifton, Arizona, for much valuable information relative to the mines of Clifton. Native copper occurs but rarely. Samples have been obtained in small bunches from the sheet porphyry which covers the bulk of the surface of the Metcalf mine. At this mine, which is 9,000 feet north of the famous Longfellow mine, there were, thirteen or fourteen years ago, the remains of Indian workings, inconsiderable in extent and, in the opinion of Mr. Colquhoun, made for the purpose of extracting a beautiful green ore—oxidized copper-glance—to be used as a paint.

On the Longfellow, so far as known, only one stone hammer was found.

We are indebted to Professor James Douglas for a specimen of a native copper from the Copper Queen Mine, of Bisbee, Arizona, which, submitted to Dr. Harry F. Keller, was reported on as follows:

"The specimen furnished consisted essentially of metallic copper, thickly coated with cuprite (partly in fine crystals) and oxide of iron. This outer crust was carefully removed, and the greater part of the mass reduced to small chips on the 'planer,' a solid piece being reserved for the estimation of iron. The chips were further freed from oxidized material by careful picking under a strong lens, and subsequent stirring with water. A sample weighing over 100 grms. was thus

1 While melting was doubtless practised, we have no positive evidence that smelting was understood in Mexico, though there are good grounds for believing it, as given by Professor Putnam, XV Annual Report, Peabody Museum, page 128.
obtained; it exhibited a pure copper-red color, metallic lustre, and gave a specific gravity of 8.896.

All the elements likely to occur in the metal were carefully tested for: gold, lead, bismuth, arsenic, tin, tellurium, selenium, cobalt, and nickel were found to be absent; the analysis yielded:—

<table>
<thead>
<tr>
<th></th>
<th>I.</th>
<th>II.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>99.7587 per cent.</td>
<td>99.7620 per cent.</td>
</tr>
<tr>
<td>Silver</td>
<td>0.0039</td>
<td>0.0037</td>
</tr>
<tr>
<td>Antimony</td>
<td>0.0020</td>
<td>Not determined.</td>
</tr>
<tr>
<td>Iron</td>
<td>0.0491</td>
<td>0.0503 per cent.</td>
</tr>
<tr>
<td>Oxygen</td>
<td>0.1220</td>
<td>0.1094</td>
</tr>
<tr>
<td>Sulphur</td>
<td>Trace.</td>
<td>Trace.</td>
</tr>
<tr>
<td>Gangue (silica)</td>
<td>0.0144</td>
<td>0.0110</td>
</tr>
<tr>
<td></td>
<td>99.9501</td>
<td></td>
</tr>
</tbody>
</table>

"The oxygen is present partly as oxide of iron, and partly as cuprous oxide. If we deduct these admixtures, as well as the silica, it is seen that the metal itself contains 99.994 per cent. of pure copper."

The reader must bear in mind that the oxygen referred to was not present throughout the entire mass of copper as combined oxygen, which does not occur in native copper, but locally, as explained above. We think it well to make this explanation, as possibly all our readers are not fully informed as to the difference, and a misconception might arise.

James Colquhoun, Esq., has kindly forwarded to us samples of native copper from the Fry mine, Clifton, Arizona. This copper, submitted to Ledoux and Company, yielded the following results:—

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>99.210 per cent.</td>
</tr>
<tr>
<td>Silver</td>
<td>0.003</td>
</tr>
<tr>
<td>Iron</td>
<td>0.045</td>
</tr>
<tr>
<td>Lead</td>
<td>None.</td>
</tr>
</tbody>
</table>

"Note: The sample was examined for bismuth, arsenic, antimony, nickel, cobalt, none of which was present.

"The sample also contains some silicious matter not combined with the copper, but held mechanically in the interstices. As this could not be considered an impurity in the metal, the amount was not determined."

As this silicious matter was included in the preliminary weighing, its absence from the result accounts for the apparently low percentage of copper in the specimen.

The Lake Superior District.—As we have stated, the copper of the Lake Superior district, where abundant evidence of prehistoric mining exists, is native, and argentiferous to the extent of about six ounces to the ton. When this percentage is exceeded, the silver is visibly present in flakes, seams and streaks, from which at times quantities of native silver can be cut. In fact, "Lake" copper with almost
one-half native silver in mechanical combination has been reported. During all our investigations we have been unable to learn of native copper from any other locality on this continent, which is visibly argentiferous, and as the researches of others have had a like result, we are strongly of the opinion that implements or sheets of copper from the mounds, in which silver can be seen, may be considered as surely having derived their material from Lake Superior.

We are informed by Professor Cushing that an object of copper containing visible silver was found in northern Florida.

Mining was unsuccessfully attempted by the English at Lake Superior in 1771–1772, and it was not until 1844, after the admission of Michigan to statehood, that a steady output was furnished from the district.¹

From this it is evident that no "Lake" copper can have been furnished by Europeans during any possible mound building period.

So many evidences of prehistoric intercourse with regions to the south have been found in the mounds of our Western States that it is safe to assume that the Lake Superior district furnished the greater part of the copper in use by Southern Indians, which was doubtless traded for shell implements and ornaments, or for the raw material obtainable only on the seaboard or on the Gulf coast. Moreover, as aboriginal copper with visible admixture of silver has been found in the Southern States, it is virtually safe to assume that with such metal went other "Lake" copper in which silver is not perceptible.

Dr. Harry F. Keller, whose residence in Michigan as Professor of Chemistry in the Michigan Mining School at Houghton, gave him exceptional advantages in respect to analysis of "Lake" copper, has furnished us with the following unpublished analyses made by himself:—

`Native copper from the Tamarack mine,² Lake Superior.

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<thead>
<tr>
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<tbody>
<tr>
<td>Copper</td>
<td>.</td>
<td>.</td>
<td>99.8049</td>
</tr>
<tr>
<td>Silver</td>
<td>.</td>
<td>.</td>
<td>0.0151</td>
</tr>
<tr>
<td>Iron</td>
<td>.</td>
<td>.</td>
<td>0.0210</td>
</tr>
<tr>
<td>Silica</td>
<td>.</td>
<td>.</td>
<td>0.0193</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>99.8633</td>
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`Native copper from Kearsarge mine, Lake Superior.

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<tbody>
<tr>
<td>Copper</td>
<td>.</td>
<td>.</td>
<td>99.7627</td>
</tr>
<tr>
<td>Silver</td>
<td>.</td>
<td>.</td>
<td>0.0183</td>
</tr>
<tr>
<td>Iron</td>
<td>.</td>
<td>.</td>
<td>0.0223</td>
</tr>
<tr>
<td>Arsenic</td>
<td>.</td>
<td>.</td>
<td>Trace</td>
</tr>
<tr>
<td>Silica</td>
<td>.</td>
<td>.</td>
<td>0.0210</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>99.8243</td>
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² The vein in the Tamarack mine is conglomerate. Dr. Keller informs us, however, that the analysis was made from a good sized nugget. Such specimens are occasionally found in conglomerate mines.
These analyses are complete. Dr. Keller informs us that the shortage was due to the oxygen present as oxide of copper or of iron resulting from superficial oxidation.

Some of our readers will recall that extensive aboriginal mining operations were carried on at Isle Royale, in Lake Superior. We are indebted to Professor Edgar Kidwell, of the Michigan Mining School, for a specimen of copper from this island, which, submitted to Dr. Keller, was reported upon by him as follows:

"The material was very carefully separated from the rock through which it was disseminated. It retained 0.2561 per cent. of insoluble matter. An exhaustive examination of the metallic portion yielded the following values:

<table>
<thead>
<tr>
<th>Substance</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Copper</td>
<td>99.9314</td>
</tr>
<tr>
<td>Silver</td>
<td>0.0271</td>
</tr>
<tr>
<td>Iron</td>
<td>0.0068</td>
</tr>
<tr>
<td>Nickel</td>
<td>0.0037</td>
</tr>
<tr>
<td>Arsenic</td>
<td>Trace</td>
</tr>
</tbody>
</table>

99.9690

"Gold, lead, tin, bismuth, antimony, cobalt, manganese, oxygen, sulphur were tested for with negative result. The absence of other metallic impurities was indirectly ascertained in the course of analysis adopted.

"The specific gravity is 8.883."

Dr. Keller has made for us a partial analysis of copper in his possession, from the Phoenix mine. Of this he writes:

"The specimen from this celebrated locality was beautifully crystallized. It contained 0.962 per cent. of quartz, and after deducting this yielded:

<table>
<thead>
<tr>
<th>Substance</th>
<th>Percentage</th>
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<tr>
<td>Copper</td>
<td>99.9462</td>
</tr>
<tr>
<td>Nickel</td>
<td>None</td>
</tr>
<tr>
<td>Arsenic</td>
<td>Trace</td>
</tr>
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</table>

"This copper contains iron but scarcely a trace of silver."

We are indebted also to Dr. Keller for copper from the Quincy mine, Hancock, Mich. We append the result of a partial analysis made by him.

<table>
<thead>
<tr>
<th>Substance</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Copper</td>
<td>99.9765</td>
</tr>
<tr>
<td>Nickel</td>
<td>None</td>
</tr>
<tr>
<td>Arsenic</td>
<td>None</td>
</tr>
</tbody>
</table>

"Silver and iron are the only impurities, a strong reaction was obtained for the former, while the latter is present merely as a trace."

Professor James Douglas, who has so greatly aided us in this paper, has presented us with specimens of copper from the Quincy, Atlantic and Central mines of the Lake Superior District. These have been submitted to Ledoux and Company for partial analysis, who report:

"Quincy Mine, Lake Superior:

<table>
<thead>
<tr>
<th>Substance</th>
<th>Percentage</th>
</tr>
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<tbody>
<tr>
<td>Copper</td>
<td>99.93 per cent.</td>
</tr>
<tr>
<td>Nickel and cobalt</td>
<td>None</td>
</tr>
</tbody>
</table>

30 JOURN. A. N. S. PHILA., VOL. X.
Another partial analysis of the same copper yielded:

"Arsenic . . . . . . . 0·0010 per cent.
Silver . . . . . . . 0·0253 "
Antimony . . . . . . . None."

A partial analysis of the "Atlantic" copper showed:

"Arsenic . . . . . . . 0·0028 per cent.
Antimony . . . . . . . None.
Silver . . . . . . . 0·0012 per cent."

A partial analysis of the "Central" copper gave:

"Arsenic . . . . . . . 0·0016 per cent.
Antimony . . . . . . . None.
Silver . . . . . . . 0·0145 per cent."

We are indebted to Thomas Nelson, Esq., Secretary and Treasurer of the Osceola Consolidated Mining Company, for very beautiful specimens of copper from the Osceola mine, as to which Ledoux and Company make the following report:

"Copper . . . . . . . 99·9500 per cent.
Silver . . . . . . . 0·0111 "
Iron . . . . . . . 0·0290 "
Arsenic . . . . . . . Trace.

"Note: The sample was examined also for lead, bismuth, antimony, nickel, cobalt and zinc, none of which was found."

James B. Cooper, Esq., Superintendent of the Calumet and Hecla Smelting Works, in addition to much valuable information, has furnished us with a number of fine specimens from various mines from the "Lake" district, and we wish here to return thanks for his courtesy and promptness. A specimen of copper from the Franklin mine, furnished by Mr. Cooper, was analyzed by Ledoux and Company, with the following result:

"Copper . . . . . . . 99·90 per cent.
Silver . . . . . . . Trace.
Iron . . . . . . . 0·018 "

"Note: The sample was examined also for arsenic, antimony, lead, bismuth, zinc, nickel and cobalt, none of which was found."

The presence of nuggets of native copper has been noted in "the drift," and it is likely that aboriginal wants were to a certain extent supplied from that source.

We have obtained from Dr. A. E. Foote a nugget of native copper said to be from "the drift," Illinois, and its derivation from "the drift" at least is unmistakably evidenced by its rounded and water-worn appearance.

This copper, analyzed by Ledoux and Company, gave the following result:

"Copper . . . . . . . 99·930 per cent.
Silver . . . . . . . 0·007 "
Iron . . . . . . . 0·014 "
Nickel and cobalt . . . . 0·006 "
"Note: The sample contains no lead, bismuth, arsenic, antimony, or zinc."

As a result of these analyses, we see that in "Lake" copper, silver and iron are constant, and sometimes the only impurities; while arsenic, nickel and cobalt are occasionally present in minute quantities. Lead and bismuth are invariably absent.

All these characteristics Lake Superior copper has in common with the copper of the mounds.

We have found no antimony in "Lake" copper, but are of the opinion that a more extended range of analyses would occasionally show its presence in minute quantities.

Conclusions.

After a careful survey of the field, we have arrived at the following conclusions, based upon facts as set forth in this paper:—

1. That the so-called copper found with objects of European make along the St. John's and, we may add, in other portions of the United States, is almost universally not copper but brass; and, conversely, that brass does not occur with original deposits of copper in mounds otherwise containing only objects of unquestioned aboriginal origin.

2. That the workmanship on the copper of the mounds of the St. John's is aboriginal.

3. That the copper itself is of aboriginal production, the proof being mechanical, archeological, and chemical.

4. That such being the case, if copper plates cannot be produced without recourse to annealing, then we must concede to the aborigines a knowledge of that art.

5. That the copper of the mounds of the St. John's is native copper, as shown by its high percentage of copper, a percentage not obtainable by early smelting processes, and by its freedom from arsenic and antimony in some instances, and the very small percentage in others of these impurities which are found to a much greater extent in the early copper from the sulphide ores of Europe. In addition, lead, used in smelting processes of Europe and not eliminated from many of the ores, is present in earlier sheet copper, and is without exception absent from native copper and from the copper of the mounds.

6. That the Florida copper may have been derived from various sources, possibly in part from Mexico, New Mexico or Arizona, and probably to a certain extent from Cuba; but that the main supply was obtained from the Lake Superior region, most of whose copper is non-arsenical.

7. That copper in which silver is visibly present, has, so far as is known, for its only source of supply on this continent, the Lake Superior region.

8. Incidentally, that mound copper from other localities, including the copper of the famous Etowah plates of Georgia, and of the no less well-known Hopewell mounds of Ohio, is, like the Florida copper, aboriginal, having nothing in common with the products of the impure European sulphides and imperfect smelting processes of the fifteenth, sixteenth, and seventeenth centuries.
"Freak" Earthenware.

We have given this title to a class of objects of earthenware found in the mounds of the St. John's, and as yet unreported from any other section of the United States, objects to which no practical use can be assigned, and valueless save for mortuary purposes—freaks of fancy in earthenware!

In addition to fantastic forms, an absence of care in manufacture and inferiority of material characterize this type, which, it may be noted, is absent in the mounds where sherds given the outlines of arrow points are found with human remains.

These objects, as we have seen, were somewhat widely distributed on the river. They were represented in the Grant Mound not far from the river's mouth; their occurrence was noted at Mt. Royal, near Lake George; at Davenport, on the Oklawaha; at Duval's, Lake County; and in the sand mound in the pine woods two miles farther west; while even Thursby Mound, near Lake Beresford, superficially contained earthenware of this type. Farther south we have found no unbroken earthenware of any sort in the sand mounds.

This type, almost invariably perforated as to the base prior to baking, has at times the bottom omitted, as the reader may see by reference to Part I. Plate VI, Fig. 1; Part I, Plate IX, Fig. 2, and Part II, Plate XXII, showing plainly that since this earthenware was made for the dead alone, forms devoted to the use of the living were not of necessity imitated.

Curiously enough, bottomless vessels are reported from prehistoric graves of Germany, for which the discoverer suggests a use as drums.1 In regard to this attribution the French reviewer writes: 2 "Assuredly vessels without bottoms could contain neither liquids nor solids, but neither could the solid marble vases of the Athenian tombs have served a practical purpose, and involuntarily in this connection the bottomless vessels of the Dannides, placed by the ancient tradition in the lower regions, are suggested. It is always a temptation to attribute a symbolical meaning to mortuary paraphernalia, whose use we cannot fathom." (Translation.)

After all, it is not impossible that these bottomless vases served as mortuary deposits, as did those of Florida. Prehistoric customs of the old world and of the new sometimes show such striking resemblances. It is, however, interesting to learn that drums of earthenware have been discovered in Chiriqui.3

Since the first part of this Report went to press many new and curious specimens belonging to this "freak" type have been met with by us, and as before, always in mounds where the occurrence of sand artificially colored with red oxide of iron was noted, and always with implements of polished stone of graceful shape, though

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not necessarily in immediate association, but never, as we have before remarked, with any objects indicating European contact.

It is evident that prehistoric Indians fabricated this “freak” earthenware in the observance of some mortuary custom, whose meaning we cannot surely determine, though unquestionably there is a connection between bottomless vessels, vessels perforated as to the base previous to baking, and vessels with base perforation made after completion.

**Mutilation of the Base of Earthenware.**

Perforation of the base of earthenware vessels by fracture subsequent to their completion has long been noted as a custom prevalent in Florida in early times, and, according to Squier, in Oregon. The reason prompting this base perforation it is impossible, with certainty, to determine. Professor Holmes, in his able paper with the first Part of this Report, suggests that the mutilation was performed to kill the vessel, so to speak, that it might more appropriately accompany its lifeless owner. This we believe to be the true explanation, and not that this base perforation was practised with a view to lessen the incentive to plunder, since, as we have said before, the most precious possessions of the aborigines are found unbroken with this earthenware.

While the custom of perforating the base of earthenware used for mortuary purposes obtained in the great majority of mounds in which earthenware other than in the form of sherds is met with, it was be no means universal. We have seen how in the mounds at Racey Point and Beauclerc numbers of imperforate vessels were found, and that total demolition of these mounds failed to bring to light any evidence of base perforation. The majority of vessels from Tick Island are imperforate, while from the mound near Duval’s came vessels showing base perforation made previous to completion, others with perforation made subsequent to baking, while others again were imperforate.

This base perforation of earthenware used for mortuary purposes is assuredly one of the most curious aboriginal customs.

**Source of Supply of Aboriginal Products from the River Mounds.**

Whether the peninsula of Florida was indebted to the neighboring islands and to the culture of Mexico, New Mexico and Arizona for at least a partial supply of the material for, or for ready made, weapons, tools, ornaments, etc., we are unable to decide.

In our Note on copper we have already made reference to intercourse with Cuba and to possible communication with Arizona, New Mexico and Mexico. As we have stated, in our opinion, there can be no reasonable doubt in the mind of any one familiar with the art of the land of Montezuma that the well-known plates

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from the Etowah Mound, Georgia, and certain other productions on copper and on shell from other parts of the Union were derived, or at least drew their inspiration from Mexico. Whether, however, similar works of art are present in Florida is still a secret of the mounds. We have found in the mound at Bluffton a tube of Andesite, a volcanic product possibly from Arizona, not met with on the mainland nearer than the Rockies, a certain indication of extended intercourse; but beyond this no object probably exotic has rewarded our search on the river.

As to Caribbean influence in Florida, theories of which are based upon certain ceramic decoration, we do not feel ourselves fitted to judge.

Shell.—Abundance of material for implements and ornaments of shell is found on every side along the seacoast of the Peninsula, and it is probable that this material, worked and unworked, was a staple export. We have found in the mounds columnæ of Fulgur and Fasciolaria detached from the whorls and probably ready for shipment, like iron in the pig, that the population of northern districts might more readily suit its taste in manufacture of beads and implements.

Stone.—Lance heads, projectile points, scrapers, and larger leaf-shaped implements are almost invariably of Chert, or of kindred stone. Jasper, Chalcedony, Hornstone, or Chert-breccia, all probably from the limestone of the west coast, and all doubtless domestic products.

For the traps and claystones from which their “celts” were made the Florida Indians had farther to seek, probably in the States of Georgia and North Carolina. though one might expect that with them would come the grooved axe, a weapon unknown to the shell heaps, the sand mounds and the surface.

Mica and Quartz crystal are not found within the limits of the State, and Catlinite, discovered by us in one mound, is unknown nearer than the Northwest.

Precious Metals.—Gold and silver, shaped into aboriginal designs, have been met with by us upon but three occasions—a disc of sheet gold, an oblong ornament of the same material and a semilunar ornament of sheet silver. All these have the beaded or punctate marginal decoration, so common a native form.

A bar-like ornament of silver, probably of European pattern, is the only other object of precious metal not distinctly showing White contact, met with by us in Florida.

All four of these objects have been figured in this Report. The first three were found near the surface of the mound, unassociated with relics showing European intercourse, but at no greater depth than such objects have been met with in the same mounds. It is, however, only fair to say that products undoubtedly of aboriginal art also have been discovered in all these mounds no farther below the surface than were the gold and silver ornaments in question.

The presence of precious metals in the Florida mounds has been previously noted, and we are indebted to Andrew E. Douglass, Esq., to George F. Kunz, Esq.,

1 A Gold Ornament from Florida, American Antiquarian, Jan. 1880.
to the late Dr. Rau,¹ and to others for more or less elaborate notices of the discovery and theories as to the source of supply of the material.

In Mr. Douglass’ interesting paper are many reasons to show that all gold ornaments found in Florida to his time of writing (1889) "are post-Columbian in date, and are fabricated from metal wrecked upon the Atlantic coast while in transit to Spain," this conclusion being based, among other things, upon the fact that no objects of gold have been reported found in Florida farther north than Mosquito Inlet, a point on the coast about fifty-five miles south of St. Augustine, while one would look for more northern discoveries was the gold derived from native nuggets of Georgia. This statement, so far as we know, holds good to the present time, though one of our silver ornaments is from a point about thirty-five miles north of the Inlet.

Now let us examine the internal evidence presented by the objects of precious metal collected by us on the St. John’s. For obvious reasons we have not desired to submit to chemical analysis articles of such small size and of such rarity.

The ornament of gold found superficially in Thursby Mound has a specific gravity of 17·166, and is of that pale color conferred by a considerable alloy of silver. This alloy, we may remark, is frequently found in native gold, and is, we are informed at the United States Mint, seen in nuggets from North Carolina and Georgia.

We are, however, unable to determine from evidence in our possession whether the specimen is from a nugget of native gold, hammered down, or from gold possibly obtained by barter or from wrecks.

Not far distant from the ornament just described was found a semilunar ornament of sheet silver, having a specific gravity of 10·083, or near that of hammered silver alloyed with copper, about 750 fine. Acid tests show the presence of copper. Again we are unable to decide as to origin.

A disc of gold from the Cook’s Ferry Mound, Lake Harney, is of a deep yellow hue, and has a specific gravity of 16·6, showing the presence of greater impurities than the gold from Thursby Mound.

The bar-shaped ornament of silver from the mound at Dunn’s Creek lay at a depth of 3·5 feet with implements of iron. Considerable digging had been done by previous investigators at this point, and it is not unlikely that sand thrown from a neighboring excavation was responsible for a portion of this depth. Its specific gravity is 10·4, or exactly that of pure cast silver. The association with iron in this case is a sure indication of its interment in post-Columbian times, though whether its manufacture preceded that period we are unable to determine.

The fineness of early Spanish coins varied considerably,² and before comparing their specific gravity with that of the gold and of the silver of the mounds the

² A Manual of Gold and Silver Coins of all Nations with Treatise on Bullion, Plate, etc. Eckfeldt and Dubois, Philadelphia, 1851.
nature of the alloy present in the coins and in the mound specimens respectively would have to be determined by chemical process.

As the reader has probably concluded by this time nothing definite as to metals can be learned without analysis.

Earthenware.—While the State of Florida is not blessed with a sufficiency of stone from which to shape its implements, abundance of material for the manufacture of earthenware exists throughout the State, the present county of Clay taking its name from argillaceous deposits.

It is not probable that any considerable amount of earthenware was imported into Florida, the types of many of its vessels being too distinct, and the method of manufacture of the majority inferior to that which characterizes the earthenware of other localities. In the northern portion of the river territory are occasional sherds bearing the complicated stamped ornamentation of Georgia and Carolina, and this ware is, we believe, always of that gritty character which is so unusual in the ordinary river pottery. Decoration of this character does not occur, so far as we have been able to determine, farther south on the river than Dunn's Creek, about ten miles above Palatka.

Cord marked pottery of gritty ware, occasionally met with in the down-river mounds, has been found superficially so far south as Mt. Royal.

A part of the earthenware of the river, however, was subject to outside influence, and occasionally we recognize types belonging to the pottery of Missouri and of Arkansas, and, upon one or two occasions, of the Gulf States. On the whole, however, the earthenware of Florida is more of its kind than is any other of its aboriginal productions.

With the exception of two mounds on Murphy Island, the terms of whose owner we have not seen fit to accept, no sand mounds of importance border the St. John's that have not been investigated by us. We are aware that the virtual demolition of a mound is the only method to form a final conclusion, and we can but hope that at some future time circumstances may make it possible for the archaeologist to know the contents and composition of the two great mounds near Mill Cove and of the mound at Bluffton. We are of the opinion that no extended notice of the river mounds can ever again be written, and we sincerely hope that others may be induced to take up and to publish reports of the mounds of the east coast, of the west coast, and of the interior, that the archaeology of Florida may be redeemed from the obscurity that has hitherto characterized it.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS WITH SPECIAL REFERENCE TO THE ORDER OF PRIMATES.

By Andrew J. Parker, M. D.

PREFATORY NOTE.

The studies upon which the following paper is based were begun by the author, Dr. Andrew J. Parker, in 1877, and a verbal, though unpublished communication embracing the main points of his interpretation of the arrangement of the cerebral convolutions, was made to the Academy of Natural Sciences of Philadelphia in the year following. From time to time Dr. Parker added to and extended his observations and still further elaborated his theories until they assumed the form embodied in the present paper. In 1890 this paper was awarded the Boylston prize by Harvard University.

The brains upon which these studies were made were derived almost exclusively from the garden of the Zoological Society of Philadelphia and were placed at the disposal of Dr. Parker through the generosity of its prosector, Dr. Henry C. Chapman. The original photographs which accompanied the manuscript have been here faithfully reproduced by outline drawings.

Ill health prevented Dr. Parker from securing the publication of his paper, and this was still further delayed by his death, which occurred in 1892. Subsequently the manuscript came into the possession of the undersigned and was presented by him for publication to the Academy of Natural Sciences of Philadelphia, of which body Dr. Parker had been an active member. The paper was referred by the Publication Committee to Professor Henry C. Chapman and the late Professor John A. Ryder, on whose favorable report its issue in the Journal was authorized.

F. X. Dercum, M. D.

The principal object of the present paper is to draw attention to a new view of the morphology of the cerebral convolutions in the Primates, and to point out their general arrangement in that order. An attempt will be made to show that they follow a definite plan and are related to a symmetrical bud growth of the cerebral hemispheres. It is also hoped, and it will be our endeavor to point out, that the proposed theory will greatly facilitate the study, and throw new light on the proper methods of correlating the excessive convolutional complexity of the human brain, and thus aid those who examine the subject from a purely practical standpoint.

Until within comparatively recent times, the study of the cerebral convolutions...
has been involved in obscurity. “Formerly,” as an eminent anatomist remarks, "they were considered as a bundle without a system and the artist drew them as he would draw any dishful of macaroni." This state of things undoubtedly arose from studying the human brain alone, and here the excessive complication in the development of secondary and tertiary furrows, produces, apparently, a perfect chaos of convolutions and obscures all idea of regularity of plan. Human brains, moreover, vary greatly in respect to their minor marking, so that we have not as yet what might be termed an average standard adult brain. Whilst some authorities still deny that the fissures and convolutions of the human brain can be elucidated by a study of related animals, I think that all unbiased minds who are familiar with the modern teachings of comparative anatomy and zoology will admit that it is only by such studies, combined with the study of the embryology of the human brain, that any scientific conclusions can be reached, and that the treatise of Gratiolet, "On the Convolutions of Man and the Primates" first laid the foundations for a proper study of the cerebral surface. Meynert also takes as his starting point the brain of a monkey, whilst Bischoff holds that the monkey brain is not a miniature model of the human brain, but represents arrested stages in the development of the latter. These opinions are shared by Huschke, Pansch, Huxley, Rolleston and, indeed, by almost all modern observers.

The morphology of the convolutions as described in the present paper is founded upon an extensive study of the brains of Primates and other animals, as well as those of Man, both in the adult and embryonic stages. The material has been derived almost entirely from my own collections and preparations.

It is evident that a comparative study of the convolutions in the lower animals and their correspondence with those found in Man is destined to become of considerable importance, and if it can be shown that these convolutions are based upon a symmetrical plan related to the structure of the hemisphere, it may have interesting bearings as regards the functions of the different portions of the cerebral cortex itself. Whether the convolutions bear precise and definite relations to these functional districts, as some suppose, or whether these districts are merely centralized at different points, with boundaries that have no connection with the individual convolutions are questions that remain to be determined. We know that one convolution passes into the next, and that all are in this way connected together in one continuous system. Hence if the separate convolutions do represent distinct centres of definite functional action, then must they also represent definite structural tracts, and be considered as but visible manifestations of deeper relations of structure.

In this respect the position held by Ecker and some others does not seem to be consistent. Ecker appears to hold the view that the faculties are resident in definite portions of the convolutions; thus he remarks,¹ "the great problem of an ontogeny of the cerebral surface, that is, of an anatomico-physiological knowledge of the

¹ Preface to Cerebral Convolutions of Man, Edes' transl.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

psychical brain organs, rests in great part in the hands of physicians. Only by accurate observations of patients, in connection with the most careful autopsies, can we gradually arrive at some knowledge of the physiological meaning of the single convolutions upon the cerebral surface.” Yet he remarks, further on, in speaking of the development of the convolutions in the foetus: “this is also the only way to learn this law of the formation of the convolutions, that is, the formation of the convolutions as a necessary consequence of certain mechanical processes in the growth of brain and skull. Up to the present time, however, we are far removed from such a knowledge. At the farthest, the fossa Sylvii is open to an explanation from this point of view.” Now, if the convolutions are produced by a process of mechanical packing, how can we expect that they will represent localized centres of different faculties? What connection can an arrangement of cerebral matter produced by “mechanical processes in the growth of brain and skull” have with the localized position of certain functional cells? The two views taken together, seem incompatible. Either the faculties are not localized in special convolutions, or, if they be considered as representing these districts, then must they also be regarded as produced structurally by processes of growth taking place within the brain mass alone, and at most merely modified in shape and position by the presence of its bony environment. The great regularity of folding, following, as we shall endeavor to show, a definite symmetrical plan related to the structure of the hemispherical mass would seem to indicate definite processes of brain-growth modified by relations of growth to the containing cavity. The following facts seem also to show that the convolutions and fissures, at least the typical ones, are not produced by a species of mechanical packing alone. Marshall, in an interesting paper, has described and figured the brains of two idiots of European descent. In it he shows that all of the principal fissures and convolutions are present, only in a simpler condition and somewhat distorted. No new fissures were found. Now, if fissures are dependent solely on gross mechanical causes, should we not expect more than a mere distortion? One has but to examine the drawings given by Marshall to see what immense differences exist in the mechanical conditions of growth between this and the normally developed brain. So great has been the interference with normal growth that even the corpora striata and thalami optici were found distorted. The cerebellum was pushed up almost to a level with the cerebral hemispheres and the whole aspect of the cerebrum changed. It would seem in a case like this that if fissures be the result of merely gross mechanical processes of growth between the brain and skull alone, we ought to find some distinct and separate fissures produced, instead of a mere distortion and pushing out of place of fissures which are found in the normally developed brain.

Reasons will be given farther on, deduced from the manner of arrangement of the convolutions not only in the Primates but in other animals, for considering that the hemispheres of the cerebrum should be looked upon as nervous buds,

1 On the Brain of a Bushwoman and Two Idiots, etc. Phil. Trans., London, 1854.
arranged around the cerebral peduncles, and that the principal or typical convolutions and fissures bear definite and symmetrical relations to these buds. In other words, in the development of the cerebrum, the fissures represent lines of retarded growth with respect to the convolutions, and having thus a morphological significance in reference to the cell growth of the brain, they may also, possibly, represent lines of structural demarcation. On the same subject Pansch remarks, "in any case the convolutions owe their origin as folds to a difference in the strength of growth of different portions of the cerebral surface."

With regard, therefore, to the cause of the production of cerebral fissures three different views are held. According to one of these, all the fissures of the cerebral hemispheres are produced by a process of mechanical packing; that is, the brain, developing more rapidly in size than the cavity of the skull, adapts itself to its constrained position by folding along the lines of least resistance, and these lines of least resistance are represented by the various fissures of the cerebral surface. According to the second view, the cerebral fissures represent lines of retarded cerebral growth, and have, therefore, a structural significance depending upon processes of cell growth within the mass of the brain itself. The last view is merely a combination of the other two, and may really be regarded as included under the second. However, we shall discuss this question more thoroughly hereafter.

There is also a difference of opinion as regards the regularity or irregularity of arrangement of the fissures and gyres: whether they are or are not founded on any definite plan. Recent anatomists have with few exceptions come to the conclusion that they are founded upon a perfectly uniform and definite arrangement; and Huschke, Bischoff and Pansch, have each given out independent views as regards the plan of this arrangement. With the plans as given by these anatomists I have not been able to agree; and the principal object of the present paper is to direct attention to a new theory as to the arrangement of the typical fissures, especially in the Primates, and to found thereon a new general system of nomenclature that shall bind together in one comprehensive whole the various isolated and conflicting views and make clear the difficulties in the synonymy of this intricate and perplexing subject.

Before proceeding with this, however, it will be necessary to review briefly the labors of previous observers in this field, especially prior to the year 1880, in order that the progress of opinion and the present state of the subject may be more clearly comprehended. I must, therefore, ask indulgence for the somewhat extended review of the literature of the subject which I feel compelled to give, for the reason that it would be extremely difficult, if not impossible, to reconcile the various conflicting opinions held at the present time by numerous observers with the new method of classification and arrangement of the fissures and convolutions which I shall offer for consideration and study. This becomes the more necessary because, so far as I am aware, no one has as yet attempted to give a complete and

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1 Ueber die typische Anordnung der Furchen und Windungen, etc.; Archiv für Anthropologie, 1869.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

systematic morphological theory which shall explain the arrangement of all the fissures of the cerebral surface as related to a distinct plan, dependent upon the structure and mode of development of the hemisphere itself, together with the disturbances and departures due to the action and interference of the bony environment.

GENERAL HISTORY.

Amongst the earliest writers on the subject of the cerebral convolutions was Erisostratus, who affirmed that they were more numerous in Man than in the lower animals, and he was of the opinion that the superior intelligence of Man is associated with this fact. Penault notices the convolutions as found in the monkeys, and says that they closely resemble those of Man, but does not describe them. Willis, however, was the founder of the comparative anatomy of the convolutions. He pointed out in 1664 the presence of the convolutions in the brains of the lower animals. He asserts that they are not so numerous as in Man, and that the ape possesses more of them than the fox, dog, etc., and he affirmed that paucity was associated with simplicity of folding. In 1789, Vicq d’Azyr devoted some attention to this subject. He remarks that in the monkeys, as in quadrupeds in general, the convolutions are less numerous, symmetrical on the two sides and are related to each other in all individuals of the same genus, but that in Man they are neither symmetrical on the two sides nor resemble each other in different individuals. He was among the first to recognize similarity of plan in Man and the monkey. He was also the first to point out certain fissures as being constant and he recognized the Sylvian and calloso-marginal as such. The plates that illustrate his work, however, are so inaccurate that they seem to be drawn almost at random and are of no value for study. In 1731, Tyson had compared the brain of an Orang with that of Man and stated that they strongly resembled one another, but did not enter into any detailed description of either. Sommering describes in his Nervenlehre, together with Th. Bartolinus, the formation of sulci and gyri and considers them only as a means of deeper penetration of the membranes of the brain. He gives them no further consideration except that he says they might seem at first glance to be irregular, but that taken in groups they are always very regular. In his “de Basi Encephali, scriptores nevrologici minores,” he has been more exact than any of his predecessors in the reproduction of several of the cerebral convolutions of Man; but that he had not given the subject sufficient attention is shown by the fact that he speaks highly of the very inaccurate plates given by Vicq d’Azyr.

Malcarne in 1795 in describing the brain of a goat notices particularly a
convolution found on the mesial surface and which surrounds the corpus callosum in the form of an ellipse. It is the only one to which he attributes a regular form. The statements of these observers on the regularity of the cerebral convolutions were followed by Cuvier in regard to some other animals. According to him, "the monkeys have much fewer convolutions than Man and among the Sapajous the posterior lobe has scarcely any. In the Carnivora the fissures are also numerous and they follow a certain order which is found the same in the greater number of the species. The rodents have few or no sensible convolutions, but the ruminants and the horses have many, as is also the case in the Dolphin. As regards the convolution in the brain of Man, Cuvier is content to say that they are the deepest of all, but without recognizing in them any regularity."¹

Lanthi² expresses about the same views. The observations of the Wenzel brothers served to render the subject still more obscure. According to them, "with Man the cerebral convolutions of one side differ from those of the other side in form, direction, relation, seat, length and size. There is, however, on the internal face of each hemisphere, immediately above the corpus callosum a convolution almost symmetrical, but we find still marked differences between that of the right and left side."³ The inferior and posterior extremity of the convolution which surrounds the corpus callosum, of which a part had been described by Malacarne and admitted by the Wenzels, has been the object of special attention by Treviranus.⁴ M. Serres, who gave to it the name lobe d’hippocampe, regards it in the same manner as Treviranus; and M. Léut has investigated its structure.⁵

In 1816 Tiedemann⁶ first gave a general account of the development of the convolutions and their times of appearance in the foetus. He did not, however, enter into a comparison of the different convolutions. In his work⁷ he has given some of the most exact and best illustrations of brains published at that period. In it are found representations of the brains of several monkeys, those of the seal, lion, cat, coati, etc.; but with these also he has not entered into any description of the individual convolutions. The work of Serres⁸ although highly spoken of by Cuvier, seems to have been retrograde in its tendency. It is full of inaccuracies and the plates of the various brains figured seem to have been drawn almost haphazard. From his researches Serres came to the conclusion that the characters of the convolutions were too inconstant to characterize species or families of mammals. He divides animals into those which have convolutions similar, the one hemisphere to the other, and those in which they are dissimilar. In the first category he places

¹ Leçons d’Anatomie comp.
³ De penitiori structura cerebrí homínés et brutórum. Tübingen, 1812.
⁴ Recherches sur la struct. et les fonctions de l’enceph. des nerfs, etc. Trad. par M. Breschet, 1823.
⁵ Note sur la substance blanche du lobe d’hippocampe, etc. Journal des Progrès, 1830.
⁶ Anatomie und Bildungsgeschichte des Gehirns im Foetus des Menschen.
⁷ Sur les cerveau des singes et de quelques mammifères rares dans nos contrées.
⁸ Anatomie comparée, 1824-28.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

the carnivora, such as the lion, tiger, wolf, fox, etc., but without indicating any differences between them. In the second he places Man, cetacea, the horse, etc. Of others he is acquainted with neither the number nor the development. In combating the opinion of anatomists who believe that the convolutions are able to furnish positive characters for the classification of mammals, he remarks that this proposition is far from being exact.

Burdach 1 has not given much attention to the convolutions. He devoted himself to the fibrous structure of the brain and only in relation to their peripheric infoldings did he pay special attention to the convolutions and fissures. He remarks, however, "through the apparent confusion, general laws seem yet to glimmer and we may recognize several principal features of the convolutions which correspond to definite elements. On the mesial surface of the brain the longitudinal direction is prominent. The upper surface is broad in front, and narrow posteriorly. It has tortuous convolutions running lengthwise. In the middle or parietal region, however, the convolutions extend transversely." In 1829 Rolando 2 first accurately described and figured the convolutions in the brain of Man. He was the first to recognize the constancy of the fissure called by his name. Notwithstanding the clearness of his descriptions and the exactness of his illustrations he does not appear to have been understood by succeeding anatomists who occupied themselves specially with the brain. Thus M. Cruveilhier, who in 1836 3 tried to bring into notice the investigations of Rolando, succeeded only imperfectly in giving an idea of the disposition of the cerebral convolutions, which he still compares according to ancient tradition to the tortuous windings of the small intestines, but of which he indicates, however, the principal disposition. Cruveilhier also speaks of the convolutions as found in the lower animals, but brings forward nothing of importance.

The figures of the brain of Man published by Gall fail in exactness in all that relates to the convolutions, and those which represent the brains of lower animals seem to be made expressly to suit his new doctrine of phrenology. Vimont remarks that "the surface of the cerebral lobes present folds which we have designated under the name of convolutions. It is easy to see with a little attention that they present differences of form and volume very pronounced. It is worthy of remark that these folds are never perfectly similar on the two sides of the brain of all animals which are well marked with convolutions." This is all that Vimont says in reference to the convolutions of Man. His plates are very inaccurate and cannot be regarded in any sense as exact representations taken from nature.

In 1832 Owen 4 began a classification of the brain in the Felidae, finding that homologous folds could be traced from species to species in that family. In the

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1 Vom Bane und Leben des Gehirns, 1819-1826.
2 Della struttura degli Emisferi cerebrali.
3 Anatomie descriptive.
same communication he notices the constancy manifested in the convolutions and speaks strongly in favor of the conclusion that the fissuring of the hemispheres in the course of development follows a determinate plan or law. In his Comparative Anatomy of Vertebrates, Vol. III., he distinguishes three leading patterns of convoluted surfaces, which, from the prevalent direction of fissuring, he terms the oblique, longitudinal and transverse, and these are exemplified respectively in the ungulate, unguliculate and quadrumanoan division of his sub-class Gyrencephala.

Leuret¹ has shown by an extensive study of the convolutions in the various divisions of the mammalia that certain convolutions are constant, and that in allied genera the character of the cerebral surface is the same. He finds that the convolutions are similar in the same animal, and he attempts to classify the mammalia by means of the arrangement of their convolutions. He distinguishes an internal convolution on the mesial surface of the brain and a varying number of external convolutions lying on the lateral aspect, which he names. He classifies animals according to their convolutional characters into fourteen groups.

In the first group are contained animals taken from various families. The convolutions are absent, the fissures of Sylvius being alone present. In this group he places animals derived from the Cheiroptera, Insectivora, Marsupialia, Monotremata and largely the Rodentia.

In the second group the convolutions are still absent, but there are depressions which announce as it were their approach. It contains Rodents, Insectivora and Marsupials. The fissure of Sylvius now becomes well marked.

The third group contains the fox, wolf, dog, etc.
The fourth, animals of the genera of cats and hyena.
The fifth, the civet, coati, ferret, weasel, otter, etc.
The sixth, only the ichneumons.
The seventh, the sloth, African ant-eater, Phascolonys and Hyrax.
The eighth, kangaroo, Orycteropus and Pteropus.
The ninth, the Ruminants and other herbivora.
The tenth, the hog, peccary, etc.
The eleventh, seal.
The twelfth, dolphin, porpoise and whale.
The thirteenth, the elephant.
The fourteenth, the lemurs, monkeys and apes, thus placing Man in a division alone.

The number, form, arrangement and relations of the cerebral convolutions says Leuret "are not formed at hazard, every family of animals has a brain constructed in a determinate manner, and the differences of opinion on the subject arise from a want of attentive examination of a sufficient number of brains. Observation has thus shown what strict induction would lead us to conclude. How, indeed, can we believe that the most important organ of the economy, that by

Each "type" of convolutions, as such, is not a fixed organization and is not as invariable as that of other parts. Each group of brains has a type which is peculiar to it, and this type is especially manifested by the form of its convolutions.

Leuret's work was continued by Gratiolet who specially studied the brains of the Simiidae and compared them with those of Man, showing that all the convolutions found in Man are fully represented in the monkeys only simpler in character. To Gratiolet we are indebted for the nomenclature generally in use at the present day. In naming the convolutions he first described them as found in each genera of the Simiidae as Cebus, Cercopithecus, Cynocephalus etc.; and afterwards applied this nomenclature to the corresponding parts of the human brain. He divides each hemisphere into five lobes: frontal, parietal, occipital, temporal-sphenoidal and central or island of Reil.

As to the posterior boundary of the frontal lobe he is uncertain and does not know whether to place it directly in front of the central fissure or in front of the anterior central convolution. The parietal lobe lies directly back of the frontal and extends to the occipital lobe, from which it is separated by the so-called fissura perpendiculares externa et interna, completely in Man on the mesial surface and incompletely on the external or lateral. Below and posteriorly it extends above the upper end of the horizontal branch of the Sylvian fissure and becomes continuous with the convolutions of the temporal lobe. Inferiorly and below, both the frontal and parietal lobes are well defined by the fissura Sylvii, while on the mesial surface they are continuous.

The occipital lobe constitutes, according to Gratiolet, the posterior portion of the hemispheres, separated from the parietal lobe in the manner indicated above, while with the temporal lobe it is continuous both on the mesial and lateral surface. Indeed, Gratiolet considered the temporal lobe which lies below the horizontal branch of the fissure of Sylvius and occupies the temporal fossa of the skull, in connection with the lower part of the occipital lobe, under the name of the temporosphenoidal lobe. He distinguishes on the lateral surfaces of each of these four lobes, three convolutions together with several so-called lobules. On the mesial surface he distinguishes a convolution surrounding the corpus callosum as the convolution of the internal zone and also a convolution lying below the hippocampal sulcus, as the gyrus hippocampi. Besides these he lays special stress on a number of small convolutions running between the occipital and the temporal and parietal lobes, which he designates under the name of the plis de passage. They are six in number, four external and two internal; that is, four on the lateral surface and two on the mesial. We shall speak further on in detail of these divisions of Gratiolet, which are those usually accepted by writers and authorities at the present time. There are many deficiencies in the description as given by this writer, especially as regards the occipital region, and its application to the brain of Man, to which he gave

1 Memorie sur les plis cérébraux de l'Homme et des Primates.
2 JOEN. A. N. S. PHILA., VOL. X.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

little attention, is very imperfect. To Gratiolet, however, is undoubtedly due the
credit of having first systematically mapped out the cerebral convolutions of the
Primates and of supplying a useful nomenclature.

Foville in 1844¹ classifies the convolutions into four orders, according to their
arrangement around the anterior perforated space. This, however, has its appli-
cation only to the brain of Man.

In Germany the subject of the cerebral convolutions has also attracted con-
siderable attention. Valentine in his studies of the Sömmering doctrine of the
relations between the brain and nerves, attempted to find constancy in the convolu-
tions. In the best anatomical text books, however, such as Arnold, Meckel, 
Hildebrand, Weber, Krause, Hyrtl and others, with the exception of a few easily 
recognized constant ones, the convolutions are not considered or designated. Arnold,
in 1851, in his Anatomy, states that neither the direction of the convolutions nor 
the divisions of the same have been studied, nor have any laws been discovered 
governing their arrangement.

Since then, Huschke, in 1854,² has attempted to lay down a plan on which the
convolutions are based. Bischoff, 1868, and Pansch, 1879, have also published
independent views on the morphology of the cerebral convolutions. Huschke,
through his studies in embryology and comparative anatomy, believed that in the
brain there are three or four ground convolutions which arch in the form of a horse-
shoe backward around the upper horizontal extremity of the fissure of Sylvius and
extend downward into the temporal lobe to the borders of the same. While these
ground convolutions are more or less distinctly recognizable in the brains of the
lower animals, in Man and the apes they are split by the development of the fissure
of Rolando or central fissure and its accompanying convolutions, the relations being
as follows: In the middle of the hemisphere we have the central fissure with its
accompanying convolutions. In front of this are three frontal convolutions, running
longitudinally, the first, second and third; back of these there are likewise three
which run backward toward the end of the hemisphere, but only the upper two
reach the same, the lower running around the Sylvian fissure and extending into
the temporal lobe, which is also formed by the upper and middle convolutions after
they have reached the posterior end of the hemispheres proceeding forward. These
posterior convolutions coil themselves more than the frontal and form three upper
lobules: the lobulus parietalis superior or vorzwickel, the cuneus or zwinkel and a
third, the end lobule, which forms the real point of the hemisphere. The middle
and lower convolutions which Huschke considers as one, show, according to
Bischoff, three lobules. On the inner surface of the posterior part of the hemi-
sphere, Huschke distinguishes the vorzwickel or praecuneus and the zwinkel or
cuneus. On the lower surface the lobulus lingualis, Zungenlappchen, and one lying
more external, the spindel-formiges Läppchen or lobulus fusiformis, both of which

¹ "Traité complet de l' Anatomie du système nerveux cérébro spinal,"
² Schädel, Hein und Seele des Menschen und der Thiere, etc.
run forward and merge with the gyrus hippocampi and gyrus cinguli running
around the splenium corporis callosi, and to these are joined the gyrus fornix
counters and convolutions of the island of Reil or central lobe. According to Bischoff,
Huschke’s explanation is particularly imperfect, because it leaves the convolutions
lying behind the central convolutions in obscurity. It also suffers from an imper-
fect and unsuitable nomenclature and from the failure to recognize a distinct
parietal and occipital lobe.

Reichert 1 avoided a topographical description of the convolutions of the brain.
He studied more particularly the development and structure in the human fuctus,
and he is of the opinion that the type in the complicated structure of the human
brain is to be explained by its embryological history. He also calls attention to
the fact that the characteristic form and arrangement shows a remarkable corre-
spondence with the type of branching and course of most of the central vessels. R.
Wagner 2 in his studies of the human brain added nothing of importance to the
results of Huschke and Gratiolet. He distinguished three frontal, three parietal, three
occipital and three temporal convolutions, but entirely excludes the plis de passage
of Gratiolet from the description of the convolutions as found in the human brain.
He did not succeed in establishing any better characteristics of the occipital and
temporal lobes than did his predecessors. Both Reichert and Wagner added little
or nothing to the doctrine of the general arrangement of the convolutions, but
Wagner’s work was of service in giving general distribution to the facts already
known.

In 1866 Pansch 2 described the convolutions as found in Man and the Simians.
On the frontal lobe he points out three fissures and corresponding convolutions. He
also describes those found on the orbital surface and includes the anterior central
convolution in this lobe. On the parietal lobe he distinguishes only two convolu-
tions externally; viz.: a gyrus parietalis superior and a gyrus parietalis inferior.
The superior parietal convolution includes the posterior central convolution and
Huschke’s vorzwiekel or precuneus; or Gratiolet’s deuxieme pli ascendant plus the
plis de passage superieure externe et interne. The inferior parietal convolution is
equivalent to Huschke’s lobulus tuberis plus the ascending branch of the posterior
parietal lobule, or equals Gratiolet’s pli courbé with the pli de passage externe
infeirvere. On the inner or mesial surface he considers only one convolution, the
gyrus fronto-parietalis, the so-called arched convolution or gyrus cinguli.

On the occipital lobe he points out a gyrus occipitais superior, medius et inferior
which correspond closely with the divisions of Gratiolet and Wagner. In the same manner on the temporal lobe he recognized a gyrus temporalis superior,
medius et inferior and on the lower mesial surface a gyrus occipito-temporalis lateralis,

1 Der Bau des menschlichen Gehirns, 1859.
2 Ueber die typischen Verschiedenheiten der Windungen der Hemisphären, etc. Göttlingen, 1860-1862.
Vorstudien zu einer wissenschaftlichen Morphologie und Physiologie des menschlichen Gehirns und
3 Habilitationschrift, De Sultes et Gyris in Cerebris Simiarium et Hominaum, Kiel.
corresponding with the lobulus lingualis of Huschke and the gyrus hippocampi of Gratiolet, Wagner, etc.; also a gyrus occipito-temporalis medius, equivalent to the lobulus fusiformis of Huschke. The attention of Pansch in these researches was directed principally to ape's brains. Since then Pansch has published another paper in which he insists that in Man and the apes there is a natural system of the convolutions, that is, a practical division of the cerebral surface which does not depend upon chance but upon genetic principles. He considers it questionable whether the division into lobes as usually designated is founded upon genetic principles. He is of the opinion that the division produced by the ramus ascendens of the fossa Sylvii is just as important as that produced by its posterior or horizontal branch, and he believes that the outer surface of the hemisphere may be divided by means of the Sylvian fissure considered as follows: an anterior portion lying in front of the ramus ascendens, a middle or upper portion lying posterior to it, and a lower or inferior part lying below the horizontal branch of the fissura Sylvii. He says that the significance of such a division by means of the ramus ascendens has never yet been given, or where it has, a misunderstanding has been the basis of it. This ramus ascendens he asserts must be the fissure next in importance to the horizontal branch of the fossa Sylvii which we must take into account in a division of the brain surface. Amongst the other furrows he recognizes no genetic differences, the only distinction being, according to him, as regards the time of their appearance; or to express it more generally, in the greater or less pertinacity of form and position; but he regards these differences as merely relative.

Pansch takes his type of the arrangement of the fissures and convolutions from their manner of development in the human embryo. He compares the system as thus deduced with the conditions as found in the adult human brain and with the brains of the lower Primates. He regards the fossa Sylvii as laying down the fundamental divisions of the hemisphere. The other fissures he divides into primary and secondary sulci. He notices the early appearance on the mesial surface of the fissura horizontalis or calcarine, the fissura perpendicularis interna or parieto-occipital and also a furrow, which separating the corpus callosum from the hemisphere and extending downward into the temporal lobe, produces finally a separation of the so-called uncus from the rest of the surface. He terms this sulcus, after the English anatomists, the fissura dentatus (fissura hippocampi) and fissure around the corpus callosum.

On the lateral surface, he distinguishes four fissures which, fan-shaped, surround the fossa of Sylvius. He calls these after Reichert, the primary radiating furrows. The first three of these lie on the anterior lateral portion of the hemisphere and are included between the two branches of the Sylvian fissures. The fourth lies parallel to the fissures of Sylvius and between it and the inferior border

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MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

of the hemisphere. He considers it doubtful whether the fissura occipitalis externa can be considered as a primary furrow.

On the mesial surface of the brain he also distinguishes an inner primary furrow (fissura calloso-marginalis) and a lower primary furrow (fissura collateralis).

He also endeavors to show that each of these primary furrows follows as it were the type of the Sylvian fissure; that is, they each present a stem, and upper and posterior branch; he endeavors to point out in the development of these fissures these different parts. By means of these so-called primary furrows, Pansch divides the surface of the cerebral hemispheres in the Primates, as follows:

A. OUTER SURFACE.

I. Inferior frontal lobe (Stirnulst).
   1. Inferior portion—Lowermost frontal or orbital convolution.
   2. Superior portion—Inferior frontal convolution.

II. Superior frontal lobe.
   3. Anterior superior portion—Superior frontal convolution.
   4. Anterior inferior portion—Middle frontal convolution.
   5. Posterior portion—Posterior or ascending frontal convolution (anterior central).

III. Superior parietal lobe (Scheitelwulst).
   6. Anterior portion—Anterior or ascending parietal convolution (posterior central).
   7. Posterior portion—Superior parietal convolution.

IV. Inferior parietal lobe.
   8. Inferior parietal convolution.

V. Anterior temporal lobe (Schlafenwulst).

VI. Inferior temporal lobe.
   10. Inferior portion—Inferior temporal convolution.
   11. Superior portion—Middle temporal convolution.

VII. Occipital lobe.
   12. Superior portion—Superior occipital convolution.
   13. Middle portion—Middle occipital convolution.

B. MESIAL SURFACE.

VIII. Mesial fronto-parietal lobe.
   15. Superior portion—Superior mesial fronto-parietal convolution.
   16. Inferior portion—Inferior mesial fronto-parietal convolution.

IX. Mesial occipital lobe.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

C. INFERIOR SURFACE.

X. Dentate lobule (Gezahnterwulst).
18. Dentate convolution.

XI. Inferior mesial long lobule (Längswulst).
19. Inferior mesial long lobule convolution

XII. Inferior lateral long lobule.
20. Inferior lateral long lobule convolution.

In this way Pansch divides the hemisphere into three surfaces, sub-divided into twelve lobules and these in their turn into twenty separate and distinct convolutions. We shall consider the morphological value of these sub-divisions hereafter.

In 1870, Bischoff published a plan or type according to which he believes the fissures and convolutions are arrayed. He considers that a large number of the convolutions of the great hemisphere are arranged around the ends of the primary furrows in more or less simple or complicated arches. The primary fissures according to him, are the anterior and posterior branches of the fossa Sylvii. the fissura centralis, the fissura perpendicularis interna, the fissura parallela and the fissura hippocampi. This latter fissure of Bischoff corresponds to the one of the same name of Gratiolet (issure des hippocampes) and includes both the fissura hippocampi and the fissura calcarina of most other writers. The type is expressed, according to his view, by these fissures, and the development of the convolutions consists merely of arched windings around the ends of these primary furrows; whilst the further development of the convolutions arises in fact, through the stronger development, bending backward and forward, rising and sinking of the lobules around the above named furrows. Through this process there arise secondary folds and fissures, side convolutions, connections and separations of individual convolutions. These, says Bischoff, may be different on the two sides of the same brain and in different individuals, the ground form being, therefore, more or less hidden, but we can recognize them easily in all brains. He hopes, however, that it will soon be possible to explain and make intelligible these individual modifications. There are, however, convolutions which, as Bischoff admits, do not appear to be in unison with this type, such as the first and second frontal and the convolutions of the occipital and temporal lobes. He can find no particular plan on which these may be based. They arise one after the other and become more and more complex, as it appears, from the purely mechanical necessity of the surface increasing in a definite space. In this manner arise the first and second frontal fissures, the second temporal, the fissura collateralis, etc., and their accompanying convolutions. Thus in the frontal lobe, Bischoff points out two upper frontal convolutions and a third or inferior arching around the ascending branch of the fossa Sylvii. In the parietal lobe, an anterior and a posterior

1 Die Grosshirnwindungen des Menschen, etc.
central convolution arching around the upper and lower extremities of the fissura centralis. Posterior to those at the upper border of the hemisphere and extending over to the mesial surface, are the superior internal parietal group of convolutions (obere innere Scheitelgruppe). Besides these he also calls attention to five so-called arched parietal convolutions:

First. An anterior parietal arched convolution (erste oder vordere Scheitelbogenwindung) surrounding the upper extremity of the horizontal branch of the fossa Sylvii.

Second. A second or middle parietal arched convolution (zweite oder mittlere Scheitelbogenwindung) surrounding the upper extremity of the first temporal fissure.

Third. A third or posterior, surrounding the upper extremity of the second temporal fissure.

Fourth. A superior internal (obere innere Scheitelbogenwindung), surrounding the upper extremity of the fissura perpendicularis interna.

Fifth. An inferior internal (untere innere Scheitelbogenwindung), surrounding the lower extremity of the fissura perpendicularis interna.

On the occipital lobe he distinguishes three convolution groups: an outer upper, the so-called camen, and two lower, an internal inferior or lobulus lingualis, and an external inferior or lobulus fusiformis. In the temporal lobe Bischoff does not differ to any marked degree from the nomenclature and boundaries of other writers.

I have dwelt particularly on the results of the investigations of Heschke, Pansch and Bischoff, as they are the only writers who have proposed any distinct morphological plan or theory according to which the convolutions and fissures are arranged in the Primates. With regard to the morphological plan given by Bischoff, I can but repeat the opinion of Ecker, "what Bischoff says is also perfectly correct that a large number of the convolutions of the cerebral hemispheres are arranged around the ends of the primary furrows in more or less simple or complicated arches; and it cannot be otherwise, for the ranges of mountains enclosing a valley must necessarily pass into each other where the valley ends, but no special explanation seems to be thereby disclosed."

Pansch's division is founded, as he claims, on the areas divided off by important fissures, those which appear the earliest in the human embryo; but these have no definite connections either amongst themselves or with the plan of the cerebral hemisphere, and do not, therefore, it appears to me, point out any type or plan. Where Pansch failed was in not recognizing the fact that the fissures of the human foetal brain do not represent the type, but only an abbreviation, of the Primate brain, and this type or plan can only be determined by comparisons and corrections made by a thorough analysis of all Primate brain forms, both in the adult condition and as far as material renders it possible with simian and especially lemurine foetal brains. Only by such an extended survey will it be possible to thoroughly accomplish this. The absence of such material, especially of foetal monkey brains, renders the undertaking at the present time exceedingly difficult.
Huschke. I believe, expressed the true relations of the convolutions to the hemisphere even more clearly than either Bischoff or Pansch, but his explanation is vague and unsatisfactory on account of the non-recognition of a distinct occipital lobe, and the relation which this lobe bears to the anterior portion of the hemisphere.

The publication of Ecker's work on the convolutions of the human brain, "Die Hirnzähnungen des Menschen, etc.," did much to favor the study of the convolutions and to relieve the obscurity due to excessive and complicated nomenclature. As recent writers have, with few exceptions, adopted the names selected or proposed by him, it will be unnecessary to consider in detail the more recent special literature of the subject. Amongst other writers who have contributed within recent years to the subject we have Huxley, Turner, Marshall, Flower, Rolleston, MacCartney, Macleod, Macleary, Lankester, Pansch, Meynert, Bischoff, Ecker, Alix, Gromier, Pozzi, Charcot, Luys, Ferrier, Hunguenin, Gervais, Cope, Hitzig, Spitzka, Richet, Garrod, Retzius, Broca, Heffler, Parker, Milne Edwards, Murie, Sander, De Bourges, Mierzejewski, Heschl, Riüdinger, Ferè, Wernicke, Schüle, Engel, Peacock, Aeby, Hamy, Luschka, Broadbent, Mills, Jensen, Weisbach, Voigt, Van der Kolk and Vrolik, Chapman, Calori, Nitsche, Sappey, Lussauara and Lemoigne, Henle, Tuke, Fraser, Major, Mivart, Darwin, Malini verni, Clevenger, Dalton, Edinger, Wilder, etc.

Divisions or Lobes of the Cerebral Hemispheres.

Anatomists primarily divided the cerebral hemispheres into two lobes. Thus Willis, in 1664, recognized only two lobes, an anterior and a posterior. Sömmering, likewise, distinguished but two. He remarks, however, that some anatomists divide the posterior lobe into two parts, under the names of middle and posterior lobes. Meckel says that each hemisphere is usually divided into two lobes, an anterior and a posterior, separated anteriorly, below and laterally, by the fissure of Sylvius. The posterior lobe is again frequently divided into a middle and a posterior, of which the last lies on the tentorium, not separated on the outer surface but only on the medial by an oblique fissure passing from above downward and forward, and on the lower surface bounded by a shallow depression. Burdach used the deeper depressions of the hemisphere to divide off the lobes, but also considered these as being directly related to the cranial bones. The anterior lobe, he remarks, lies in the division of the skull formed by the hollow of the frontal bone and almost fills this, so that the coronal suture corresponds with its posterior boundary. The parietal lobes lie within the parietal bones, so that the coronary and lambdoidal sutures very nearly correspond with their anterior and posterior

1 Cerebri anatome.
2 Gehirn und Nervenlehr.
3 Handbuch der Anatomie, III., p. 479.
4 Vom Baue und Leben des Gehirns, 1826.
border. On the upper and mesial side they are directly continuous with the anterior, posterior and inferior lobes. On the outer side, however, they are separated from these by the prolongation of the fissure of Sylvius backward. Of the lower or inferior lobe, he only remarks that it lies in the middle cranial fossa, but of its posterior boundary he says nothing. The posterior lobe is bounded on its inner surface anteriorly by the Hinterspalte (fissura parieto-occipitalis). On the lateral surface it approaches nearly to the cleft of the Sylvian fossa. Of a boundary on the lower surface, he merely remarks that it lies on the tentorium above the cerebellum. He seemed to think that these divisions corresponded to the contained nervous matter of three cranial vertebrae, and he stated that the divisions of these lobes corresponded in the human brain to the regions covered by the frontal, parietal and occipital bones. Bischoff has shown, however, that this is not so, and that the limits of these bones both in Man and the lower animals does not bear any constant relations to the contained brain.

Krause, in his Anatomy, pp. 1,006-1,008, accepts these divisions of Burdach. Of the posterior lobe, he remarks that on its lower surface it is bounded by a shallow furrow corresponding to the upper angle of the pyramid of the petrosal bone. Valentin, following Sömmering, likewise accepts Burdach's division. The posterior lobe, he says, covers the middle and posterior part of the small brain and forms the hindmost part of the hemisphere, and he states that it corresponds in extent to the upper part of the supra-occipital bone.

Arnold distinguishes five lobes: 1. The anterior or frontal lobe is separated by the fissure of Sylvius, on the outer side posteriorly by a perpendicular fissure (fissura centralis) and superiorly corresponds with the frontal bone, with the exception of the most posterior part of the same, which extends beyond and covers part of the next lobe. 2. The parietal lobe is covered by the posterior part of the frontal and by the larger anterior portion of the parietal bones. It is bounded anteriorly by the perpendicular fissure mentioned above, and inferiorly by the fissure of Sylvius. 3. The occipital lobe corresponds with the posterior part of the parietal bone and with the upper half of the occipital scale (supra-occipital) passes forward and downward without distinct separation into the temporal lobe, so that it seems as though it were a prolongation of the latter. 4. The lower or temporal lobe occupies the middle cranial fossa, one on each side, and is separated anteriorly by the Sylvian fissure and above by the horizontal prolongation of the same. 5. The stem lobe or island of Reil. Arnold was the founder of these five divisions which were afterward adopted by Gratiolet, except that he terms the island of Reil the central lobe (lobus centralis) and the temporal lobe, temporo-sphenoidal.

Huschke followed no definite principle in dividing the cerebrum into lobes. Although he doubts that the brain has adapted itself to the skull but rather the

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1 Handbuch der Anatomie.
2 Schädel, Hirn, etc.
33 Journ. A. N. S. Phila., Vol. X.
reverse, he still follows the coronary suture in order to divide off the anterior or frontal lobe. The parietal lobe, his Zwischencheitellirn, he separates by a transverse cut drawn perpendicular to the corpus callosum and across the hemispheres. Still he remarks that for a future division he would choose the Hinterspalte (parieto-occipital fissure) and a cut passing from it through the outer and lower surface of the hemisphere. Of the boundaries of the inferior lobe Huschke does not speak. Reichert did not direct his attention to the division of the hemisphere into the usual five lobes, because he does not believe that it is founded on any genetic principles. He gives a representation of the hemisphere based on its embryological development. He also regards the occipital lobe as a later development of the hemisphere backward, and therefore only regards it as a secondary lobe.

Sappey recognizes only an anterior and a posterior lobe which are separated by the fossa Sylvii and rejects the division posterior to the Sylvian fissure into a temporal and occipital lobe. He does not note any separation at the upper and inner surface.

R. Wagner distinguishes a frontal, parietal, temporal and occipital lobe and separates the latter above and on the mesial surface in the same manner as Gratiolet, by means of the fissura perpendicularris interna (parieto-occipital.)

Owen defined the occipital lobe as that part which covers the posterior one-third of the cerebellum and extends beyond it. This has, as was shown by Flower and Huxley, no connection with the state of things as they exist in nature. Pansch separates the frontal from the parietal lobe by means of the fissura centralis. He divides the parietal from the occipital lobe by means of the fissura perpendicularis interna, whilst a boundary between the occipital and temporal lobes on the lower surface does not, according to him, exist.

Bišchoff maps out on the cerebral surface the outlines of the different bones, and believes that in this way the brain may be divided into principal parts or lobes. He admits, however, that we cannot take this as a genetic relation and, therefore, this division cannot be transferred to the relations existing in animals or in childhood, for neither comparative anatomy nor embryology would justify it. In his descriptions, however, he follows the divisions into the usual five lobes which were established by Arnold and Gratiolet. He places the posterior boundary of the frontal lobe in front of the anterior central convolution instead of in front of the central fissure; for, as he remarks, this fissure with its surrounding convolutions constitutes a whole, and the tearing apart of these two inclosing convolutions and the placing of one in the frontal and the other in the parietal lobe is not natural. He also considers that on the mesial surface of each hemisphere the boundary between the frontal and parietal lobes is indicated by the anterior central convolution passing into the longitudinal fissure.

The parietal lobe he divides as previous writers have done, and it corresponds

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1 Traité d'Anatomie descript.
2 Annals and Magazine of Nat. History, 1861.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

265
to the division given by Gratiolet, except that he includes the four external 

plis de passage, which Gratiolet placed in the occipital lobe. The boundaries of the occipital lobe are, according to Bischoff, very indistinctly marked. He regards it as filling up that part of the occipital bone above the tentorium and inferiorly extending to the upper angle of the pyramid of the petrosal bone. The separation on the mesial surface from the parietal, is as is generally recognized, by means of the fissura perpendicularis interna or parieto-occipital. Inferiorly, he considers that the occipital lobe passes farther forward than it does at its upper border. This inferior anterior border is a shallow depression, recognized only in the entirely fresh and not yet softened brain, produced by the upper edge of the petrosal ridge. It corresponds to the anterior edge of the hemisphere of the cerebellum. He remarks, however, that this lower boundary is not distinctly given because the convolutions of the occipital lobe fuse with those of the temporal lobe. He believes, nevertheless, that this boundary is marked by distinct furrows, and is also indicated by the course of the arteries. He does not recognize the separation on the lateral surface from the parietal lobe, by means of the fissura perpendicularis externa, for he believes that in the adult human brain this fissure is wanting. The boundary is, according to him, only indicated by an ideal line descending from the upper extremity of the fissura perpendicularis interna, obliquely forward to the lower edge of the hemisphere and by a frequently noticeable nick, the convolutions of the parietal and occipital lobes fusing with one another. With regard to the boundaries of the temporal and Stammlappen (island of Reil) he does not differ from previous writers, except as to the posterior boundaries of the temporal lobe.

Ecker, in his division of the cerebral hemispheres into lobes, does not differ from those who have preceded him. He recognizes the usual five lobes, frontal, parietal, occipital, temporal, and central. These he considers as more or less separated from one another by three fissures, the fissura Sylvii, fissura centralis and fissura parieto-occipitalis.

The English anatomists, Turner, Huxley, Marshall, Flower, Rolleston, etc., in their descriptions of the brain have followed the divisions of Gratiolet and Ecker.

Before proceeding to the new views which the author proposes to apply in studying the morphology of the primate brain, it will be necessary to outline as briefly as possible the topography and nomenclature of the cerebral surface as it is accepted at the present time. This is absolutely essential, since without it, it would be impossible to comprehend the extensive changes as regards the general arrangement and relations of the cerebral fissures and convolutions which the author has to offer. In preparing this general account the author is much indebted to Ecker's work on the convolutions of the human brain,¹ and to Clevenger's Cerebral Topography,² which works have been closely followed.

¹ Die Hirnwindungen des Menschen, etc., 2d ed., Braunschweig, 1883.
² Journal of Nervous and Mental Disease, October, 1879.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

NOMENCLATURE AND SYNONYMY OF THE CEREBRAL FISSURES AND CONVOLUTIONS IN THE PRIMATES.

Fissure.

I. Fissura longitudinalis.

*Synonyms:* fissura or scissura cerebri longitudinalis; superior longitudinal sinus; fissura cerebri longitudinalis superior, inferior et horizontalis posterior; interlobular fissure; fissura magna cerebri; interhemispheric fissure.

II. Fissura Sylvii (with ramus ascendens and ramus anterior horizontalis).

*Synonyms:*

Pansch: fissura Sylvii mit ramus anterior horizontalis und ramus anterior ascendens.
Bischoff: Stamm, vorderer senkrechter Ast und hinterer horizontaler aufsteigender Ast der sylvischen Spalte.
Ecker: fissura Sylvii, mit ramus ascendens seu anterior und ramus posterior seu horizontalis.
Henle: fissura lateralis posterior et anterior.
Broca: scissure de Sylvius, branche antérieure et branche ascendente.
Turner: fissure of Sylvius with horizontal and ascending limb.
Gratiolet: fossa de Sylvius.
Pozzi: scissure de Sylvius.
Lussana e Lemoigne: scissura di Silvio.
Richet: scissure de Sylvius.
Various authors: fissura or fossa Sylvii; fissura anterior, inferior et externa; fissura inferior: fissura transversa.

III. Fissura occipitalis.

Pansch: fissura occipitalis.
Ecker: fissura parieto-occipitalis pars medialis et lateralis.
Bischoff: fissura occipitalis perpendicularis interna.
Henle: fissura occipitalis perpendicularis.
Broca: scissure occipitale.
Turner: parieto-occipital fissure, internal and external.
Huxley and Charcot: the same as Turner.
Gratiolet: scissure occipitale interne et externe occipito-parietale.
Lussana e Lemoigne: scissure perpendiculaire.
Ferrier: parieto-occipital fissure.
Foville: scissure postérieure.

IV. Fissura calcarina (rami ascendens et descendens).

Bischoff: fissura hippocampi.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

Henle: fissura occipitalis horizontalis.
Broca: scissure calcarine.
Fowler, Charcot: calcarine fissure.
Lussana e Lemoigne: scissura occipito-parietale interna.
Gratiolet: scissure interne, scissure des hippocampes.
Richet: scissure en pied de cheval, branche supérieure et branche inférieure de la même.

V. Fissura hippocampi.
Pansch, Ecker, Fowler, Charcot, Huxley: fissura hippocampi.
Broca: rainure du grand hippocampi.
Turner: dentate fissure.
Richet, Ferrier: sulcus hippocampi.

VI. Fissura Rolando.
Ecker: sulcus centralis.
Bischoff: sulcus centralis, sulcus Rolando.
Broca: scissure de Rolando.
Huxley: postero-parietal sulcus.
Henle: sulcus centralis.
Huguenin: fossa Rolandi.
Pansch (formerly): fissura transversa anterior.
Turner, Ferrier, Fowler: fissure of Rolando.
Lussana e Lemoigne: scissura di Rolando.
Richet: scissure de Rolando.
Gratiolet: sillon de Rolando.

VII. Fissura parietalis.
Ecker: sulcus inter-parietalis.
Pansch: sulcus parietalis.
Broca: sillon parietal.
Turner, Huxley, Ferrier: intra-parietal fissure.
Richet: sillon parietal.
Lussana e Lemoigne: scissura intermedia.
Various authors: sulcus postcentralis, sulcus postrolandicus.

VIII. Fissura precentralis.
Pansch: sulcus frontalis (posterior division).
Ecker: sulcus precentralis.
Broca: sillon prerolandique.
Turner: ascending limb of Sylvian fissure.
Fowler: vertical frontal fissure.
Lussana e Lemoigne: sillon ascendente.

IX. Fissura frontalis superior.
Pansch, Ecker: sulcus frontalis superior.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

Broca: Richet, premier sillon frontal.
Turner: Huxley, supero-frontal fissure.
Lussana e Lemoigne: scissura di verga.
Various authors: sulcus praecentralis superior, sulcus prerolandicus.

X. Fissura frontalis inferior.
   Pansch: sulcus frontalis (anterior division).
   Ecker: sulcus frontalis inferior.
   Broca: sillon second frontal.
   Turner, Huxley: infero-frontal sulcus.
   Ferrier: inferior frontal fissure.

XI. Fissura temporalis superior.
    Ecker: sulcus temporalis superior.
    Pansch: sulcus temporalis.
    Galton, Ecker: first temporo-sphenoidal fissure.
    Broca: premier sillon temporal.
    Turner: parallel fissure.
    Richet: sillon parallèle.
    Gratialet: scissure parallèle.
    Huxley: superior temporo-sphenoidal fissure.
    Fowler, Charcot: superior temporal fissure.
    Lussana e Lemoigne: scissura parallela.
    Bischoff: fissura parallela, sulcus temporalis superior.

XII. Fissura temporalis medius.
     Ecker: sulcus temporalis medius.
     Bischoff: fissura temporalis medius.
     Broca: deuxième sillon temporal.
     Turner: second temporo-sphenoidal fissure.
     Fowler, Charcot: middle temporal fissure.
     Richet: represented in wood cut but unnamed.

XIII. Sulcus temporalis inferior (?)
     This sulcus is of doubtful constancy.

XIV. Fissura collateralis.
     Pansch, Ecker: sulcus occipito-temporalis inferior.
     Bischoff: fissura collateralis, sulcus temporalis inferior.
     Huxley: fissura collateralis.
     Broca: quatrième sillon temporal.
     Turner: collateral fissure.
     Fowler: sulcus occipito-temporalis lateralis.
     Lussana e Lemoigne: scissura occipito-temporalis.

XV. Fissura olfactorius.
     Broca: premier sillon orbitaire.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

XVI. Fissura calloso-marginalis.
   Ecker: sulcus calloso-marginalis.
   Pansch: sulcus calloso-marginalis and sulcus medialis fronto-parietalis.
   Broca: scissure sous frontale.
   Turner: calloso-marginal fissure.
   Gratiolet: grand sillon du lobe fronto-parietale.
   Ferrier, Huxley, Richet: sulcus calloso-marginalis.
   Lussana e Lemoigne: scissura crocchiata, scissura parietale interna.

XVII. Fissura occipitalis transversus.
   Generally portrayed as a ramus at the lower end of the fissura parietalis. It
   is important as a means of bounding Gratiolet's plis de passage on the
   occipital extremity.

XVIII. Fissura orbitalis.
   Ecker: sulcus orbitalis.
   Ferrier: orbital sulcus.
   Fowler: orbital sulcus.
   Henle: indicated.
   Gratiolet: sillon de la face orbitaire du lobe frontal.
   Lussana e Lemoigne: solco orbitale.

XIX. Fissura occipitalis longitudinalis inferior. Ecker.

XX. Fissura paracentralis.
   Betz: transverse furrow of the paracentral lobule.

CONVOLUTIONS.

A. External Surface.

I. Gyrus frontalis superior.
   Pansch: gyrus frontalis superior.
   Ecker: erste Stirnwindungsgruppe.
   Henle: oberster gyrus frontalis.
   Huxley: supero-frontal gyrus.
   Broca: première circonvolution frontale.
   Turner: superior frontal gyrus.
   Huguenin: dritte Stirnwindung.
   Valentin: gyrus adplicatus anterior.
   Lussana e Lemoigne: circonvoluzione parietal anteriore.
   Ferrier: superior frontal convolution.
   Fowler, Charcot: first frontal convolution.
   Richet: première circonvolution frontale.
   Gratiolet: première circonvolution frontale.

II. Gyrus frontalis medius.
   Pansch: gyrus frontalis medius.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

Bischoff: zweite Stirnwindungsgruppe.
Henle: mittlere gyrus frontalis.
Broca: deuxième circonvolution frontale.
Turner: middle frontal gyrus.
Hueguenin: zweite Stirnwindung.
Lussana e Lemoigne: circonvoluzione circolare.
Ferrier: middle frontal convolution.
Fowler: second frontal convolution.
Gratiolet, Richet: deuxième circonvolution frontale.
Huxley: medio-frontal gyrus.

III. GYRUS FRONTALIS INFERIOR.
Ecker: gyrus frontalis tertius seu inferior.
Bischoff: dritte Stirnwindungsgruppe.
Henle: unterer gyrus frontalis, gyrus transitions (nach Huschke).
Broca: troisième circonvolution frontale.
Turner: inferior frontal gyrus.
Hueguenin: erste Stirnwindung.
Lussana e Lemoigne: circonvoluzione spirale.
Ferrier: inferior frontal convolution, Broca’s convolution.
Fowler: second frontal convolution, Broca’s convolution.
Gratiolet, Richet: troisième circonvolution frontale.
Huxley: infero-frontal gyrus.

IV. GYRUS ROLANDICUS ANTERIOR.
Pansch: gyrus Rolandicus anterior.
Ecker: gyrus centralis anterior.
Bischoff: vordere Centralwindung.
Henle: gyrus centralis anterior.
Broca: circonvolution prerolandique.
Turner: ascending frontal gyrus.
Fowler: ascending frontal convolution.
Ferrier: anterior central convolution.
Hueguenin: vordere Centralwindung.
Lussana e Lemoigne: circonvoluzione parietale anteriore.
Valentin: gyrus adplicatus anterior.
Richet: circonvolution frontale ascendante.
Pozzi: quatrième circonvolution frontale.
Rolando: processi anteriori verticali di mezzo (parte anteriore).
Huxley: antero-parietal gyrus.
Gratiolet: première pli parietal ascendant.

V. GYRUS ROLANDICUS POSTERIOR.
Pansch: gyrus Rolandicus posterior.
Ecker: gyrus centralis posterior.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS. 271

Bischoff: hintere Centralwindung.
Henle: gyrus centralis posterior.
Broca: circonvolution postrolandique.
Turner: ascending parietal gyrus.
Huguenin: hintere Centralwindung.
Lusanna e Lemoigne: circonvoluzione-parietale post-lunga.
Valentin: gyrus adplicatus posterior.
Richet: circonvolution parietale ascendente.
Ferrier: posterior central convolution.
Fowler, Charcot: ascending parietal convolution.

VI. GYRUS PARIETALIS SUPERIOR.
Pansch: gyrus parietalis superior.
Ecker: lobulus parietalis superior.
Bischoff: Vorzwieckel und innere obere Scheitelbogenwindung.
Henle: præcuneus.
Broca: première circonvolution pariétale.
Turner: postero-parietal lobule.
Ferrier: postero-parietal lobule.
Fowler: superior parietal lobule.
Richet: lobule pariétal supérieur.
Huguenin: dritte Scheitelwindung.

VII. GYRUS PARIETALIS INFERIOR.
Pansch: lobulus parietalis inferior.
Ecker: lobulus parietalis inferior, a. lobulus supra-marginalis, b. gyrus angularis.
Bischoff: vordere und mittlere Scheitelbogenwindung.
Henle: lobulus tuberis.
Broca: deuxième circonvolution pariétale.
Turner: lobule of the supra-marginal and angular gyri.
Richet: lobule parietal inférieur et pli courb.
Ferrier: inferior parietal lobule, gyri supra-marginalis et angularis.
Lussana e Lemoigne: lobo quadrangulare.
Huguenin: erste und zweite Scheitelwindung.
Fowler: inferior temporal lobule, lobulus parietalis inferior et gyrus angularis.

VIII. GYRUS TEMPORALIS SUPERIOR.
Pansch: lobulus temporalis superior.
Ecker: gyrus temporalis superior.
Bischoff: erste obere Schläfenwindung.
Huguenin: erste Schläfenwindung, gyrus temporalis I.
Broca, Richet: première circonvolution temporale.
Turner: superior tempo-ro-sphenoidal convolution.
Lussana e Lemoigne: prima circonvoluzione temporale.
Ferrier: first tempororo-sphenoidal convolution.
Fowler: first temporal convolution.

IX. Gyrus temporalis medius.

Pansch: upper half of lobulus temporalis inferior.
Ecker: gyrus temporalis medius.
Bischoff: zweite mittlere Schläfenwindung.
Henle: unnamed but indicated.
Broca: deuxième circonvolution temporale.
Turner: middle tempororo-sphenoidal convolution.
Huguenin: zweite Schläfenwindung, gyrus temporalis II.
Lussana e Lemoigne: secondo circonvoluzione temporale.
Gratiolet: pli temporal moyen.
Valentin: supplementum gyri anguiformis posterior et inferior.

X. Gyrus temporalis inferior.

Pansch: gyrus temporalis lateralis.
Lussana e Lemoigne: terza circonvoluzione sfeno-temporale.
Gratiolet: pli temporal inférieur.
Rolando: processo semi-duplicato del lobo di mezzo.

B. Median Surface.

XI. Gyrus marginalis.

Pansch: gyrus medialis fronto-parietalis of the lobulus medialis anterior.
Ecker: gyrus frontalis supérieur, mediale Fäche.
Bischoff: Innerfläche des ersten Stirnwindungszuges und obere Bogen-
verbindung der Centralwindungen.
Broca: première circonvolution frontale.
Turner: marginal gyrus.
Richter: face moyenne de la primière circonvolution frontale.
Lussana e Lemoigne: Cintura periferica.
Huxley: marginal convolution.

XII. Gyrus fornicatus.

Pansch: gyrus cinguli of the lobulus medialis anterior.
Ecker: gyrus fornicatus and praecuneus.
Bischoff: gyrus fornicatus.
Broca: grande circonvolution du corps calleux.
Turner: convolution of corpus callosum and quadrilateral lobule.
Huguenin: gyrus fornicatus.
Fowler: convolution of corpus callosum.
Lussana e Lemoigne: processo quadrilatero e circonvoluzione madre-interna
dell' orletto.
Valentin: circonvolutio cristata.
Richet: precuneus et gyrus fornicatus.

XIII. Gyrus cuneus.
  Pansch: lobulus medialis posterior, gyrus medialis occipitalis seu cuneus.
  Ecker: gyrus cunei.
  Henle: cuneus.
  Broca: lobule triangulaire.
  Turner: cuneus or occipital lobule.
  Bischoff: Zwinkel.
  Lussana e Lemoigne: circonvoluzione angulare-occipitale.

XIV. Gyrus occipito-temporalis medialis.
  Pansch: lobulus occipito-temporalis medialis.
  Ecker: gyrus occipito-temporalis medialis seu gyrus Hippocampi.
  Bischoff: untere innere Hinterhauptwindungszug und gyrus Hippocampi.
  Huschke: lobulus lingualis.
  Henle: gyrus Hippocampi.
  Huguenin: Zungenwindung.
  Broca: cinquième circonvolution temporale.
  Turner: uncinate gyrus, middle internal temporal gyrus.
  Richet: gyrus hippocampi et gyrus uncinatus et lobulus lingualis.
  Ferrier: gyrus uncinatus, uncus gyri fornicati, subiculum cornu ammonis and
          crochet with gyrus occipito-temporalis medialis (lobulus lingualis).
  Fowler, Charcot: unciform and hippocampal convolutions.

C. Basilar Surface.

XV. Gyrus occipito-temporalis lateralis.
  Pansch: gyrus occipito-temporalis lateralis.
  Ecker: gyrus occipito-temporalis lateralis.
  Bischoff: unterer äusserer Hinterhauptwindungszug und ein Theil der dritten
          Schlafenwindung.
  Huschke: gyrus fusiformis.
  Broca: quatrième circonvolution temporale.
  Turner: inferior internal temporal gyrus.
  Ferrier: gyrus occipito-temporalis lateralis (fusiformis).
  Richet: gyrus occipito-temporalis, lobulus fusiformis.
  Lussana e Lemoigne: processo fondamentale posteriore.
  Fowler, Charcot: occipito-temporal lateral convolution.
  Huguenin: Spindelwindung.

XVI. Gyrus orbitalis.

SPECIAL LOBULES AND GYRI.

A. External Surface.

a. Gyrus operculum.
  Gratiolet: pli surciliier.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

Various authors: operculum; Klappdeckel; opercule; l'operculo; coperchio; convolution of Broca; circonvoluzione spirale; roof of Island of Reil.

b. Gyrus supra-marginalis.
   Gratiolet: lobule du pli courbé.
   Lusanna e Lemoigne: circonvoluzione marginale.
   Huschke: lobulus tuberis.

c. Gyrus angularis.
   Gratiolet: pli courbé.
   Ferrier, Huxley and others: angular gyrus.

d. Gyrus occipitalis primus.

e. Gyrus occipitalis secundus.

f. Gyrus occipitalis tertius.
   These are the three bridging convolutions or plis de passage of Gratiolet, which Ecker calls first, second and third occipital gyri as above.
   Huxley: annectant external gyri.
   Lusanna e Lemoigne: gyri abrupti e cuneiformi, piega occipitale de passaggio.

B. Median Surface.

g. Gyrus uncinatus.
   Usually mentioned by many names by each writer: gyrus uncinatus; crotchet; gyrus Hippocampi; uncus gyri fornicati; subiculum cornu ammonis; the hook or reduplication of the uncinate gyrus.

h. Gyrus dentatus.
   Hippocampal gyrus of some authors.

i. Gyrus paracentralis.
   Named by Betz, who, with Mierzejewski, discovered here the so-called giant cells.

   K. Gyrus praecuneus.
      The quadrilateral lobule or praecuneus; Vorzwickel; avant coin.

   L. Gyrus descendens.
      Between the rami of the fissura calcarina.

C. Basilar Surface.

   M. Gyrus rectus.

   N. Gyrus orbitalis medius.

   O. Gyrus orbitalis lateralis.

   Figs. 1, 2 and 3, Pl. XXXIV, are diagrams of the human brain, with the various fissures and convolutions numbered and lettered (see Explanation of Plates); whilst figs. 4 and 5 give the corresponding parts as found in a simian brain, Macacus nemestrinus. By means of these one can readily follow the succeeding descriptions.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

FISSURES AND CONVOLUTIONS OF THE PRIMATES.

The order Primates includes the various races of mankind, the apes, monkeys and lemurs. It may be sub-divided into the following groups:

1. LEMURIDÆ
   1. Cheiromyini (Cheirogaleus or Aye-Aye.)
   2. Lemurini (Lemurs or half apes).

2. SIMIADÆ
   1. Arctopithecini (Marmosets of South America.)
   2. Platyrhini (New World): Atelids, Cebus, Oedip穩s, etc.
   3. Cattarhini
      2. Anthropomorpha
         1. Hylobatæ.
         2. Pithecæn
         3. Troglophytès: niger and Gorilla.

3. ANTHROPIDÆ
   2. Leiotrichi

1. Australoid.—Australia and in the Dekhan.
2. Mongoloid.—Mongol, Tibetan, Chinese, Polynesian, Esquimaux and American races.
4. Melanochroic.—Iberians, Black Celts and dark complexioned white races.

By many, and recent evidence confirms this view, the Lemurs or Lemuroid animals are placed in a distinct sub-order of the Primates; or even by some as forming an order apart, without any very near affinities with the animals with which they have hitherto been so closely associated. *Anaptomorphus homunculus* from the Lower Eocene of Wyoming, an animal smaller than *Tarsius spectrum*, is considered by Cope to be "the most simian lemur yet discovered, and probably represents the family from which the true monkeys and men were derived." The Lemuroidea have been divided as follows:

**Family 1. LEMURIDÆ**

<table>
<thead>
<tr>
<th>Sub-Families</th>
<th>Genera</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Indrisinæ</td>
<td>Indris</td>
</tr>
<tr>
<td></td>
<td>Propithecus</td>
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<tr>
<td></td>
<td>Avahi</td>
</tr>
<tr>
<td>2. Lemurinæ</td>
<td>Lemur</td>
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<tr>
<td></td>
<td>Hapalemur</td>
</tr>
<tr>
<td></td>
<td>Lepilemur</td>
</tr>
<tr>
<td>3. Galaginiæ</td>
<td>Cheirogaleus</td>
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<tr>
<td></td>
<td>Galago</td>
</tr>
<tr>
<td>4. Lorisinæ</td>
<td>Loris</td>
</tr>
<tr>
<td></td>
<td>Nycticebus</td>
</tr>
<tr>
<td></td>
<td>Perodicticus</td>
</tr>
</tbody>
</table>

**Family 2. TARSIIDÆ**

**Family 3. CHIROMYIDÆ**
The monkeys and apes have also been arranged as follows:

<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Sub-Families</td>
<td>2. Semnopithecæ</td>
<td>Simia</td>
</tr>
<tr>
<td></td>
<td>3. Cynopithecæ</td>
<td>Hylobates</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Semnopithecus</td>
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<tr>
<td></td>
<td></td>
<td>Colorus</td>
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<tr>
<td></td>
<td></td>
<td>Cercopithecus</td>
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<td></td>
<td>Macacus</td>
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<td></td>
<td>Cynocephalus</td>
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<td></td>
<td>Atelæ</td>
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<td>Brachyurus</td>
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<td></td>
<td>Lagotrichæ</td>
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<td></td>
<td>Cercus</td>
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<td></td>
<td>Mycetes</td>
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<td></td>
<td></td>
<td>Pithecia</td>
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<td></td>
<td>Brachyrhynchos</td>
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<tr>
<td></td>
<td></td>
<td>Nyctipithecus</td>
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<tr>
<td></td>
<td></td>
<td>Chrysothrix</td>
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<tr>
<td></td>
<td></td>
<td>Callithrix</td>
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<tr>
<td></td>
<td></td>
<td>Hapale</td>
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<tr>
<td></td>
<td></td>
<td>Midas</td>
</tr>
</tbody>
</table>

The mistake is often made by those studying the fissures and convolutions of other orders of mammalia, of attempting to compare their convolutional characters with those of the Primates, including Man. These mistakes have been made not so much by comparative anatomists as by physiologists in attempting to transfer to the case of Man experiments made upon the lower animals in respect to cerebral localization. From all the evidence at our command the Primates are only closely related to the group of the discoidal placental mammals, a group which includes, besides the Primates, the orders Rodentia, Insectivora and Chiroptera. Thus, the genetic affiliation of the Primates with the other existing mammalian orders must have been through an almost smooth-brained ancestor, and as a consequence of this the fissuration of the primate brain must be studied as a type of itself. We cannot expect, nor do we find any exact homological relations between the convolutions of this phylum and those of the other mammalian phylla possessing convoluted brains, which formerly were grouped together by Owen under the name of the Gyrencephala.

MORPHOLOGY.

From the preceding historical and general survey, it will be seen that the subject of convolutional morphology is a highly complex one and the difficulties have been greatly increased by the various, and in many cases unsuitable, nomenclature that has at different periods been applied to the numerous gyres, lobules, fissures and sulci of the cerebral surface. Evidently there must be certain morphological laws or principles upon which the production of fissures and convolutions depends, and if it be possible to discover those laws, it will undoubtedly give rise to a simpler and more methodical system of naming the different parts of the great brain surface. We have already seen that Huschke, Bischoff and Pansch have each attempted to formulate such a plan; but to all of these the writer believes there are certain fundamental objections, the nature of which will be pointed out in the following pages.
MORPHOLOGY OF THE CEREBRAL CONVOLUSIONS.

Reference has been made to the only three conceivable theories which can be held to account for the various cerebral depressions and elevations. According to the first of these, which is advocated by Ecker and some others, the fissures and convolutions are believed to be due to the effect of pressure: the brain mass growing more rapidly than the containing bony cavity, the increased cerebral surface is necessarily thrown into folds and depressions, the directions, relations, height, breadth and depth of which must evidently depend upon the relative or differential rates of growth in different regions of the brain-mass and its bony environment. A study of the brain surface according to this view would, therefore, be really a mechanical problem involving the determination of the differential composition and resolution of the component strains and pressures produced by brain growth as compared with skull expansion. Undoubtedly many and, indeed, most of the important fissures, those formed earliest in the history of development, are produced in this manner, and it is proposed in this paper to attempt to establish as part of the morphological plan upon which the fissures and convolutions are built up that this is really the case; that these typical or foundation fissures are modified, turned aside, rendered more tortuous and complex by laws of growth peculiar to different regions of the cerebral mass itself, and in this way to determine—to repeat a previous quotation from Ecker—"the law (or plan) of the formation of the convolutions; that is, the formation of the convolutions as a necessary consequence of certain mechanical processes in the growth of the brain and skull. Up to the present time, however, we are far removed from such knowledge. At the farthest, the the fossa Sylvii is open to an explanation from this point of view." It will be shown that not only the fossa Sylvii but many other of the primary and fundamental fissures, those which lay down the groundwork or plan of the cerebral hemisphere, are produced in this way.

The second theory depends for its explanation upon genetic principles having their seat in the brain substance itself. This view is held by Pansch, who insists "that in Man and the apes there is in fact a natural system of the convolutions; that is, a practical division of the cerebral surface which does not depend upon chance, but upon genetic principles, and that the convolutions owe their origin to a difference in growth in certain portions of the surface." Bischoff, from his insistence that all of the principal and primary furrows are surrounded at each extremity by arched convolutions, and that they cannot according to his view be at any time absent, must also accept this theory as the explanation of the production of the depressions and elevations of the cerebral surface. In treating of the relations of the brain to the cranial bones he remarks: "I believe that in this way the brain may be divided into principal parts or lobes." He declares, however, that we cannot take this as a genetic relation, and that it cannot, therefore, be transferred to the relation existing in animals or in childhood. We can, therefore, recognize from the relations of the surrounding bones to the different parts of the large brain no principle founded in the genetic relations of the two. Different, however, is the case in re-
spect to the development of the hemisphere itself, by which a separation of the same into different divisions very decidedly and distinctly appears.

Huschke\(^1\) also doubts that the brain has adapted itself to the skull, but holds rather that the reverse is the case.

The third and last view is merely a combination of the other two. According to this, certain of the fissures and convolutions, including the most important, are produced by merely mechanical causes, whilst others owe their origin to morphological processes of growth in the brain substance itself, the fissures representing lines of retarded, whilst the convolutions represent areas of increased growth.

The last is the view adopted by the writer.

**DEVELOPMENT OF THE BRAIN.**

The brain arises from the primitive medullary tube, first by the expansion of its anterior end into three so-called cerebral vesicles known as the primary cerebral vesicles. From the most anterior of these, which eventually forms the cavity of the third ventricle of the brain with its surrounding parts, known as the thalamencephalon, there are given off anteriorly a pair of secondary vesicles, known as the right and left cerebral vesicles, and these give rise respectively to the right and left hemispheres, the contained cavities becoming the corresponding right and left ventricles, which communicate posteriorly with the third ventricle by means of a common Y-shaped opening, the foramen of Munroe, as shown in fig. 1. It will be seen that the two hemispheres at this stage of evolution consist of two ovoidal sacs connected with the thalamencephalon posteriorly, whilst anteriorly they each give off in their turn a vesicle which becomes the olfactory bulb. As development proceeds there arise in connection with these sacs all the important structures of the adult brain. A portion of the internal walls on each side forms the corpora striata, whilst the remaining portion develops the cerebral mass, the outer or peripheric wall differentiating into the cortical surface, producing the covering of gray ganglionic material which forms the substance of the cerebral convolutions. The cavities form the lateral ventricles, and these, following the development of the cerebral sacs, assume with them a crescentic form, the anterior portion of which bends around the cerebral peduncle to form the anterior or frontal portion, whilst the posterior or inferior curves downward and forward underneath the cerebral peduncle to form the inferior or temporal portion of the hemisphere. In this way is produced the

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\(^1\) Schädel, Hirn, etc.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

anterior and middle or descending horn of the lateral ventricle. This stage of
development is well represented in the figure of a three months human foetal
brain, Plate XXXV, fig. 1, where cp. is the cerebral peduncle, F the frontal, T
the temporal and P the posterior portion of the crescentic cerebral vesicle, whilst
S shows the position of the commencing fossa of Sylvius. It will also be noticed
that the mechanical action due to the surrounding cranial bones is exerting its
influence in moulding or pressing the hemispherical mass into shape; for whilst
the outer portion of the cerebral sacs retain their primitive rotundity, owing to
the external resistance, they have been forced together in the median line, thus
producing two opposed flat surfaces, the future mesial portions of the hemispheres.
In this way is produced the great longitudinal fissure, separating the two hemi-
spheres in the median plane. This fissure in all animals below the mammalia
extends downward and forward as far as the lamina terminalis. Lt., fig. 1, which is
simply the anterior wall of the first primitive cerebral vesicle. In the mammals,
however, owing to the evolution of the corpus callosum, it extends anteriorly and
above merely to this great commissure. Plate XXXV, fig. 2, is a lateral view of
the same foetal brain shown in Plate XXXV, fig. 1. The crescentic shape of the
hemispherical sac is very apparent and in OF and OT can be seen those portions
which develop into the frontal and temporal lobes. The occipital lobe has not
as yet made its appearance but develops shortly afterward, as can be seen in
Plate XXXV, figs. 3 and 4, which represent the human foetal brain towards the
end of the fourth month. The posterior portion of the hemispherical sac has
developed backward, producing a distinct occipital lobe, O, the lateral ventricle
following to form the posterior horn.

In this way we have developed from the original ovoidal shaped cerebral vesicle
a hollow nervous bud connected with the thalamencephalon and posterior portions
of the central nervous system by the cerebral crura. This bud is arranged after
a tri-radiate plan and marks out what I believe to be the future lobes of the hemi-
sphere. I distinguish, therefore, only three lobes to each hemisphere: an anterior,
an inferior and a posterior; thus returning to the old sub-divisions of Burdach.
For these three lobes I propose the following names:

1. Occipito-Frontal=Anterior of Burdach et al.
2. Occipito-Temporal=Inferior of " "
3. Occipital=Posterior lobe of " "

As regards the so-called parietal lobe of recent writers I can by no means ad-
mit that it represents a lobe of the hemisphere in any morphological sense compar-
able or homologous to the three lobes described above. The consideration of this
region however, we will leave for the present.

These three lobes, as above described, are related to the fundamental structure
of the cerebral vesicle, its cavity and the three horns of the lateral ventricles. The
occipito-frontal lobe arches forward and descends around the position of the cere-
bral crus above. The occipito-temporal arches downward and forward beneath the
28 JOURN. A. N. S. PHILA., VOL. X.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

crus, whilst the occipital passes directly backward. The arrangement is, therefore, that of a symmetrical, tri-radiate, hollow, nervous bud, separated anteriorly by a depressed fossa, the fossa of Sylvius.

The Island of Reil, or central lobe of recent writers, develops at the bottom of this depressed area, directly opposite the point of entrance of the cerebral peduncle and immediately lateral of the corpus striatum, with which it has close and important connections. It is not in any sense morphologically similar to the other lobes of the hemisphere and should not, therefore, be considered in the same light with them. I would, therefore, propose for it the name central nucleus of the cerebral cortex or lobulus centralis.

This is evidently the fundamental morphological type or plan of the cerebral hemisphere and I shall attempt to show that the fissures and convolutions of the cerebral cortex are related in a regular and symmetrical manner to these hollow tri-radiate hemispherical buds.

CEREBRAL FISSURES.

Before the appearance of the permanent fissures of the hemisphere we find developing towards the end of the third month certain fissures which, with a few exceptions, finally disappear in the fourth month without leaving any trace behind. Tiedemann mentions these furrows and the times at which they appear, but he fell into the error of regarding them as the foundations of the fundamental fissures. Schmidt describes them as appearing in the middle of the third month on the upper surface of the hemisphere as several deep and transverse folds which disappear at the close of the fourth month, stating that they form rather high walls of the lateral ventricles and that the cerebral wall is thinner at these points of folding. Kölliker expresses the same opinion and finds that these furrows reach in the fourth month their greatest development; and, with the exception of a few well marked features in the fifth month, again disappear; so that in the sixth month the brain surface is again entirely smooth. My own observations would lead me to agree with Schmidt as I have found that the brain is entirely smooth a little after the close of the fourth month.

Ecker has also noticed these temporary or transient fissures and convolutions. Bischoff maintains that these furrows are only artificial productions and arise through plications due to the action of alcohol. He says the hemispheres are smooth up to the moment of the origin of the true or permanent fissures and that in brains hardened in chloride of zinc they do not appear. This is certainly not correct, for I have found them in perfectly fresh foetal brains during the fourth month and Plate XXXV, figs. 1, 2, 3 and 4 show them distinctly in brains that were hardened in chloride of zinc. Ecker expresses the same opinion and also explicitly

\[\text{Zeitschrift für wissenschaftliche Zoologie, Bd. XI, 54.}\]
\[\text{Entwicklungsgeschichte.}\]
\[\text{Zur Entwicklungsgeschichte der Furchen und Windungen auf den Grosshirnhemisphären des Menschen und der Affen. Archiv für Anthropologie, 3er Band.}\]
\[\text{Die Grosshirnwindungen}\]
states that he has found them in the brains of embryos of the third month, which he had especially examined in the fresh condition. Foetal brains hardened in alcohol do, it is true, show contractions, but these are quite different in appearance from these furrows, well seen in their internal and external characters in Plate XXXV, fig. 4, where, through the absence of a part of the wall of the cerebral vesicle, the internal projection can be plainly seen in the portion marked x. Undoubtedly the causes or forces acting to produce these plications are due to the fact that the hemisphere is growing much more rapidly than the surrounding skull, and the fact that the cerebral sac again becomes smooth proves that later the skull accommodates itself to this increased growth by a more rapid expansion, and, as a consequence, these plications unfold. These foldings may, therefore, be well called the temporary plications or furrows. That they bear precise and definite mathematical relations to the relative growth of brain and skull is shown by their mode of arrangement. On the outer surface, as can be seen by referring to Plate XXXV, figs. 2 and 3, they radiate toward the middle of the fossa of Sylvius which evidently is the centre of pressure, and it can readily be understood from the dome shaped resisting surface of the interior of the skull that the resolution of pressure forces could produce just such an arrangement of plications when acting upon a hollow-walled plastic body. A longer posterior radiating fissure, Plate XXXV, fig. 3, Pt, has the same direction as the longitudinal axis of the Sylvian fossa, indicating that the same forces are at work, at this time, in the production of these two depressions. Later on, owing to the increased rapidity of growth of the frontal over the temporal and occipital portions, the lines of strain do not follow the same direction, the axis of the Sylvian fossa assuming a more oblique position, as shown in Plate XXXV, fig. 3, where Pt. is the posterior temporary fissure. On the mesial surface, Plate XXXV, fig. 4, the mathematical regularity is even more pronounced, since the conditions are simpler, the resolution of forces taking place along a plane instead of upon an irregularly spheroidal surface. The accompanying diagram, fig. 2, was made directly from the brain represented in Plate XXXV, fig. 4, before mutilation and distortion had occurred. Upon the mesial occipito-frontal surface we find six temporary furrows which converge to a common centre situated at about the centre of the hemisphere, at the point where the cerebral crus passes into the striated body directly opposite or beneath the position of the point of concentration of the external radiating fissures, situated along the axis of the Sylvian fissure, as can be seen by comparing Plate XXXV, figs. 3 and 4. Moreover these axes of prolongation are inclined to each other at about or very closely approaching our angle of 30°. One of these fissures, axis of prolongation A Y, fig. 2, is perpendicular to A X, the axis of
prolongation of two fissures, one in the frontal and the other in the occipital lobe, fissure 4 running parallel to and with the same inclination as the axis of the Sylvian fissure.

In the occipito-temporal lobe we find three furrows radiating from a centre common with those of the occipito-frontal and following the direction of the prolongations of the axes A Y and 2, 7.

The posterior prolongation of the hemisphere forming the occipital lobe seems to be symmetrically developed in a relation to a centre of its own, which is situated at the junction of the three horns of the lateral ventricle at B, fig. 2, and Plate XXXV, fig. 4. Two fissures, 5 and 6, separate the occipital region. O, from the occipito-frontal above and the occipito-temporal below, and are prolonged outward for some distance upon the lateral surface of the hemisphere. On the mesial surface they are inclined at an angle of 60° to B, X, and are, therefore, respectively parallel to the axes of prolongation 2, 7, and A 4. These two fissures cut off a posterior rhomboidal shaped mass, which, more or less modified, becomes the future occipital lobe.

Besides the radiating fissures we also find upon the mesial surface an arched fissure surrounding the corpus callosum and fornix, the Bogenfurche of Arnold, or, as I should prefer to call it, the mesial arched fissure (fissura arcuratus medialis). This fissure remains as a permanent fissure, described however, as two separate fissures, the callosal, surrounding the corpus callosum and following the anterior horn of the lateral ventricle, and the hippocampal, following the course of the descending horn. Indeed, these two fissures, or as a whole the mesial arched fissure, depend for their formation upon the presence of these two cavities, and it can readily be seen that the same forces which urge the two hemispherical sacs into contact in the median plane, would also, if continued, produce this crescentic inrolling into the ventricles, forming an arched fissure following in this way the course of the corpus callosum and fornix.

In the same manner there is produced, as a resolution of the pressure forces, an inrolling into the posterior horn of the lateral ventricle, the fissure B X, fig. 2, which is also a permanent fissure and becomes the future fissura calcarina. Thus we find at this early stage the permanent fissures of the mesial surface have a tri-radiate arrangement corresponding with that of the lateral ventricles. The accompanying diagram, fig. 3, will render plain the morphological type of fissuration as regards the permanent fissures of the brain at this early stage in its development. For the fissure as a whole I propose the name fissura tri-radiatus or fissure of the ventricle. For the arched portion (Bogenfurche) the name fissura arcuratus medialis, consisting of an upper anterior portion, the
fissura callosalis or fissure of the anterior horn, and an inferior portion, the fissura hippocampi or fissure of the descending horn. The posterior backward prolongation remains as the fissura calcarina or fissure of the posterior horn.

As development proceeds beyond the fourth month the brain, as we have already mentioned, again becomes almost entirely smooth, and we see the conditions produced represented in Plate XXXV, figs. 5 and 6, of the human foetal brain at the middle of the fifth month. We have here what I believe is not only the fundamental morphological plan of the human brain, but also that of all the Primates, with the possible exception of some of the Lemuridae. It is for these reasons that I separate the Primate brain into the following divisions, based upon the internal structure of the cerebrum itself, as shown by its ventricles and upon the appearance of certain fundamental and primary fissures.

LOBES.

1. The occipito-frontal lobe, following and surrounding the anterior horn of the lateral ventricle and having for its plan fissure the fissura callosalis: O F Plate XXXV, figs. 5 and 6.

2. The occipito-temporal lobe, following and surrounding the descending horn, and having for its plan fissure the fissura hippocampi: O T, Plate XXXV, figs. 5 and 6.

3. The occipital lobe surrounding the posterior horn and having for its plan fissure the fissura calcarina: O, Plate XXXV, figs. 5 and 6.

4. The central lobule (Island of Reil) C, Plate XXXV, fig. 5.

PRIMARY OR TYPICAL FISSURES OF PRIMATE BRAIN.

1. The fissura Sylvii or fossa of Sylvius.

2. The mesial arched fissure; consisting of:—

3. The callosal fissure, surrounding the corpus callosum and following the anterior horn.

4. The fissura hippocampi, following the fornix and descending horn.

5. The fissura calcarina, following the posterior horn.

These fissures form the fundamental or plan fissures upon which the convolutions of all primate brains are based. They are not only the first to appear in the development of the human brain and in all other Primates, as may be seen by reference to the plates; but they have also definite relations to the hemisphere itself. We shall also find that all of the other fissures and convolutions, as they appear during the development of the brain, are related in a definite manner to these primary furrows.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

I divide the fissures of the cerebral surface into five classes as follows:

1. Primary or fundamental fissures.
2. Secondary fissures.
3. Sulci (following Pansch) which are usually either vegetative repetitions of the secondary fissures as a whole, or they are due to the separation of these fissures into a number of similar parts. They are the lesser cortical fissures or furrows, constant in the adult brains of the higher Primates, including Man.
4. Sulpuli (Pansch), inconstant or little sulci or furrows, having no apparent regular location or relationship to the convolutions; they are usually vegetative repetitions of the sulci.
5. Rami, constant branches of fissures or sulci, etc.

PRIMARY FISSURES.

These fissures constitute, according to the morphological view I have to offer, the typical fundamental fissures of the hemispheres in the Primates, and I will attempt to show that all the remaining fissures bear precise and symmetrical relations to them.

The fundamental or plan fissures are, as has been pointed out, few in number and simple in character, bear precise and symmetrical relations to the structure of the hemisphere, and are produced by a purely mechanical action taking place between the growing brain and the expanding skull. In the early stages of development the differential forces produced are simple in their relations as indicated by the precise and mathematical regularity of the direction and position of the temporary radiating furrows. As development proceeds these relations become more and more complicated; so much so that when the secondary fissures commence to make their appearance the primitive simplicity has entirely disappeared and the directions of the lines of least and greatest resistance to brain growth have not only changed but they commence to assume a more or less tortuous aspect.

These conditions and the accompanying results will be pointed out as we proceed. Plate XXXV. figs. 5 and 6, show the human foetal brain at the middle or toward the end of the fifth month. With the exception of the Sylvian fissure it is entirely smooth on the lateral aspect; whilst on the median we see well developed the fissura tri-radiatus with its various branches as given in the diagram, fig. 3.

Having now pointed out the general relations and connections of these fundamental or plan fissures in the developing human brain, it becomes necessary to inquire into their constancy throughout the Primates. I have found that the evidence, as derived from these sources, is not only in harmony with the results to which I had been led by a study of the foetal human brain, but seems almost sufficient of itself to demonstrate that the fissures pointed out above as fundamental and establishing the true morphological type or plan, have in every respect the significance and importance which has been ascribed to them. I think it will also serve to show that many of the fissures on which more attention has been bestowed and
which have been considered as fundamental and establishing the morphological type, such as the fissura centralis (fissure of Rolando), the ramus anterior ascendens of the fissura Sylvii, the fissura perpendicularis internus (parieto-occipital), etc., have not the significance that has been attached to them, but belong to the class of secondary fissures which we have not as yet discussed. It is true that in Man and most of the Primates these fissures attain great importance as respects depth, form and constancy of development. This, however, is due to special conditions of growth and not to any increased morphological significance. I regard, for instance, the fissura centralis in the same light and as of the same importance morphologically as the fissura frontalis, superior et inferior and the fissura temporalis superior et inferior, etc. To the fissura parieto-occipitalis may be ascribed a somewhat deeper significance. The reasons which have led me to these conclusions will be given in another place.

FISSURA SYLVII.

The fissure or fossa of Sylvius is the most constant and important of all of the fissures of the hemisphere, and may be recognized in the brains of all the Primates as a typical, well marked fissure. With regard to the fundamental and primary nature of this fissure there can be no doubt, and on this point all writers are agreed. According to Pansch, it is, however, absent in *Chiromyys*, at least in the sense in which it exists in the other Primates; that is, there is no Island of Reil covered by an overgrowing mantel or operculum. In Plate XXXIV, fig. 24, may be seen the brain of the Aye-Aye, *Chiromyys*, and a fissure, S., which at least represents in appearance and position the fissure of Sylvius. Pansch, from this and other facts, does not believe that the Aye-Aye should be classed with the Primates, but that it belongs to another group principally constituted by the Carnivora. With this exception it is uniformly present, together with an accompanying operculum which covers the Island of Reil.

It is found distinct and well marked in the brain of Man at the end of the third month. Plate XXXV, figs. 1 and 2. The Sylvian is here seen as a broad depression or fossa, S.S., extending backward from the place of entrance of the cerebral peduncle, C.P., to a position midway between this point and the posterior part of the hemisphere. It serves, even at this early date, to divide the hemisphere into two parts, an occipito-frontal, O.F., and occipito-temporal, O.T. The floor of this fossa at its anterior part becomes the future Island of Reil or lobulus centralis, which corresponds internally with the position of the corpus striatum. The two portions, O. F. and O. T., grow forward as development advances, in such a manner that the whole hemisphere appears bent into an arch around the point of entrance of the cerebral peduncle.

As development advances, this fossa gradually deepens and also widens at its anterior portion. From the material at my command it seems to attain its maximum breadth at about the middle or toward the end of the fifth month. In the brain of a foetus at the middle of the fifth month, hardened in chloride of zinc, I
found it on measurement to be \( \frac{7}{16} \) of an inch. In one of five months it was about the same. Between the fifth and sixth month it gradually becomes narrower. In a foetus of the middle of the sixth month it measured \( \frac{5}{16} \) of an inch. Its length also increases as development advances. At three months the fossa was \( \frac{1}{2} \) of an inch long, at three and a half months, \( \frac{3}{4} \) of an inch; at four and a half months, \( \frac{5}{8} \) of an inch; at five and a half months, \( \frac{1}{2} \) of an inch. Its general shape also changes. Thus, at the end of the third month it has the appearance of an oval-shaped fossa. This oval shape is still present at the middle of the fourth month, Plate XXXV, fig. 3. At the middle of the fifth month this fossa has assumed a triangular shape, Plate XXXV, fig. 5. This triangular shape is also preserved at the middle of the sixth month, Plate XXXV, fig. 7. In both of these the floor is seen raised up. This is the portion that has received the name of the central lobule or Island of Reil. Ecker, in a brief note on the development of this fissure, does not give the shape as triangular at this early period. He says, "at the end of the sixth month this oval trench is changed by the formation of the anterior or upright branch (fissura Sylvii) into a triangular one." (Edes' transl.) The figures of Pl. XXXV will show, however, that the shape of this fossa is triangular some time before the anterior branch of the Sylvian makes its appearance, there being no indication of its presence in either figure 5 or 7. This wide fossa is gradually narrowed. The temporal lobe grows upward to some extent, but the closing is mainly effected by the development downward of the frontal. This development is rather peculiar. It is not by a direct growth downward of the whole lobe but by a fold of the frontal rolling downward and backward over the floor of the fossa, gradually shelving it in. In Plate XXXV, fig. 5, the formation of this shelf is just perceptible, while in fig. 7 it may be seen extending downward to a slight extent, the thickness of the fold being at this stage about one-eighth of an inch. In this way, as may be seen by comparing figs. 3, 5 and \( \frac{7}{16} \) of Plate XXXV, and figs. 1, 3 and 7, Plate XXXVI, is the fossa gradually filled up, until it becomes, at about the time of birth, a mere fissure. In this way is the Island of Reil gradually covered. The fold has, from this, received the name of the operculum, because it covers or conceals the central lobe. The fissure of Sylvius thus at an early date divides, anteriorly, the hemisphere into two lobes.

At the end of foetal life the fissure is not yet completely closed and the Island of Reil may be distinctly seen without pulling apart the two edges of the fissure. In the adult white brain this concealed lobe is not visible. Curiously enough, however, in the brain of the negro it is distinctly visible; the brain of the negro approaching in this respect a foetal character. I have observed this condition in many negro brains that I have examined with special reference to this point. Marshall also found it in the brain of a Bushwoman, and Gratiolet described the same condition as existing in the brain of the Hottentot Venus. Both of these writers recognized its foetal character, and it would, therefore, seem with good reason to be a characteristic of the negro brain as compared with that of the white race. An interesting fact in this connection is that in the brain of several mulattos the Island was also visible but to
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

287

a less extent than in the brain of the negro, thus occupying in this respect an intermediate position between the negro and white, a condition we might almost a priori be led to expect. Plate XLI, fig. 1, and Plate XLII, fig. 1, are drawings from photographs of two negro brains, and it will be seen that, owing to the development of the ascending or perpendicular branch of the Sylvian fissure the third frontal convolution is deficient just over the position of the Island.

This peculiarity of the negro brain, although it is fetal in its character, has not been found in the brains of any of the adult Primates with the exception of some of the Anthropomorpha. Pansch has stated that he has found it not only in the gorilla but also in a chimpanzee and in an orang brain. It must, however, be exceptional in the two latter species. I have had the opportunity of studying the brains of two chimpanzees and one orang and in none of these was it present, as may be seen in the figure of the chimpanzee brain, Plate XXXIX, fig. 4, where, although the ascending Sylvian, a. s., is present and well developed, the Island is entirely hidden. Bischoff also states that he has observed it in the brain of a gorilla and also in a female orang brain. Neither the descriptions nor the plates of anthropoid brains given by Owen, Vrolik, Tiedemann, Turner, Rolleston, Marshall, Gratiot-le, or Duvernoy give this condition as existing, nor is the Island stated specially to be covered. Huxley, however, gives a plate and also makes the statement that the insula is uncovered. In all other Primates as far as known the anterior branch of the Sylvian is either rudimentary or does not develop, and as a result the Island is never exposed. It would appear, therefore, that this condition is found only in the negro and higher apes.

The Sylvian fissure begins at the base of the brain back of the point of origin of the olfactory nerves. It runs thence outward and then ascends obliquely upward and backward. In respect to the general direction of this fissure I have found a difference in the negro as compared with the white brain. In the latter it ascends as we have remarked, obliquely backward and upward; but in the negro brain it assumes at its anterior portion a horizontal direction and the posterior runs in a direction nearly perpendicular to this. This arrangement was also noticed by Marshall in the brain of the Bushwoman, and it may also be seen in the figure given by Gratien of the brain of the Hottentot Venus.

The Sylvian fissure gives off at its anterior portion an ascending branch, A. S, Plate XLI, fig. 1. This passes directly up into the frontal lobe and constitutes the anterior boundary of the so-called operculum. This fissure has been considered by Pansch, Bischoff, Ecker and others as a fundamental fissure. It is true that it makes its appearance early in the history of human development, as may be seen by comparing figures 8 to 16, Plate XXXV, but as we have already seen, it is present as a well-developed fissure only in Man and the Anthropomorpha. A slight indication of it can also be seen in Cynecephalus, Plate XXXVIII, fig. 4, but in the Primates in general there is no sign of its development, as may be noted by examining figures on Plates XXXVII and XXXVIII. I do not, therefore, consider

1 Comparative Anatomy of Vertebrates.

36 JOUR. A. N. S. PHILA., VOL. X.
it as of fundamental morphological significance but regard its appearance as the result of the excessive growth of the frontal region in Man and the few exceptional cases of Anthropomorphs in which it is found.

The appearance and extent of development of the Sylvian fissure in the Arctopithecini, Lemuridæ and the Simiadæ may be seen in Plates XXXVII, XXXVIII, XXXIX.

MESIAL ARCHED FISSURE.

(Fissura arenatus, medialis or interna.)

The mesial arched fissure (fissura callosalis and fissura hippocampi) is, with the Sylvian, the most constant of the fissures of the hemisphere and I consider it of the greatest importance as regards an understanding of the true character and arrangement of the other fissures and convolutions. Previous writers do not appear to have considered this fissure, as a whole, as primary and fundamental. Indeed, curiously enough, many writers do not describe its upper branch, nor do they give it a special name. This upper branch arches around the corpus callosum and Owen has called it, therefore, the fissura corporis calosi or callosal fissure, and Arnold described it as part of his arched fissure (Bogenfurche). The lower branch has, however, been recognized and described by all recent investigators under the name of the fissura hippocampi, anterior part of the scissure des hippocampes (Gratiolet), fissura dentatus of Huxley and the English anatomists. It extends downward and forward, producing the elevation in the descending horn known as the hippocampus major, and at its lower extremity separates the gyrus uncinatus (see figures) from the rest of the cerebral surface. Shortly after the formation of the above fissure there appears in connection with the evolution of the occipital lobe, a posterior horizontally directed fissure which is continuous with the mesial arched, see figs. 4 and 6, Plate XXXV, and is known as the fissura calcarina. It forms one of the branches of what I have termed as a whole the fissura tri-radiatus and follows the course, as we have previously mentioned, of the posterior horn producing in it the prominence known as the calcar avis or hippocampus minor; whence the name calcarine given to it by Huxley. It represents the posterior part of the scissure des hippocampes of Gratiolet, the fissura horizontalis of Pansch, the fissura posterior or horizontalis of R. Wagner, the fissura hippocampi of Bischoff. This is one of the most constant fissures of the hemisphere and is found well developed in all Primate brains with the exception of some of the Lemuridæ. It appears in the human foetus as a well marked fissure when the rest of the hemisphere is completely smooth. It may be seen, fig. 4, Plate XXXV, in the brain of a foetus of three and a half months, well developed. This fissure in the Simiadæ is continuous anteriorly with the fissure, m. a., and Gratiolet called the fissure extending from the end of the occipital lobe to the extremity of the temporal, the scissure des hippocampes, thus distinguishing but one fissure instead of two. He applied the same nomenclature to the brain of Man. In the human brain, however, the poste-
rior part of this fissure becomes separated from the anterior by a small convolution, g. f., fig. 4, Plate XXXVI. This is the convolution called by Huxley and Ecker the gyrus dentatus, the *corps goudronné* of Gratiolet and others. It has its origin back of the splenium corporis calloosi and connects the gyrus forniciatus, g. f., with the hippocampal.

It has been stated that the presence of this convolution and the separation in consequence of its development of the calcarine, c.a., from the hippocampal, Hp, is a characteristic of the human as distinguished from the ape brain. On this point Ecker remarks as follows: "there is hardly a point in which the brain of most apes is so essentially distinguished from that of Man as in regard to the just mentioned fissura hippocampi. In Man, as we have seen, the gyrus forniciatus passes without interruption into the gyrus hippocampi, and thus the fissura calcarina and fissura hippocampi are separated from each other by this continuous series of convolutions. In the apes, on the contrary, so far as known, with the exceptions of *Ateles* and *Hylobates*, the two just named fissures pass immediately into each other and thus in them the gyrus forniciatus and gyrus hippocampi are separated from each other. Hence Gratiolet who derived his whole terminology from the ape's brain, described the two fissures which we separate as fissura calcarina and fissura hippocampi as one, the *scissure des hippocampes*.

With this I can by no means agree. I have examined in respect to this point the brains of eighteen monkeys of different genera and species, and in every instance this convolution was plainly developed. It may be seen marked x in *Macacus nemestrinus*, fig. 5, Plate XXXVII, completely separating the deeper portions of the calcarine, c.a., from the hippocampal, Hp. It appears absent in the monkeys because the upper edge of the convolution lying below the calcarine fissure shelves over and conceals it. If this be lifted, however, it will be found extending across the calcarine fissure and separating it from the hippocampal. The nature of these relations is well seen by comparing this gyrus dentatus as it exists in the chimpanzee, g.d., fig. 3, Plate XXXIX, with its condition as found in the brain of a negro, fig. 2, Plate XLI, x. Even in so low a simian as the American monkey *Chrysotrichia*, Plate XXXVIII, fig. 8, I found it distinctly developed, although sunk deeper into the depths of the fissure than in the higher monkeys. The human foetus at the middle of the fifth month presents in this respect a condition almost identical with that found in *Chrysotrichia*. The calcarine joins the hippocampal at the upper part of its depth, but if the sides of the fissure be pushed a little apart, the convolution may be seen stretching across the calcarine and separating it completely at its lowest part from the hippocampal. In the brain of a foetus at the middle of the sixth month this convolution is developed well up to the surface and presents the same relations as found in such monkeys as *Macacus, Cercopithecus*, etc. In the brain of a foetus of eight months it was just perceptible superficially, Plate XXXVI, fig. 2, g. f., in this respect representing the condition as found in *Ateles*, Plate XXXVII, fig. 17, and *Hylobates*. As further evidence that there is nothing peculiar in this convolution
as found in the brain of Man to distinguish it from the conditions as found in the Simiadae, I have occasionally found in the negro brain that it was entirely invisible superficially or at most presented the appearance as seen in the chimpanzee, Plate XXXIX, fig. 3, showing in this respect the nearer relation of the negro than the white brain to the simian type. Indeed, there is not one of all the points which have been asserted to be characteristic of the convolutions of the human as distinguished from the ape brain which the study of the negro brain will not show to be entirely relative. Many of these points will be indicated hereafter, and the author firmly believes that had the negro brain been utilized by previous investigators in elucidating the relations of the human to the simian type, many mistakes would have been avoided, especially in the comparison of the occipital lobes.

Posteriorly the calcarine fissure proceeds directly backward to the extremity of the hemisphere. It is straight, or nearly so, in the monkeys and apes, but in Man it becomes more or less curved with the convexity directed upwards, Plates XLII and XLIV, fig. 2. In the brain of Ateles, Plate XXXVII, fig. 17, this curve is also found to a slight extent. In Chrysothrix, Plate XXXVIII, fig. 8, it curves slightly downward. It ends in an expanded cleft or transverse fissure, one branch ascending and the other descending. For this I propose the name of transverse calcarine, fissura calcarina transversus, t. ca., figures of Plates XXXVII and XXXVIII. With regard to this fissure I have observed some interesting developments in the brain of Man. In all of the Simiadae the transverse is continuous with the horizontal portion of the fissura calcarina, but in Man a bridging convolution is often found separating it from this in such a manner that the transverse calcarine may be pushed so far backward as to make its appearance upon the lateral surface of the apex of the occipital lobe. This is the case in Plate XXXVI, fig. 6, and in Plate XLIV, fig. 1, where the end of the calcarine, ca, is seen separated from the transverse calcarine, t. ca, which now appears apparently as a fissure of the lateral surface and as such has been described by several writers, thus leading to considerable confusion. By comparing the mesial surface of same hemisphere, Plate XLIV, fig. 2, the calcarine, ca, may be seen running around the extremity of the occipital lobe and a tendency to a vegetative repetition, as I consider it, of the transverse calcarine has made its appearance, the sulcus calcarina transversus, (see classification of fissures).

On Plate XLI, fig. 2, the transverse calcarine is seen situated some distance from the extremity of the occipital lobe and a bridging convolution may be seen completely separating it from the calcarine. On Plate XLIII, fig. 3, a bridging convolution is seen curving backward and downward from the apex of the cuneus, giving this brain a peculiar aspect in this region. In the other hemisphere of this brain, fig. 4, this bridging convolution is not present, but its place is taken by one situated more posteriorly.

In the brain of a Chinaman, Plate XLI, figs. 5 and 6, in both the right and left hemisphere we have a bridging convolution well developed, giving quite an unusual appearance to this portion of the brain as found in the white race. I pro-
pose for these bridging convolutions the name transverse calcarine lobules or rather the transverse lobuli of the calcarine fissure: lobulus calcarinæ transversus. A comparison of the degree of development and the position of these fissures and lobules in different races will, I believe, prove interesting and important; for in Man the occipital lobe reaches its highest complexity, as it is also the last to completely develop. Naturally, therefore, in this lobe especially, we may expect to find racial peculiarities. Thus in the negro as shown in fig. 2, Plate XLII, and fig. 5, Plate XXXVI, the calcarine is continuous throughout its whole length, and this I have found is usually the case in this race, just as it is in the Simians. The development of these antecedent folds is, therefore, an indication of high cerebral development in this region, corresponding in this respect to the evolution of the plis de passage extending between the occipital and parietal and temporal portions of the brain surface. I have been able to trace the evolution of these transverse calcarine lobules from the stage in which they lie entirely concealed in the depths of the calcarine fissure and not separating the transverse from the horizontal portion, up to a stage of development in which they have not only become widely separated, but, as is shown in fig. 6, Plate XXXVI, the transverse portion has been pushed so far back as to become apparently a fissure and convolution belonging to the lateral surface; and it is in this way that those perpendicular furrows often found on the human occipital lobe are produced. Here we have a condition of affairs which has not been properly recognized by previous observers, and it introduces a new element into the mechanical theory of the evolution of the convolutions. In this case, instead of fissuration giving rise to convolutions, we find through local morphological development, the evolution of convolutions giving rise to the production of new fissures; and it is for this reason that I have accepted the third view as to the origin of the fissures and convolutions already stated. We shall find that the recognition of the differences between these two processes of cerebral differentiation will greatly aid us in solving many of the complexities of fissural development in the human brain. Of the same character with the transverse calcarine lobules are the plis de passage, and they always arise in the depths of fissures produced by the differential action of the pressure forces due to the growth of the cerebral surface within its bony environment. The vertical or transverse direction of these transverse calcarine fissures is evidently due to the fact that the developing backward of the occipital lobe which is characteristic of the higher Primates, is limited by the supra-occipital bone.

The calcarine fissure is peculiar to the Primate brain and develops only in connection with a posterior lobe and a posterior horn to the lateral ventricle.

The primary or fundamental fissures, viz.: the Sylvian, and the fissura triangulatus with its three branches, form the groundwork or plan upon or around which the remaining fissures and convolutions are arranged. Their relations to the hemisphere are exhibited in the accompanying diagrams, figs. 4 and 5. We have already studied the relations that these fissures bear to the hemisphere in its early stages of development and also the forces acting to produce them. On Plates XXXV
and XXXVI their position and relations are well shown during the whole course of embryonic development in the human brain.

Having now pointed out the general relations of these groundwork or plan fissures to the central hemisphere and manner of development in the foetus, it becomes necessary to inquire into their constancy throughout the Simiidae. I have found that the evidence as derived from this source is not only in harmony with the results to which I had been led by a study of the arrangement of the convolutions in monkeys and Man, but it seems of itself sufficient to show that the fissures pointed out above as fundamental have really the importance and significance ascribed to them. These fissures are present in all the monkeys as the best marked fissures of the hemisphere, and we may trace, in a descending scale, the gradual disappearance of the other fissures, until in the lowest form of monkeys, the Arctopithecini or marmosets, they remain as the only fissures of the hemisphere, as may be seen in the brain of Hapale jacchus and Midas, Pl. XXXIV, figs. 11, 12 and 13. They are also the first to appear in the development of the foetal monkey brain as shown in Pl. XXXIV, figs. 27 and 28, which represent the condition as found in a foetal Cebus apella. No other fissures are present in these brains, the rest of the cerebral hemisphere remaining entirely smooth, resembling in this respect the condition as found in the human foetal brain at the end of the sixth month.

Thus the brain of an adult monkey, Hapale midas, the brain of a foetal monkey, Cebus, and the brain of Man in one stage of his existence are similar as regards type of fissuration: a beautiful illustration of that firmly established principle that what is transient and embryonic in a higher form is permanently represented in a lower; and that the history of development of an organ tells us the history of its origin. These facts of development and comparative anatomy appear to me to place almost beyond question the fundamental nature of these fissures. I shall further attempt to show that the arrangement of the remaining fissures when they appear, points to the same conclusion. In Man and
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

some of the higher Simiadæ the posterior branch of the fissura tri-radiatus becomes separated, as we have seen, by the development of the small annectant or bridging convolution known as the gyrus dentatus. The arrangement of the fissures remains, however, unchanged.

In the Lemurs these fissures are present as well marked depressions, as may be seen in Lemur nigrifrons, Pl. XXXIV, fig. 17; in Indris, fig. 8, and Propithecus Edwardsii, fig. 23. In a few forms, however, such as Avahis, fig. 20, the calcarine appears to be absent. Pl. XXXVIII, fig. 8, shows them in Chrysothrix sciureus. In Plate XXXVII, figs. 5, 7, 14, 17 and Plate XXXVIII, fig. 12, they may be studied as they exist in the Simiææ as a class, whilst Plate XXXIX, fig. 3, shows the relations as found in the chimpanzee as an example of the character of their appearance in the Anthropomorpha, Plate XL, figs. 2, 5, 6; XLII, 2, and XLIII, 3 and 4, show them as in Man.

LOBES OF THE BRAIN.

By means of these primary and fundamental fissures the brain may be divided, as we have already seen, into three lobes: a posterior or occipital, and two anterior, the occipito-frontal and occipito-temporal. It now becomes necessary to seek for a more definite boundary separating the occipital from the other lobes. We here approach, perhaps, the most confused subject in the whole range of anatomy. The occipital lobe has been defined to be that part of the hemisphere posterior to the parietal and temporal lobes, a rather indefinite division, since the posterior boundaries of these lobes are not given by the writers who make this statement. It is relatively smaller in Man than in the Simians and is also much better defined in them from the rest of the hemisphere than in the human brain. We shall first consider its relations in the monkeys, leaving the consideration of its proper boundaries in Man until we come to treat of the convolutions found on its surface. The fissura occipitalis-interna (parieto-occipital), fig. 2, Plate XXXIV; 3, has been considered by most writers as separating on the mesial surface the occipital from the parietal lobe, but in Man this fissure ends at the lateral upper border of the hemisphere, being surrounded by a small outwardly arched convolution, fig. 1, Plate XL, shown in left hemisphere at 2.

If we examine the brain of a monkey, such as Macacus, Cebus, Cynocephalus, etc., Plates XXXVII and XXXVIII, we will not find the fissura perpendicularis ending in this way, but it becomes directly continuous with a long lateral fissure, O, the so-called external perpendicular fissure (fiss. perpendicularis externa). In the higher apes as a rule, however, such as the chimpanzee, fig. 13, Plate XXXVIII, right hemisphere, and also in Atëles, fig. 15, Pl. XXXVII, the fissure will be found cut off in the same manner as in Man, by the convolution 2. Often this occurs in one hemisphere only, as is the case in the two specimens referred to. The occipital lobe is, therefore, very well marked off in most monkeys from the parietal by means of this fissure. The portion of the occipi-
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

...tal lobe directly back of this fissure (occipitalis externa) has been called by Gratiolet the operculum, because in the monkeys, and sometimes, though rarely, in Man, it covers in or conceals two small convolutions running from the occipital to the parietal lobe: the superior external or premier pli de passage and the deuxièmeme pli de passage externe. Near the lower border of the occipital lobe there is found another fissure, O², Plate XXXVII, figs. 1, 2, 6, 7, 8, 9; Plate XXXVIII, figs. 4, 11, the two together, O¹ and O², cutting off a posterior triangular portion, the apex looking forward, which maps off distinctly, upon the lateral surface, the outlines of the future occipital lobe. As the exact significance of these two fissures taken together has not been noted by previous investigators, I propose for them the name primary occipital arch, the relations of which externally may be studied on Pl. XXXVII, figs. 1 and 19. The upper branch, O¹, corresponds with the combined fissura-perpendicularis interna and externa, but in order to designate it as a whole and to render its important character distinct I propose for it the name, superior occipital fissure (fissura occipitalis superior). The lower branch, O², curiously enough, has received little attention, and in Man it has been seldom even recognized as a distinct fissure except by Wernicke and a few others. It has sometimes been designated in the nomenclature of the human brain as Wernicke's fissure. I propose to call it the inferior occipital fissure, (fissura occipitalis inferior). These two fissures of the arch pass forward toward the apex of the occipital lobe where they are separated from each other by a small bridging convolution, P, one of the plis de passage of Gratiolet. Posteriorly they pass around on to the mesial surface and their extremities are related in a scroll-like manner to the ends of the transverse calcarine fissure, t. ca., as represented in fig. 6, which should be compared with Plates XXXVII, fig. 5 and XXXVIII, figs. 5 and 12. It will be seen at once that the primary occipital arch, a name I have given it on account of these relations, cuts off a perfectly symmetrical occipital lobe which is also related, as we shall see hereafter, to the occipito-frontal and occipito-temporal lobes in a perfectly definite and symmetrical manner.

In studying the temporary fissures of the mesial surface, fig. 2 and Pl. XXXV, fig. 4, we found two fissures cutting off a rhomboidal shaped mass, O¹, O². Of these, the lower one completely disappears, whilst the upper one, O¹, partly remains to form a portion of the permanent fissure. I believe, at least, that I have been able to determine that such is the case, and in fig. 4, Pl. XXXV, I think it can be distinguished as a small oblique fissure situated at the end of, and communicating with the calcarine. Ecker also states that he believes he has been able to make this out, but is not positive about it. However this may be, what I particularly
wish to direct attention to is the fact that two branches of the primary occipital arch, O' and O', take the place, direction and relations of the two temporary radiating mesial occipital fissures amongst the permanent fissures of the hemisphere. We have given good reasons to show that the production and lines of direction of these temporary fissures were produced by a differential action of the pressure forces produced by the growing brain and the more slowly expanding skull at that period. We then found that owing to an accelerated development of the bony environment the cerebral surface became once more almost entirely smooth; and finally, when these relations are again reversed we find appearing as permanent fissures the two branches of the primary occipital arch, having the same relative directions and bearing the same relations to the calcarine as the primary furrows did. From these facts, since the mechanical conditions have not materially changed, relatively, we must, I think, conclude that the primary occipital arch in its turn, like the primary radiating occipital furrows, owes its origin to mechanical adjustments of the pressure forces acting upon the cerebral surface. The accompanying diagrams, figs. 7 and 8, exhibit the morphological plan of the cerebral hemisphere as regards the division into the three lobes which I have proposed. The occipital lobe, O, in many of the monkeys, is on its lateral and mesial surface entirely smooth as may be seen in figs. 19 and 20, Plate XXXVII, and comparing these with Plate XXXVII, fig. 1, Plate XXXVIII, fig. 11, etc. In others, it becomes furrowed, and this furrowing gradually increases in complexity as we ascend towards Man, at the same time that the whole lobe becomes relatively smaller, its place being taken by the progressively increasing development in the region between the occipital and occipito-frontal lobes of the plis de passage. The consideration of the evolution of these fissures and convolutions we will reserve for future discussion.

BOUNDARIES OF THE LOBES OF THE CEREBRAL HEMISPHERE.

1. The occipito-frontal lobe is separated posteriorly from the occipital lobe by the upper branch of the occipital arch. O 1, superior occipital fissure, which in its turn has been separated by previous writers into two separate fissures, the internal perpendicular (parieto-occipital), and the external perpendicular (occipital), and pro-
ceeds forward to the extremity of the hemisphere, where it meets the apex of the occipito-temporal lobe from which it is separated by the fissure of Sylvius, which also separates these two lobes for a considerable distance on the lateral surface. They run into each other or become continuous back of the position of the posterior extremity of the horizontal portion of the fissure of Sylvius around which they arch. On the mesial surface this lobe is separated from the mesial surface of the occipito-temporal posteriorly, by the anterior portion of the calcarine fissure, and proceeds anteriorly surrounding the corpus callosum.

2. The occipito-temporal lobe has corresponding relations. Posteriorly it is separated from the occipital lobe by the inferior branch of the primary occipital arch, O2, fissura occipitalis inferior. It passes forward following the fornix and is separated from the occipito-frontal as described above.

3. The occipital lobe forms the posterior part of the undivided hemisphere and is a single symmetrical lobe cut off from the preceding by the development of two arching fissures, 01 and 02, as previously mentioned.

4. The lobulus centralis or Island of Reil is situated at the junction of the occipito-frontal and temporal lobes anteriorly, is similarly related to each, and is covered in the adult condition more or less completely by the so-called operculum, and below by the superior temporal convolution.

Owing to its simpler character and the retention of its primitive relations to the remaining portions of the hemisphere, we shall first proceed to discuss the fissures and convolutions of the occipito-temporal lobe.

**OCCIPITO-TEMPORAL LOBE.**

The occipito-temporal lobe, OT, occupies the temporal fossa of the skull and is situated partly above the cerebellum, resting upon the anterior portion of the tentorium. Its general boundaries and connections have been already described.

**Fissures and Convolution.**

The convolutions and fissures of the occipito-temporal lobe are comparatively simple and can be easily distinguished. On the lateral surface three convolutions, OT or S. O.T; OT or M. O. F., and OT or I. O. F (see plates) separated from each other by two fissures (o.t.) and (o. t.) are found. The fissure o. t is the superior temporal, sulcus temporalis superior, the scissure parallele of Gratiolet, antero-temporal sulcus of Huxley. This is the most persistent and constant fissure of the lateral surface. It is well marked in all the Simiidae except the marmosets. In *Chrysothrix*, Plate XXXVIII, figs. 6 and 9, it is well defined. In the negro I have found it straighter and less tortuous than in the caucasian. In a chimpanzee it was found by Turner to be continuous with the Sylvian above, so that the Sylvian had the appearance at first of mounting much higher than normal, as this

fissure extends to some distance above the posterior end of the Sylvian. A similar condition to this is described by Gratiolet as occurring sometimes in the brain of *Cercopithecus sabaeus*. I have also found this occurring in brains of *Macacus cynomolgus*, *M. nemestrinus*, Plate XXXVII, figs. 1, 2, 8 and 9. The fissure, o. t, represents the second inferior occipito-temporal fissure. It is the middle temporal of Ecker and some other writers, the postero-temporal of Huxley. It is not as strongly marked as the first and it varies greatly in different individuals. These two fissures mark out and separate quite distinctly three laterally situated occipito-temporal convolutions the most inferior of which extends inwardly to form a large portion of the infero-mesial surface.

The superior occipito-temporal convolution, S. O.T., O.T', the superior temporal of Huschke and most others, gyrus temporalis primus of Wagner and the antero-temporal of Huxley, is the best defined and most constant of the lateral convolutions of the occipito-temporal lobe. It is contained between the Sylvian and superior occipito-temporal fissures and extends from the anterior extremity of the temporal lobe backward to join the inferior parietal gyrus, P P arching around the posterior extremity of the fissura Sylvii. I have found this convolution simpler in the negro brain, that is, possessing fewer secondary markings, than in the white. It is also narrower, Plate XLI, fig. 1, Plate XLII, fig. 1, approaching in this respect the condition as found in the chimpanzee, etc., Plate XXXIX, fig. 4.

The middle occipito-temporal convolution, M. O. T, gyrus occipito-temporalis medius, lies directly below the superior, separated from it by, s. o. t, and bounded below by the inferior-occipito temporal fissure, i. o. t. It extends from the anterior extremity of the temporal lobe backward to the occipital.

The third occipito-temporal convolution, I.O.T., gyrus temporalis inferior, lies directly below the middle and extends inwardly, so as to appear upon the mesial surface. It, like the two preceding, extends from the occipital to the anterior extremity of the occipito-temporal lobe.

Mesial Occipito-temporal and Occipito-frontal Surfaces and their Relation to Each Other and to the Occipital Lobe.

The mesial surface is separated by the fissura tri-radiatus into three divisions:

1. A posterior marked off by the internal extremities of the primary occipital arch, O1 and O2, fig. 8, which forms the mesial portion of the occipital lobe.

2. A mesial occipito-temporal below, rightly recognized by Gratiolet, Ecker and others, situated beneath the calcarine and inferior branch of the mesial arched, the hippocampal fissure, fig. 8.

3. A portion above the calcarine and upper branch of the mesial arched, the callosal fissure, which so evidently corresponds in its relations and structure to the preceding that I propose to designate it as the mesial occipito-frontal surface of an occipito-frontal lobe. This mesial occipito-frontal, M.O.F., fig. 8, represents the combined mesial surface of the parietal and frontal lobes of Ecker and others, the fronto-parietal of Gratiolet and the French authorities. Good reasons for this
change in the nomenclature will be given presently, apart from the fact that it designates this surface in conformity with the name given to the corresponding portion of the occipito-temporal.

**Occipito-temporal Lobe (Mesial Surface).**

On this surface may be distinguished two convolutions separated by a single fissure, m.o.t. This fissure is the sulcus occipito-temporalis inferior of Ecker; sulcus longitudinalis inferior of Huschke, sulcus occipito-temporalis, Pansch; fissura collateralis, Huskley; fissura collateralis or temporalis inferior of Bischoff. I adopt the name given to it by Pansch, prefixing, however, the word mesial, calling it the mesial occipito-temporal fissure, m.o.t. Between this fissure and the fissura occipito-temporalis inferior, ot², on the lateral surface, is a very irregularly developed space or convolution which is the mesial portion of the third or inferior occipito-temporal convolution previously described as found on the lateral surface. Ecker and some other writers, divide this space into two separate convolutions by means of a fissure, which he calls the sulcus temporalis inferior, numbered 13 in fig. 3, Pl. XXXIV. The convolution lying on the outer or lateral side of this fissure he designates as the third temporal convolution, whilst that on the inner or mesial side of this fissure he calls the gyrus occipito-temporalis lateralis. With this division of Ecker I cannot agree. It is true that a fissure more or less distinct is sometimes found in this place, but when present it is very irregular and constantly bridged over and, as Ecker himself states, it is frequently wanting. It is not found in the brain of the Simiade except faintly indicated, perhaps, in the Anthropomorpha, and its significance is entirely secondary and not of primary importance. It is not even mentioned by Pansch, and must be considered of doubtful constancy and compounded of important sulci merely marking the meso-inferior portion of the third occipito-frontal convolution. This convolution should not, therefore, be divided into two. In the greater number of brains examined, I have found no indication at all of a distinct fissure dividing this convolution, and in those few brains where I have observed it, it has been short and frequently interrupted. Ecker also remarks in connection with this point as follows: "Sometimes in this space (the space between the first temporal and the mesial occipito-temporal fissure) there are two fissures distinguishable, more or less parallel with the above named, by which three convolutions are marked; at other times only one fissure is to be recognized and of course only two convolutions."

Between the mesial occipito-temporal fissure on the one hand, and the calcarine and lower branch of the mesial arched or hippocampal, hp, on the other, is a long, continuous convolution, M.O.T. in Pl. XLII, fig. 2 and Pl. XLIV, fig. 2, extending from the occipital lobe, O, to the anterior extremity of the temporal. This I will term the mesial occipito-temporal convolution (gyrus occipito-temporalis medialis) following Ecker and Pansch. Different writers have separated this single convolution into two or more separate and distinct ones. By including it as a whole under one name, and then, merely for purpose of description and location, designating
the smaller important portions as lobules much mislocation and confusion are avoided. Thus the portion, Pls. XLI, fig. 2 and XLIV, fig. 2 x, directly beneath the calcarine fissure and posterior to the position of the hippocampal, h.p., has been termed by Huschke the lobulus lingualis (Zungenlippchen). It is the untere renere Hinterhauptswindungsgruppe of Bischoff. The anterior portion, H, is called by most writers the gyrus hippocampi; it is the pli unifor me or temporal moyen interne et lobule de l'hippocame of Gratiolet; the fourth temporal, vierte Schlafenwindung of Bischoff; the uncinate gyrus of Huxley. This division of M.O.T. into two convolutions, as though they were separate and distinct, and without recognizing it as a whole, seems to me not to represent the true relations and, at the same time, serves to give false notions with respect to the arrangement of the convolutions found in this region.

As, however, it may be convenient for purposes of description to name the two portions, H. and X., separately, the former may be designated as the anterior or hippocampal and the latter as the posterior or calcarine portions of the mesial occipito-temporal convolution; always recognizing, however, that they represent but one and not two separate and distinct convolutions.

The occipito-temporal lobe consists, therefore, of four occipito-temporal convolutions separated from each other by three occipito-temporal fissures. Of these, two convolutions and two fissures are found entirely upon the lateral surface, one convolution and one fissure entirely upon the mesial surface, whilst the remaining convolution, the third or inferior occipito-temporal is found extending from the lateral through the inferior on to the mesial surface. The arrangement and relations to the other lobes of the brain may be seen in the accompanying figures 9 and 10, which can be compared with the figures in the various plates. It will be seen from this, that the fissures of the occipito-temporal lobe with their accompanying convolutions form together a symmetrical whole, which is related to the structure of the occipital lobe in a perfectly definite manner and according to a fixed morphological type, which I farther on will attempt to show is also the type upon which the occipitofrontal lobe is built.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

DEVELOPMENT OF OCCIPITO-TEMPORAL FISSURES.

The first fissure to make its appearance upon the occipito-temporal lobe is the mesial occipito-temporal. On Plate XXXV, fig. 6, it may be seen marked m. o. t., whilst by comparing fig. 5, it will be seen that the rest of the lobe, together with the whole lateral surface of the hemisphere, is entirely smooth at this period of development, which is about the end of the fifth month. Above may be seen the mesial occipito-frontal which makes its appearance at about the same time, though somewhat earlier. This is undoubtedly due to the fact that the occipito-frontal lobe grows more rapidly than the occipito-temporal and as a result there is an increased amount of pressure in this region.

By the beginning of the seventh month, Plate XXXV, fig. 8, there has appeared a well marked superior or first occipito-temporal, and this is followed by the appearance about the middle of the seventh month of the posterior portion of the inferior or second occipito-temporal fissure. These grow deeper and better defined and gradually become slightly tortuous as development proceeds, until toward the end of the ninth month they assume the appearance as found in Plate XXXVI, figs. 3 and 4, which may be compared with the condition as found in the chimpanzee, figures 7 and 8, same plate.

Fissures and convolutions of the occipito-temporal lobe as found in the Primates.

1. In the Lemuridae we find all of these fissures well developed except that in some cases the inferior occipito-temporal is but slightly developed. Indeed the type of configuration of the cerebral surface of these animals corresponds perfectly to the brain of the human foetus, at the middle of the seventh month, as may be well seen by comparing Plate XXXV, figs. 10 and 11, with those of Lemur nigri- frons, Plate XXXIV, figs. 16 and 17; Propithecus diadema, Plate XXXIV, figs. 15, 22 and 23; Propithecus Edwardsii, Plate XXXIV, fig. 15; Avahis, Plate XXXIV, figs. 18, 19 and 20; Indris, Plate XXXIV, figs. 6, 8 and 10.

2. In Arctopithecini or marmosets, Plate XXXIV, figs. 11, 12 and 13, we find the brain surface entirely smooth, with the exception that in some species, as Hapale jacchus, fig. 13, the mesial occipito-temporal and frontal are partly outlined, corresponding with the condition as formed in the human foetus at the end of the fifth month, Plate XXXV, fig. 6.

3. In the Platyrhini and Catarrhini or simians of the Old and New World, we can trace two corresponding lines of fissural and convolutional evolution. In Chrysothrix, Plate XXXVIII, figs. 8 and 9, and Callithrix, Plate XXXIV, fig. 26, the mesial occipito-frontal and temporal are well developed, extending, as indicated in the morphological type laid down in fig. 9, from the position of the extremities of the primary occipital arch, O 1 and O 2, forward to the end of the lobes, corresponding with the human foetal brain as found in the middle of the sixth month, Plate XXXV, fig. 7. In Cebus, Plate XXXVIII, fig. 12, we have a stage corresponding
in degree of development to the Old World macaques. Plate XXXVII, figs. 1, 5, 6, 7, 8, 9 and 14, and also similar to the human foetal brain at the end of the eighth month. In Ateles, Plate XXXVII, figs. 17 and 18, we have a still nearer approach to the human type, whilst in the Anthropomorpha, including the gibbons, orang, chimpanzee and gorilla, the brain becomes almost identical with the brain of the human foetus of a little past the middle of the ninth month.

**Occipito-Frontal Lobe.**

The boundaries and connections of this lobe have already been given. It occupies that part of the cranial cavity formed by the frontal and parietal bones, the lower part of its anterior extremity resting upon the orbital surface of the frontal bone, known by the name of the orbital surface. It presents besides this, two other surfaces: a mesial, corresponding to the mesial of the occipito-temporal and a supero-lateral curvilinear surface similar to the infero-lateral of the same lobe. We will first call attention to the structure and relations of the mesial surface.

**Occipito-Frontal Lobe (Mesial Surface).**

On the mesial occipito-frontal surface two convolutions separated by a fissure m. o. f. are found. This has been termed by Huxley, Bischoff, Turner, Marshall, Ecker, etc., the fissura calloso-marginalis, and by Pansch the sulcus medialis-fronto-parietalis, the grand sulcus du lobe fronto-parietal of Gratiolet. The posterior termination of this fissure is, according to all previous authorities, at the point marked 16, Pl. XXXIV, fig. 2, and c. m. in various figures of plates showing the mesial surface.

This point of termination I cannot consider as the proper morphological extremity of this fissure, but believe that its real termination is farther back, consisting of what is usually considered as a sulcus constantly found on the so-called lobulus praecuneus. This is an elongated H-shaped fissure marked m. o. f. on the plates. It is true that in the higher Primates this fissure is usually separated from the anterior portion, the calloso-marginal, but this fissure itself is very seldom a continuous one in these animals, being generally divided into a number of short branches as may be seen in Pl. XXXIX, fig. 3, Pl. XL, fig. 2, and Pl. XLII, fig. 2. I think it will be perceived at once that this sulcus of the praecuneus, m. o. f. is similar in all respects to the other H-like separations of the calloso-marginal, and ought, therefore, to be considered as a part of it. This fissure as a whole is one of the most distinct fissures of the hemisphere and was even recognized as constant by Vicq d'Azyr. I propose for it, therefore, a name in consonance with the corresponding fissure of the occipito-temporal mesial surface, and will call it the mesial occipito-frontal fissure, (fissura occipito-frontalis medialis).

It appears in the human foetus a short time previous to the appearance of the mesial occipito-temporal fissure and may be distinctly recognizable at the middle
of the fifth month, Pl. XXXV, fig. 6. Its after development may be traced in Pl. XXXV, figs. 9, 11, 13, 15, 17 and Pl. XXXVI, figs. 2 and 4. The tendency to break up into a number of similar parts which are mere vegetative repetitions of one another in appearance, is also plainly indicated as development proceeds, until finally it attains its most complex development in the adult human brain.

It is well developed in all the Primates with the exception of the marmosets and Cheirogaleids. In Lemur nigrifrons, Plate XXXIV, fig. 17, and Indris, fig. 8, it is a straight or slightly curvilinear continuous furrow. In Propithecus diadema it appears in one specimen as a somewhat tortuous fissure, Plate XXXIV, fig. 23, which is somewhat broken up in another, fig. 22. In Avahi, Plate XXXIV, fig. 20, it becomes continuous with a fissure extending in a curve around and on the mesial surface of the occipito-temporal lobe closely following the curve of the mesial arched fissure; the calcarine being separated from this and only represented by a posterior portion continuous with what would be, in this case, a secondary mesial arched fissure. It would appear from this that the production of both the mesial-occipito-frontal and the mesial occipito-temporal fissures are produced by the action of the same resultants of the pressure forces which gave rise to the mesial arched fissure itself and, indeed, to be merely a vegetative repetition of this fissure, separated into two portions by the action of the resisting forces of the developing occipital lobe.

In most of the Simiidae it consists of one or more somewhat straight or more or less tortuous fissures, as may be seen in Pl. XXXVII, fig. 5; Pl. XXXVIII, fig. 12. Posteriorly as may be seen in Pl. XXXVII, figs. 5, 7 and 14; Pl. XXXVIII, figs. 12 and 13, is seen a fissure marked "m.o.f." It separates the superior internal *pli de passage* from the inferior internal *pli de passage*, two small bridging convolutions running from the mesial surface of the occipital lobe to join the mesial parietal portion (praeunum) of the occipito-frontal lobe. This fissure corresponds with the posterior portion of the mesial occipito-temporal fissure (collateral) and in Pl. XXXVII, fig. 5 and Pl. XXXVIII, fig. 12 the exact similarity of these two fissures and their identical relations with the two extremities of the primary occipital arch can be plainly seen. I regard them, therefore, as morphologically homologous. Evidently the conditions of growth must have been similar. This small fissure, m.o.f. represents, therefore, the most posterior extremity of the mesialo-occipito-frontal fissure, and if we examine the mesial surface of the brain of *Chrysothrix*, Pl. XXXVIII, fig. 8, we see a single continuous fissure extending from a position just anterior to the mesial extremity of the superior branch of the primary occipital arch, forward to the end of the occipito-frontal lobe.

From these observations it will be seen that the morphological type of the mesial surface of the brain is a perfectly definite and symmetrical one and corresponds to the diagram, figure 10. Additional reasons will be given in support of this view, under the head of the convolutions of the occipital lobe and the significance of the *pli de passage*.

The mesial occipito-frontal fissure includes the following named furrows:
1. The calloso-marginal with its various vegetative separations and repetitions, among which are the so-called transverse furrow or sulcus of the gyrus paracentralis of Betz, J. Pl. XXXIV, fig. 2 and Pls. XLI and XLII, fig. 2; and the sulcus of the precuneal lobule, m.o.f.

2. The fissure between the two internal plis de passage when these are present.

**Mesial Occipito-Frontal Convolutions.**

The mesial occipito-frontal fissure separates, as may be well seen in fig. 2, Plates XLII and XLIV, two convolutions. Of these, I shall call the upper for the present the marginal mesial occipito-frontal, whilst the lower, M. O. F., evidently corresponds to M. O. T. I therefore designate it as the mesial occipito-frontal convolution. This convolution posteriorly is connected with the occipital lobe by means of the gyrus cunei (internal inferior pli de passage), Plate XLII, fig. 2, and proceeds forward surrounding the corpus callosum to the end of the hemisphere. Posteriorly below the splenium it becomes continuous with the gyrus hippocampi. It corresponds to the gyrus fornicatus of other writers.

Not only do I believe that this method of considering the mesial surface of the hemisphere is the most convenient, but I will endeavor to show that this nomenclature represents the nature of the arrangement of these parts, and at the same time brings the occipito-frontal portion into harmony with that of the occipito-temporal, parts which I believe are morphologically homologous.

**Occipito-Frontal Lobe (Lateral Portion).**

The lateral portion of the occipito-frontal lobe has been considered by all recent writers as consisting of two distinct lobes, the frontal and parietal. We have already given reasons for dissenting from this view, yet it will be convenient to divide it into two regions, a frontal and a parietal, separated from each other by the well marked fissura centralis (Rolando). Anatomists are not at all agreed as to the posterior limitations of the frontal from the parietal portion. Pansch and Ecker place all that portion of the hemisphere anterior to the central fissure in the frontal lobe. Others, including Bischoff, Huxley and the English anatomists who have written on this subject, place the posterior boundary of the frontal lobe directly in front of the anterior central convolutions, A. C, so that both of the convolutions surrounding the central fissure, C, are placed in the parietal lobe. With regard to this point Gratiolet expresses himself as undecided, although in his writings he places the boundary in front of the anterior central convolution or premier pli ascendant, as he terms it. Regarding as I do, the separation of the upper anterior portion of the brain into the frontal and parietal lobes as of secondary morphological value, and its chief use for convenience of description, the division adopted by Pansch and Ecker appears to me to be in every respect preferable to that of the other writers before mentioned. The central fissure forms a fixed and a definite separation, while
the other is exceedingly variable, depending on the relative development, width and outline of the anterior central convolution.

The parietal portion lies directly back of the fissura centralis, extends backward and is separated in the Simiidae from the occipital lobe by the lateral portion of the upper branch of the primary occipital arch O¹, Plate XXXIX, fig. 4, the so-called fissura occipitalis perpendiculairis externa. In the brain of Man this precise and definite boundary is not present and this portion of the cerebral surface undergoes considerable evolution, changing to a marked degree the aspect of this region. We will leave the consideration of this portion of our subject, however, until we discuss the convolutions of the occipital lobe and its relations to the plis de passage or annexant convolutions. Below and anteriorly it is separated from the occipito-temporal lobe by the posterior extremity of the Sylvian fissure, its lowest convolution, P 2, P 2¹, becoming continuous with the superior occipito-temporal, to form an arch surrounding this extremity. On the mesial surface, as we have already seen, the parietal region is continuous with the frontal without any signs of separation, whilst posteriorly its boundary is very distinct, it being either completely separated from the occipital lobe by the internal portion of the occipital arch, O², the fissura parieto-occipitalis, as in Man, or joining it by means of a small convolution, the gyrus cunei or inferior internal pli de passage of the Simiidae.

**Fissura Centralis.**

The central fissure or fissure of Rolando, begins at the upper border of the hemisphere and runs obliquely downward and forward, terminating generally some distance above the position of the Sylvian, as in Pl. XLI, fig. 1. Turner gives an instance¹ in which he found it terminating in the Sylvian. Ecker, in speaking of this observation, states that he has never so found it; whilst Bischoff, owing to his peculiar morphological views regarding the arched windings of the central fissure, says it cannot take place. Benedikt claims that in thirty-eight cerebral hemispheres he found this complete union eighteen times. These results are startling when it is considered that prior to the observation of Benedikt very few instances of confluence of these two important fissures had been reported; among others one by McDonald and Mills, and two by Parker. In Zernoff¹’s collection of one hundred brains, referred to by Benedikt, it occurred in but one instance. Since the publication of Benedikt’s work Osler has reported that out of sixty-three hemispheres, from thirty-four individuals, he found the central fissure communicating with the fissure of Sylvius three times completely and seven times incompletely. I have met with this condition frequently, especially as found by Benedikt in the brains of confirmed criminals. It may be seen in the brain of a murderer, existing in both hemispheres, Pl. XLIII, figs. 1 and 2; also in the brain of a mulatto, Pl. XLIV, fig. 1, and in the left hemisphere of the brain of a china-

¹ Edinburgh Med. Jour., 1866.
man, Pl. XLI, fig. 3. I have not met with it, nor, so far as I am aware, has this connection been found in the brains of any of the Simiidae.

Pansch, Ecker and most other writers consider this fissure as a primary and fundamental furrow. It is true that in the brain of Man and the higher Simians this fissure is constantly present, and that it forms a sure point of departure in searching out the convolutions in Man is also a fact, but this alone is not a sufficient reason for considering it as a primary and fundamental typical furrow of the Primate brain. Other fissures than this are far more constant, such as the superior occipito-temporal, o.t.1, which is the most persistent of all the fissures of the lateral surface of the hemisphere except the Sylvian, being found as a well marked furrow in all the Primates, with the exception of some of the Marmosets, such as *Hapale midas*, etc. The central is absent in many of the lower forms, such as the Lemuridae and it is only as we approach the higher Simiidae that it gradually assumes a high state of development, reaching its most fully developed condition in Man. In *Chrysothrix*, Pl. XXXVIII, fig. 9, the superior occipito-temporal is well developed, but the central is barely perceptible as a slight indentation, c c. Certainly, therefore, on the grounds of constancy, it must be considered simply as a peculiar development of one of the constant fissures of the lateral surface, of the same morphological value as the occipito-temporal and frontal fissures, and is by no means to be placed in the same category with such fissures as the Sylvian, the fissura tri-radiatus of the mesial surface, or even with the fissures forming the primary occipital arch, fissura occipitalis superior et inferior.

Occasionally it is bridged over and its continuous course interrupted by annexant gyri. I have never observed this myself, but it may be seen in the figure of the brain of the great clinician, Dr. Fuchs, figured by Wagner. It appears in the human fetus in the beginning of the sixth month, as may be seen in Plate XXXV, fig. 7, c c., the frontals, temporals and interparietals making their appearance at about the same time, Plate XXXV, fig. 8. The central fissure appears to me to have morphologically the same value and significance as these fissures. In fact it may be considered as comparable to the posterior portion of a superior occipito-frontal fissure, which, owing to the mechanical condition produced by the excessive development and growth of the occipito-frontal lobe as compared with the occipito-temporal, develops downward, separating from its anterior portion, and carrying with it its accompanying convolutions, A. C. and P. C., fig. 1, Plate XLIII, the so-called anterior and posterior central convolutions, which are, therefore, to be regarded morphologically as displaced posterior portions of the superior and middle frontal convolutions. The central fissure, owing to this downward development, becomes completely separated from the superior frontal fissure. Owen1 has also reached the same conclusion.

In the Lemurs, Plate XXXIV, figs. 16 and 17, no sign of a distinct and separate fissure is present; and a series of these brains will give a perfect illustration

1 Comparative Anatomy of Vertebrates, Vol. III.
of the manner of its formation. Thus, in Lemur nigrifrons, fig. 16, Propithecus diadema and Edwardsit, figs. 14, 15 and 21, Avahis, figs. 18 and 19, and Indris, figs. 6, 7, 9 and 10, it is not present, but we find two parallel running fissures, more or less broken up, which correspond in position, relation and direction to the two occipito-frontal fissures, o f₁ and o f₂, and I designate these as the superior and inferior occipito-frontal fissures.

In Chironmys or Aye-Aye, Plate XXXIV, fig. 24, the superior frontal will be seen curving perpendicularly downward at its anterior extremity, producing a corresponding separation of the inferior occipito-frontal into two portions, an anterior which corresponds with the inferior frontal fissure of the higher Primates, and a portion extending backward into the temporal lobe, the anterior portion of which represents the fissura interparietalis.

In the Gibbon, fig. 25, the step will be seen by means of which the curving fissure of the Aye-Aye becomes the fissura centralis of the higher Primates. In this brain the posterior portion of the inferior occipito-frontal fissure arches around the posterior extremity of the fissura Sylvii, and becomes continuous with the superior occipito-temporal, o t₁, whilst the anterior separated portion becomes the inferior frontal fissure. The interparietal in such brains is represented by the curved fissure surrounding the posterior extremity of the fissure of Sylvius.

The primitive condition, therefore, of the lateral surface of the occipito-frontal lobe as found in the Lemurs would be as in the diagram, fig. 11, and this gives, I believe, the original morphological type of the lateral surface of the occipito-frontal lobe as illustrated in fig. 11, which is variously modified by separation of single

![Diagram](image)

fissural lines into one or more parts and bendings due to the generic and specific forms of cerebral and skull evolution. Fig. 12 shows the conditions produced by the separation and bending downward of the posterior part of the fissure, o f₂, to form the fissura centralis, and it can be readily seen that as this vertical type of development, which is undoubtedly due to the enormous antero-posterior development of the occipito-frontal lobe, progresses, the condition as found in Man and the higher Primates is brought about. (Compare with figs. 1 and 4, Plate XXXIV.)

Thus it will be found that the pressure forces produced by the enormous elongation
of this region as compared with the occipito-temporal lobe produces a change in the convolutional configuration, producing lines of depression or fissuration having the same general relations to the fossa of Sylvius as regards inclination as the primary radiating furrows of the fetal brain possessed, and due no doubt to a somewhat similar composition of pressure forces as was found at that early period. These facts seem to show an alternation in the lines of direction of the resultant pressure forces in different regions of the brain, from a radiating arrangement to a curvilinear one and vice versa. These reversals take place, not only during the development of the individual but also during the evolution of the phylum, and are due to the varying rates of growth of different portions of the brain and skull at corresponding periods of development. Besides the fissure of Rolando we find several other vertical depressions originating in this region, such as precentral, post-central, etc.; but we leave the consideration of these sulci and their relations until we have discussed the general structure of the fronto-parietal region.

As already remarked, I cannot accept the parietal portion of the hemisphere as a distinct and separate cerebral lobe comparable to the three lobes previously pointed out, but for purposes of description divide the lateral surface of the occipito-frontal lobe into two regions, a frontal and a parietal, separated from each other by the fissura centralis.

I. ANTERIOR OR FRONTAL DIVISION OF THE OCCIPITO-FRONTAL LOBE.

On the lateral surface of this region in Man and most of the Primates, three convolutions, separated by two fissures, are found. These convolutions are known respectively as the first, second and third, or superior, middle and inferior frontal convolutions, F₁, F₂ and F₃, whilst the fissures are designated as the first and second or superior and inferior frontal fissures, f₁, f₂, Pl. XLIII, fig. 7. The inferior frontal fissure at its posterior part joins a perpendicular fissure, f₃, the sulcus pre-centralis of Ecker, the antero-parietal fissure of Huxley. Much confusion has arisen in regard to this fissure; many writers entirely disagreeing as to its relations. The names given by Ecker and Huxley are inappropriate and liable to create confusion. This is not a distinct and separate fissure morphologically as these names would seem to indicate, but is merely the posterior portion of the inferior frontal fissure which has assumed a more or less perpendicular direction, following the line of inclination of the fissura centralis. Pansch recognized this and he called it ramus descendens sulci frontalis medii. He called it a branch of the middle frontal because in some of the monkeys another fissure runs beneath it. I should prefer to term it the vertical or branch sulcus of the inferior frontal fissure.

Turner has identified this fissure with the ascending branch of the Sylvian, and he considers its separation from the latter by a part of the lower frontal convolution as exceptional. This identification is incorrect. It is true that it sometimes is continuous with the ascending ramus of the Sylvian, as in fig. 1, Plate XLII, but it is this condition which is exceptional. Occasionally it extends as far as the Sylvian fissure and joins it superficially, but this is always back of the
position of the ascending ramus and a more or less concealed separating gyrus can always be found. This is the case in the brain of a Chinaman, Plate XLI, figs. 3 and 4, and also in the brain, Plate XLIII, fig. 2. Its ordinary aspect is seen in fig. 1, Plate XLII. Huxley says that it opens into the supero-frontal sulcus, a statement which Ecker regards as probably a slip of the pen. Possibly, however, another fissure, f₁, Plate XLII, fig. 1, which is a vertical branch of the superior frontal, may have been inadvertently mentioned, and this might readily occur. This fissure, f₁, is very differently developed in different brains; sometimes, as in the figure indicated, being almost as well marked as the central itself, and in others, Plate XLII, fig. 3, being quite feebly developed. It seems to be related inversely to the extent of development of f₃, being long when this is short and vice versa. Although it is thus as well marked in the human brain as the praecentrales, f₆, and in many cases even more largely developed, it does not seem to have attracted the special notice of previous writers. Ecker does not even mention it. I think it probable that when largely developed, as in Plate XLII, fig. 1, or Plate XLIV, fig. 1, it has been confused with the vertical lower frontal or praecentrales, f₆, instead of recognising its true character as a vertical prolongation downward of the superior frontal fissure. I propose for it, therefore, the name of the vertical sulcus of the superior frontal, sulcus frontalis verticalis superior. We must remember, however, that they are not distinct and separate fissures from a morphological standpoint, comparable in value to the frontals themselves, although sometimes they become separated from the horizontal part by small bridging gyri, and then take on apparently the appearance of individual fissures. The varying degrees of development of these two sulci may be well seen by comparing Plate XLIII, fig. 2, with Plate XLIV, fig. 1. Gratiolet does not name or distinguish either of these fissures in Man. He describes, however, the inferior vertical frontal in the brain of Cercopithecus, and has figured it as existing in the human brain. In the simian brain the inferior vertical frontal is usually well marked, but the superior is not found in most of them, owing to the slight and irregular development of the superior frontal fissure. It may be seen, however, indicated in the brains of Cynocephalus and Ateles, Plate XXXVIII, fig. 3, and Plate XXXVII, fig. 15, (in the descending portion of f₁) whilst in the Chimpanzee, Plate XXXVIII, fig. 13, f₁, and Plate XXXIX, fig. 4, f₁, it approaches the human type.

The convolution, A C, lying directly in front of the central fissure and contained between it and the two vertical frontals, is the anterior central convolution of Huschke and Ecker, anterior parietal gyrus of Huxley, premier pli ascendant of Gratiolet, and ascending frontal gyrus of Turner. This convolution is constant in its appearance, depending as it does upon the development of the central fissure, and is continuous as a rule both above and below with the posterior central convolution, P C; but, as we pointed out previously, in a certain number of cases it is separated from the posterior central by the fissura centralis becoming confluent with the Sylvian. In front it unites with the three frontal convolutions.

These lateral convolutions of the frontal region can generally be distinguished
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

without difficulty. Sometimes, however, they are obscured by crossing or bridging convolutions. I have found, as a rule, they are more distinctly mapped out in the brain of the negro than in the white, Plates XI, and XII, fig. I. Ecker states that they can best be distinguished in the brain of the new-born child, a fact which I can corroborate. He says that in these brains the typical parts can be recognized almost as in a diagram. I have no doubt that this, as a general statement, is perfectly true; but there are exceptions, as in the brain of one new-born child that I carefully studied. I found the frontal convolution almost as complex as in the average adult brain. It is difficult, therefore, as Bischoff remarks, to determine to what extent development of the convolutions proceeds after birth. The great individual variety as regards the development of secondary and tertiary convolutions in the adult brain, together with the fact of the great differences as regards these points in the brain at birth, renders the solution of the question as to the amount and degree of development almost impossible.

Gratiolet states that in the European the lower frontal fissure is the most clearly defined, while the upper and middle more often run into each other. In the Bushman, he says, on the contrary, the upper remains independent, while the middle and lower blend. From the study of a large number of negro brains as obtained in the United States, this has not been my experience. In those examined, the lower frontal was the most clearly separated, while the upper and middle blended most with each other. The distinctness of the inferior frontal fissure is well seen in Plates XI, and XII, fig. I. In the mulatto, Plate XLIV, fig. 1, the two fissures were about equally distinct, the lower one being very much arched upward, the lower frontal convolution becoming the largest I have met with. It was about two-thirds the width of the superior and middle combined. This is exceptional, the middle frontal being almost constantly the widest of the three.

On the orbital surface of the frontal lobe are found several small sulci which are somewhat variable in their arrangements in different brains. They generally assume a tri-radiate appearance, or that of an elongated letter H, or like two Y's placed stem to stem, whence the name of the tri-radiate sulcus of Turner, the soleo-cruiform of Rolando. Ecker terms it the sulcus orbitalis, which appears to be the best name. These sulci seem to bear no definite relation to the general morphological type of the hemisphere, but appear to be due chiefly to local conditions dependent upon the adaptation of the inferior or orbital surface of the occipito-frontal lobe to the surface of the orbital plates of the frontal bone. Another fissure is found on this surface which is produced by the presence of the olfactory lobe, which lies embedded in it. This is known as the sulcus olfactorius, and defines a small straight ridge lying between the olfactory bulb and the mesial margin of the hemisphere which is known as the gyrus rectus.

2. POSTERIOR OR PARIETAL DIVISION OF THE OCCIPITO-FRONTAL LOBE.

On the lateral surface of the so-called parietal lobe, according to the boundaries I have adopted, nearly all writers distinguish at least three convolutions. Pansch,
however, distinguishes but two, and I believe he correctly considers this region.

Three distinct and separate convolutions of morphological value cannot be separated. The three generally described by authors are the posterior central, P C, the superior parietal, S P, and the inferior parietal, I P. Pansch considers the convolution, S P + P C, that is, the posterior central plus the superior parietal of other writers, as a single convolution, and calls it the gyrus parietalis superior, while I P or P P, he terms the gyrus parietalis inferior, separated from each other by the fissure, i e, the interparietal of Turner. With this method of considering the parietal region I entirely agree. Evidently, as may be seen by referring to any of the plates, the convolution back of the central fissure, P C, is not distinct from the portion marked P, but is directly continuous with it. Recognized in this way, the structure of the lateral parietal surface can be easily understood, whilst viewed in the manner usual with most writers, that is, dividing it up into a number of separate lobules without pointing out their morphological relations, it becomes very difficult to understand. I will first briefly direct attention to how it is regarded by previous investigators, and will then point out what appears to me to be its true structure. In the first place there has been distinguished a separate convolution, P C. Ecker calls this the posterior central convolution, deuxième pli ascendant of Gratiolet, the ascending parietal of Turner; posterior parietal gyrus of Huxley. The portion, S P, is called by Ecker the lobulus parietalis superior, the lobule du deuxième pli ascendant of Gratiolet, the posterior parietal lobule of Huxley, Turner and other English authors. With regard to the convolution, I P, or P P P, still greater confusion exists. Pansch and Ecker give to this convolution as a whole a distinct name. Pansch terms it the gyrus parietalis inferior and Ecker lobulus parietalis inferior. These names appear to me to be correct although I object to the term lobule of Ecker. This convolution, especially in the negro, is as distinct and well marked as any of the frontal convolutions, and if this does not satisfy us of its typical nature its appearance as presented in the Simiadae certainly should. In them it constitutes one of the best marked convolutions of the hemisphere, far better marked than any of the frontals. The portion P Ecker calls the anterior division or lobulus supra-marginalis, and the portion P 2 he terms the posterior division or gyrus angularis. These correspond with the parts called by Gratiolet the pli marginal supérieur, P, and the pli courbé P 2. Wagner's division of this convolution adds still greater confusion. Thus he calls the posterior division, P 2 , the second parietal convolution, zweite oder mittlere Scheitellappenwindung, and the anterior portion, P 2 , the third parietal convolution, dritte Scheitellappenwindung. Bischoff, with his peculiar theory of the manner of arrangement of the convolutions, calls the anterior portion, P, erste oder vordere Scheitelbogenvindung, and the posterior, P 2 , zweite oder mittlere Scheitelbogenvindung. This method of nomenclature seems to me to be not only faulty but it absolutely obscures all idea of relation and connection in this region. The convolution, P 2 P 2 , is not two separate and distinct convolutions as this division would lead us to suppose, but a single and distinct gyrus. Its individual
and separate character can be better discerned and studied in the negro, where it will be found much freer from secondary and tertiary markings, approaching in this respect more nearly the conditions as found in the monkeys and apes, than in the white brain. If it should be considered necessary to divide it into two portions under distinct names for purposes of description and localization, then these two divisions should be considered in their proper light; that is, merely as separations of the typical convolution, P^1 P^2, and not as distinct and separate convolutions comparable with the others.

The fissure i p. interparietal, separating the convolutions, P^1 from P^2, was first recognized and described as typical by Turner,^1 who gave to it the name of fissura interparietalis. It has been recognized as typical by Pansch, Ecker and other more recent writers. It has been due to the non-recognition of the typical nature of this fissure by many writers that much of the confusion respecting this lobe, referred to above, has arisen. Bischoff admits that this fissure is present in the foetus, and typical, but he does not agree with Turner as regards its nature in the adult brain. He remarks in his paper,^2 according to my observations, although it arises in the foetus a typical furrow, it is, as I believe I can demonstrate, misunderstood by Turner, and is not present in the adult in the manner described by him." He does not state, however, how he found it, nor in what the difference consists. All the more recent writers have, however, admitted the existence and typical nature of this furrow. It is true that it is usually bridged over in one place, sometimes in two, but this is no reason for rejecting its typical nature, for the frontals are constantly bridged and even the calcarine and central have been found so. It appears, therefore, to be in every respect typical in its character. In the Simiadae its important nature is very evident, see figures of Plates XXXVII and XXXVIII, where it will be found as one of the best marked furrows of the lateral surface of the hemisphere. In the negro brain this fissure is much more simple in its nature and better defined than in the white brain. Indeed, in the negro brain it is a deeply marked and but slightly tortuous fissure, often completely unbridged and approaching very closely the condition as found in the higher Simiadae, such as the Chimpanzee, Plate XXXVIII, fig. 13 and Plate XXXIX, fig. 4. In the posterior view of the occipital lobe of the negro, Plate XXXVI, fig. 5, the posterior portion of this fissure will be seen, the anterior portion of which is so well marked in Plate XLII, fig. 1. In this brain the whole extent of the fissure is only interrupted by the small annectant or bridging gyrus marked x, corresponding in this respect to the condition as found in the left hemisphere of the Chimpanzee, Plate XXXVIII, fig. 13, and Plate XXXIX, fig. 4. This was also the case in many other negro brains examined, whilst in some, as is seen in that of a mulatto, Plate XXXVI, fig. 6, and Plate XLIV, fig. 1, it is found to be entirely uninterrupted throughout its whole extent. Its sides are, however,

^1 Edinburgh Medical Journal, 1866.
^2 Die Grosshirnwindungen des Menschen, etc.
^3 Journ. A. N. S. PHILA., Vol. X.
more tortuous than is usually the case in the negro. In highly convoluted white brains this fissure often becomes very tortuous and much broken, whilst in those of less convolutional development it assumes a simple character, and, although interrupted, can be readily distinguished as a whole, Plate XLIII, figs. 1 and 2. In the Mongolian, so far as can be determined from a single specimen, Plate XLI, figs. 3 and 4, it presents quite as tortuous and complicated an appearance as found in the Caucasian.

The brain of the negro, Plate XLII, fig. 1, illustrates another very interesting fact in this connection. In this brain the interparietal fissure terminates directly in the Sylvian at its upper extremity, so that in this brain the lobule du pli marginal (supra-marginal lobule) which Gratiolet asserted, and other writers have repeated, was characteristic of the human brain as distinguished from the Simian brain, is entirely absent on the surface, the slightest trace of its presence being indicated by the very small fold, P2, which lies entirely concealed within the interparietal fissure in its natural condition. I have slightly widened this fissure by pushing aside its two borders in order to bring this concealed fold into view. This

![Fig. 13](image1)

![Fig. 14](image2)

is a very interesting specimen, since it shows that we cannot make any absolute distinction between the simian and human brain. In the brain of the negro, Plate XLI, fig. 1, this concealed fold has come to the surface, but exists as a simple small quadrangular lobule, P2. In the brain of the mulatto, Plate XLIV, fig. 1, it will be found well developed, assuming the character found in the white brain. In the Chimpanzee, Plate XXXIX, fig. 4, P2, it is also well developed. Here, then, can be traced a perfect series as regards the development of this supra-marginal lobule, from the monkeys, through the Anthropomorpha, thence to the brain of the negro by intermediate steps to the condition as found in the brain of the Caucasian race.

I believe that an attentive study of a large number of negro brains will clear up many points in respect to the comparison of the human and anthropoid brains. I have especially found such comparisons of the greatest value in unravelling the complexities of convolutional configuration in the human occipital lobe.
According to the view advanced in this paper the structure of the parietal region of the occipito-frontal lobe is as follows:

One fissure, the interparietal, is recognized separating it into two convolutions, a gyrus parietalis superior, P₁, and a gyrus parietalis inferior, P₂ P₂'.

Morphologically, however, I regard it differently. We have seen, in speaking of the fissura centralis, c c, reasons for believing that this fissure represents the posterior portion of a superior occipito-frontal fissure developed downward. If, therefore, we imagine or consider the central fissure pushed upward and backward into its primitive morphological position we will find that the convolution A C, or anterior central convolution, will take a position above the superior parietal convolution. The diagrams, figs. 13, 14, 15, 16 and 17, will make my meaning clear. Figure 13 represents the condition of the fissures and convolutions in the brain of Man and the higher monkeys, and fig. 14 the arrangement as found in the Lemurs; which, through the brain of Chironymys, fig. 15, is plainly related to the type of fissuration as found in the Carnivora, Plate XLV, figs. 9-22. We have already seen that we may trace the steps in the Lemurs by means of which the central fissure gradually develops from a downward prolongation of the posterior portion of a superior occipito-frontal fissure, OF₁, figs. 13 and 14, Chironymys. Considering the fissure, c c, as restored gradually to its position as found in the Lemurs, we have the relations represented in fig. 17, and by comparing this arrangement with an interme-

diate form like the Gibbon, fig. 16, the various transitions from a Lemur type of brain to that of Man will be readily understood and it will be perceived that the primitive type of structure of the lateral surface of the occipito-frontal lobe is similar to that of the occipito-temporal, consisting of two longitudinally-running occipito-frontal fissures, o. f₁ and o. f₂, a superior and an inferior, separating three primitive occipito-frontal convolutions, corresponding to three similarly related convolutions found in the occipito-temporal lobe as indicated in fig. 17. The anterior central con-
volution, AC, then, becomes directly continuous with the superior frontal convolution, and represents morphologically, if we should divide the brain in this state into a frontal and parietal lobe, a superior parietal convolution. The middle frontal, F°, figs. 14 or 15, becomes directly continuous with the superior parietal convolution. P/, and the inferior frontal, F; with the inferior parietal, P° P° whilst the interparietal fissure would be the posterior portion of the inferior frontal convolution, f°, separated from its anterior portion by the downward development of the posterior part of the superior occipito-frontal fissure, o. f°, forming the so-called fissura centralis or fissure of Rolando. This relation shows that the convolution P°, which, following Pausch, we have called the gyrus parietalis superior, is really morphologically, in the primitive type of Primate brain, a middle parietal convolution, and such I believe is its real significance. However, as I have remarked in speaking of the division of the cerebral hemispheres into lobes, I consider the division of that portion of the brain lying above the fissure of Sylvius into a frontal and a parietal lobe as merely convenient for purposes of description, and since in all Primates above the Lemurs. Marmosets, and lowest of the Simiaedae the fissura centralis has become a well differentiated portion of the primitive superior occipito-frontal fissure, I think it best to retain the name of superior parietal convolution, because it really represents the condition as found in the brain of Man and the higher Simiades. Moreover, the instant we give the fissure of Rolando its true primitive morphological position, the distinction between the parietal and frontal divisions or lobes entirely disappears, and we merely have three lateral occipito-frontal convolutions extending from the occipital lobe, O, to the anterior extremity of the frontal lobe, O F, and as such morphologically, it appears to me, they should be considered. The evolution of this region of the cerebral surface takes place as follows: Of the three lateral occipito-frontal convolutions, fig. 17, the superior O F; differentiates into the superior frontal, F; and the anterior central, A.C.; the middle, O F°, into the middle frontal, F°°, the posterior central, P C, and the superior parietal, P°°, fig. 16; the third, O F°°, becomes the inferior frontal, F°°, and the inferior parietal, P°° P°°.

The two lateral occipito-frontal fissures separate into a superior frontal, o.f°, and the fissura centralis, c., and the second into an inferior frontal, o.f°°, and the interparietal, i.p. This is exactly the arrangement found in many of the Lemurs, and we can trace through the curious synthetic and aberrant form Cheirornys resemblances to the convolutional structure of the brains of the Carnivora.

**Development of the Fissures and Convolutions of the Occipito-Frontal Lobe in the Human Fetus and their Appearance and Relations in the Brains of the Simiades.**

The lateral surface of the occipito-frontal lobe at the beginning of the sixth month is entirely smooth in the human fetus, Pl. XXXV, fig. 5. Shortly afterward there appears upon its surface three radiating furrows, which constitute three of the primary furrows of Pansch, Pl. XXXV, fig. 8. Of these the central one, represent-
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

ing, the future fissura centralis, appears somewhat earlier than the other two represented by the foetal brain at the middle of the sixth month, Pl. XXXV, fig. 7. The anterior, f.3, fig. 8, becomes the inferior frontal fissure, together with its vertical branch, the inferior vertical frontal or fissura praecentralis. The posterior, i.p., develops into the fissura parietalis. Differentiation takes place as seen in figs. 10 and 12, until finally, at a little past the beginning of the eighth month, fig. 16, this region assumes the appearance as found in the higher Simiidea and in Man. In the meantime, as can be seen in fig. 12, the superior frontal fissure has developed. In figs. 14 and 16 the gradual increase in tortuosity and complexity can be noted, together with the evolution of fissures, f.4 and f.5, the superior and inferior vertical branches respectively of the first and second frontal fissures. Increase in complexity, due to the formation of numerous sulci, takes place even after birth, but the general type is still adhered to, until finally we have the varied and complicated configuration as found in the adult human brain.

In the Lemurs the fissures of the lateral frontoparietal region retain their primitive structure, a definite development of the fissura centralis having as yet not taken place, although indications of its future appearance can be readily seen in Cheironomys, fig. 24. Usually, however, this surface of the occipito-frontal lobe is divided up by two longitudinally-running fissures, which are more or less interrupted in their course and which separate three occipito-frontal convolutions, OF1, OF2, OF3. Indications can, however, be distinguished, as in Propithecus diadema, fig. 21, of the tendency to produce a vertical arrangement, f.3 and f.4 being slightly represented. The fissuration as a whole of the entire lateral surface of the hemisphere exhibits a primitive homogeneous and scarcely characteristic form of development.

In the Marmosets, Pl. XXXIV, figs. 11, 12 and 13, no signs of fissuration exist on the lateral surfaces of either the occipito-frontal or occipito-temporal lobes, representing a condition similar to that found in the human foetus at the beginning of the sixth month.

In the lowest forms of Platyrhina or New World monkeys, such as Chrysothrix, we find but a slight advance in development over the conditions as exhibited in the brain of the Arctopitheci. The absence, or at most slight fissuration of the cerebral surface of these animals, is undoubtedly due to the enormous antero-posterior expansion of the skull, which in these forms reaches its highest relative development, so much so that in Chrysothrix sciureus the posterior extremity of the hemisphere extends back of the cerebellum to an extent relatively much greater than in that of any other Primate, not even excepting man. In Pl. XXXVIII, figs. 6 and 9, we have views of the upper and inferior lateral surface of the brain of this monkey, and it will be seen that the only fissures represented are the Sylvian and the external perpendicular portion of the fissura occipitalis superior, which are continuous, and the superior occipito-temporal, o.t.1. Faint indications can, however, be discerned of the fissura centralis; otherwise the brain is entirely smooth upon the lateral surface. The convolitional development of these brains is, therefore, simpler
in character than that of the Lemuriidae, but the type stamps them as being more closely related phylogenetically to the higher Simiidae.

The gradual increase in complexity can be studied in the Simiidae, in the figs. of Plates XXXVII and XXXVIII, where \( f^1 \) or \( o f^1 \) is the superior frontal; \( f^2 \) or \( o f^2 \), inferior frontal; \( f^3 \), inferior vertical frontal or praecentralis; \( f^4 \), superior vertical frontal and cc. central fissure. \( F^1 \) or \( OF^1 \) is the superior frontal; \( F^2 \) or \( OF^2 \), middle frontal; \( F^3 \) or \( OF^3 \), inferior frontal; \( AC \), anterior central convolution, and \( o p \), operculum. From such an examination it will be seen that the vertical portions of the frontal fissures appear first, and the horizontally-running fissure, situated just above the orbital surface, represents merely the horizontal branch of the inferior frontal fissure, which, eventually, joining the vertical portion, becomes a whole the inferior frontal with its vertical branch. Pansch has considered this portion of the inferior frontal as a distinct fissure in the monkey brain, thus describing three lateral longitudinal frontal fissures dividing the frontal lobe into four frontal convolutions. An attentive study, however, of different monkey brains and comparison with those of the Anthropomorpha will show, I think, that this inferior fissure should be classed with and considered as an after developed portion of his first primary furrow.

In the Chimpanzee, by the development of bridging convolutions, triradiate and H-shaped zygal sulci, the frontal surface acquires a complexity which closely relates it not only in general, but also in special characteristics to the human brain. This resemblance can be fully appreciated by comparing fig. 3, Pl. XXXVI, which is from the brain of a human fetus toward the end of the ninth month, with fig. 7, or Pl. XXXIX, fig. 4, which is a drawing of the left hemisphere of the brain of a Chimpanzee.

In the parietal region of the Simian brain we find a single well marked fissure, the interparietal, 1 p, separating two distinct convolutions, the gyrus parietalis superior and inferior, the former of which is directly continuous anteriorly with the posterior central convolution, and, indeed, forms with it a single gyrus; whilst the latter, extending from the space between the extremities of the Sylvian and interparietal fissures arches upward, backward and then downward, surrounding the posterior extremity of the superior occipito-temporal fissure in the form of an arch, the anterior portion of which has been called the supra-marginal lobule and the posterior the gyrus angularis. In the majority of the Simiidae the interparietal unites with the external portion of the superior occipital fissure, fissura perpendicularis externa, as may be seen by examining figs. 1, 2, 3, 4, 8 and 9, Pl. XXXVII, and figs. 1, 2, 3, 4 and 11, Pl. XXXVIII. In Ateles and often in the Anthropomorpha, as we have also found to be the case in Man, these two fissures are separated from each other by a small gyrus which rises from the depths of the superior occipital fissure, the \textit{plis de passage supérieur externe} of Gratiolet. This may be seen in \textit{Ateles ater}, figs. 15 and 16, Pl. XXXVII, and also in the right hemisphere of the Chimpanzee, fig. 13, Pl. XXXVIII. We shall, however, discuss this occipito-parietal region more in detail under the heading of the \textit{plis de passage}, as it is especially in this region that the most marked changes take place in the human as compared with the Simian brain.
CONVOLUTIONS AND FISSURES OF THE OCCIPITAL LOBE.

We now come to the consideration of the fissures and convolutions of the occipital lobe, and here we approach, as we have before remarked, perhaps the most confused subject in the whole range of anatomy. Ecker, in speaking of this lobe, remarks that there is indeed no doubt that the understanding of the convolutions of the occipital lobe is more difficult than that of all the other lobes. He regards this difficulty as arising from the great individual variation, and by the transference of the nomenclature of the monkey brain directly to that of Man. He says that in no part of the cerebral surface is the difference between the brains of the apes, *Cercopithecus, Indris, Cynocephalus, Cebus,* etc., upon which Gratiolet's description was founded, and the human brain, more marked than in the occipital lobe. He considers that the various connecting convolutions, the *plis de passage* of Gratiolet, may have a meaning in the lower apes, but none at all in Man. He says, "the separation of certain intermediate portions under the name of transition convolutions, *plis de passage,* between the convolutions of the occipital lobe on the one hand and the parietal and temporal on the other, has no justification in the human brain, and makes this understanding of the region more difficult. I have, therefore, wholly rejected the name." I cannot wholly agree with Ecker as regards these transition convolutions in the human brain, and, farther on, I will endeavor to point out what appears to me to be their exact significance. The attempt to separate these parts as distinct convolutions in the human brain, as has been done by Gratiolet and the English anatomists, is certainly productive of confusion, and gives an erroneous interpretation to this region. Indeed, even in the monkeys, I do not think they should be considered as separate convolutions in any sense comparable to the other gyri of the cerebral surface. I cannot, however, agree with Ecker in the statement that the confusion arises from the transference of the nomenclature of the monkey's brain to that of Man. It is true, confusion has arisen, but it appears to me that this is owing to the faulty method of considering this lobe and not to any essential differences existing in the arrangement of the lobe in Man and the Simians. I believe if these lobes be rightly compared, not only can the nomenclature of the ape brain be transferred directly to that of Man, but positive advantage arises therefrom, and many points that appear unimportant and obscure in the human brain assume new and interesting relations, and acquire a deep significance when viewed from a morphological standpoint. Complex nomenclature and the identification of secondary fissures as of primary importance, together with the non-recognition of the true relations existing between the convolutions and fissures of this lobe, appear to me to be the causes of this confusion. Before describing the occipital lobe as it exists in Man, it will be necessary, on account of its more simple character, to study its structure and mode of arrangement in the Simidae. We have already pointed out in discussing the boundaries of this lobe in these animals that it can be almost completely separated from the occipito-frontal and occipito-temporal portions by two transversely-running fissures, \( o^1 \) and \( o^2 \) forming together what I have termed the primary occipital
arch, the upper branch receiving the name of fissura occipitalis primus or superior, \( \sigma^2 \), and the lower that of fissura occipitalis secundus or inferior, \( \sigma^1 \). Of these the upper or superior occipital fissure, \( \sigma^1 \), has been known as the fissura occipitalis perpendicularis, which again has been subdivided into an external portion, the external perpendicular, and a mesial portion, the internal perpendicular or parieto-occipital of the human brain. The lower fissure, \( \sigma^2 \), has only been recognized as existing in the human brain by a few of the most recent writers, e.g. by Wernicke, after whom it is sometimes called,—by Wilder, who terms it the exoccipital, and by Schwalbe, who calls it the anterior occipital. These two fissures mark off in all but the highest Simiae a perfectly smooth or but slightly furrowed occipital lobe, as may be seen in *Macacus cynomolgus*, Pl. XXXVII, fig. 1, which should be compared with figs. 2, 8, 9, 12, 19 and 20, Pl. XXXVII, and fig. 11, Pl. XXXVIII. In *Chrysothrix sciureus*, the upper branch of the arch, \( \sigma^1 \), joins the Sylvian fissure, whilst the lower arch is but imperfectly developed on the lateral surface, although the posterior scroll-like portion is well represented, as can be seen by comparing Pl. XXXVIII, figs. 7, 8 and 9.

The superior occipital fissure, \( \sigma^1 \), in the lower Simiae is a perfectly continuous fissure, but as we ascend toward the higher forms there is a tendency to separate this primitively single fissure into two by the development of a small convolution, fig. 13, Pl. XXXVIII, 2, from the floor of this fissure. This annexant fold is present in most of the monkeys, but in the greater number it lies entirely concealed within the fissure; it may be seen in the brain of *Cebus apella*, Pl. XXXVIII, fig. 12, marked 2 in its concealed position, the fissure \( \sigma^1 \) being opened in order to show its relations. It is even better displayed in *Macacus nemestrinus*, Pl. XXXVII, fig. 5, 2 2'. This is the convolution called by Gratiolet the superior external *plis de passage*. This annexant gyrus is shown as it exists in Man, Pl. XL, fig. 1, and Pl. XXXVI, figs. 5 and 6. In this way in Man, in the Anthropomorpha, and occasionally in such Simiae as *Ateles*, Pl. XXXVII, figs. 15 and 16, the parieto-occipital fissure is separated from the lateral surface of the hemisphere.

The occipital lobe, delimited as above described, is perfectly smooth in such Simiae as *Cercopithecus*, Pl. XXXVIII, fig. 11, or *Macacus cynomolgus*, Pl. XXXVII, fig. 20, where the boundaries of the lobe are distinctly outlined by the primary occipital arches. In some species of Macaques it is furrowed, as is shown in Pl. XXXVII, figs. 10, 11, 12 and 13, and this fissuration becomes more and more pronounced the nearer we approach toward Man. From this occipital lobe the convolutions proceed forward to the frontal and temporal lobes. Leaving the consideration of the lateral surface of the occipital lobe for the present, we will pass to the consideration of its mesial surface. For this purpose we shall first study its structure as it appears in *Chrysothrix*, Pl. XXXVIII, fig. 8. The mesial extremities of the two fissures, \( \sigma^1 \sigma^2 \), are seen arching, as stated previously around the upper and lower extremities of the transverse calcarine, c a, and in this way is the mesial portion of the occipital lobe completely marked off from the anterior portions except that two small gyri lying one above and one below the fissura calcarina connect it with the
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS. 319

mesial occipito-frontal convolution above and the mesial occipito-temporal convolution below. The arrangement as found in this low American monkey represents on the mesial surface the morphological type on which all the Simian and human brains are based. The differences that are observed in the higher monkeys and in Man are due merely to secondary complications, and it will be found that these secondary modifications conform to definite and regular laws. The portion of the fissure, o', seen on this surface, Pl. XXXVIII, fig. 8, represents the internal perpendicular or parieto-occipital of Man. With regard to this point, an immense amount of confusion exists, Gratiolet, Marshall and others being entirely wrong in their identifications in the human brain. Thus Marshall, following Gratiolet, in describing the brain of a Bushvoman, calls the lateral portion of the parieto-occipital the external perpendicular fissure, identifying it with the external perpendicular of the apes. This identification is incorrect and has been one of the most fruitful causes in producing much of the confusion as regards the fissures and convolutions of the occipital lobe. Pansch and Ecker recognize the true condition, but do not properly apply it; thus, Pansch in speaking of the fissura occipitalis externa, remarks, "I have very seldom found an indication of this fissure in the foetal brain, and I cannot find in the adult brain any indication in this region of a typical furrow. I mean that had the human brain been examined alone (I speak only as regards foetal brains now before me) one could not arrive at the conclusion that the fissura occipitalis externa is a fissure of importance equal to the others, or as at all to be regarded as a typical furrow. Of course it is true that we see here frequently a transverse fissure, but either it is very shallow or it varies very much in different brains and is very short. That we find in many brains a fissure which corresponds to the so-called fissura occipitalis of the apes I do not deny, but only that it is a typical furrow of the human brain."

Bischoff rightly identifies the internal perpendicular, but he introduces fresh confusion. In the foetus he identifies the external perpendicular, but he states that it disappears in the seventh and eighth month on account of the development of new fissures and convolutions in this region. He says that he is not in a position to maintain that a furrow appearing on the outer side and a nick often found on the edge between the inner and outer surface is not a remnant or further development of this fissure. It corresponds distinctly, however, with the occipital fissure found in the majority of the Simiidae and which separates the parietal and occipital lobes. On this subject Ecker expresses the following opinion with which I entirely concur: "Bischoff mentions the fissura perpendicularis externa which arises at the end of the seventh month and descends perpendicularly over the posterior part of the hemisphere, but is not further developed and does not give origin to any permanent furrows, but in the eighth month entirely disappears without taking part in the formation of the furrows later noticeable in the occipital lobe. Of course it is very easily possible that a furrow which exists for such a short time, so that it has a life of only three weeks, can very easily escape the notice of an observer, and I am very far removed from wishing to throw doubt on this observation of Bischoff. That the furrow, however, which I designate as fissura occipitalis transversus, and which is fre-
quently continuous with the fissura interparietalis; does not behave in the above-
mentioned manner. I believe I have proved by repeated observation. This furrow is
in the majority of seven months foetuses not yet visible. On the contrary, there is
such a fissure in the eighth and ninth month which does not again disappear. In
the fifth month, on the other hand. I have again and again, sometimes alone and
sometimes present with other transverse furrows, often seen a deep entering fissure
pointed at both ends which corresponds exactly in its position with that mentioned
by Bischoff as running across the occipital lobe, and that this fissure later again dis-
appears is probably certain, for at this spot during the sixth and seventh month there
is generally no trace of such a fissure."

With Ecker I have found in foetal brains the fissure which he terms the fissura
occipitalis transversus well developed and not disappearing, but fully represented in
adult human brains. It is represented in figs. 8, 10, 14 and 16, Pl. XXXV, and
figs. 1 and 3, Pl. XXXVI. It represents the external perpendicular of the apes,
which has been thrust backward and variously contorted by the increased convolu-
tional development taking place in this region in the higher Primates including Man.
It is the fissure marked o, in figs. 5 and 6, Pl. XXXVI, and fig. 1, Pl. XL. It may
be seen by studying these figures that the external perpendicular fissure is separated
from the internal by the development of the convolution, 2, upward from its floor.
The simpler, and in this respect more ape-like character of the negro brain, renders
the true nature of this change as found in the human brain very evident. Fig. 5,
Pl. XXXVI, is from the occipital lobe of the brain represented in fig. 1, Pl. XLII,
whilst fig. 6, Pl. XXXVI, is a posterior view of the mulatto's brain of fig. 1, Pl.
XLIV.

Marshall, as we have already seen, calls the lateral portion of the parieto-
ocipital the external perpendicular; but this is, as we now see, only the upper end
of the fissura perpendicularis interna. The external is really the fissure marked o,
the fissura occipitalis transversus of Ecker and more recent writers; and the condi-
tion of things in the Anthropomorpha, Ateles, Hylobates, and in the brain of Man,
is produced in the following manner: In most of the monkeys, such as Cebus, Cercopithecus,
Macacus, Cynocephalus, etc., we will find on looking directly down
upon the hemisphere the fissures arranged as in the diagrams, figs.
18 and 19, where AB represents the line of the longitudinal fissure
separating the two hemispheres from each other, i p, the interpa-
rietial fissure; O, the external perpendicular. PO, the parietal-
ocipital. P1 and P2 are respect-
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

obviously the gyrus parietalis superior and inferior and O represents the position of the occipital lobe.

At the point, PO, at which the external perpendicular becomes continuous with the internal, but concealed within its depths, there develops in the monkeys, from its floor, a small bridging convolution, 2, fig. 19, and the external perpendicular fissure, O', is pushed backward just in proportion to the development of this convolution; the fissura interparietalis, i.p. is also displaced to a corresponding extent downward and backward, and this is precisely the condition as found in the human brain, with the exception that the fissuration assumes a tortuous aspect. In this manner the internal perpendicular appears as a fissure, PO, nicking or extending slightly outward upon the lateral surface of the hemisphere. This is also the case in the Orang according to Bischoff, and may be seen in the brain of *Ateles*, Plate XXXVII, figs. 15 and 16, and also in the Chimpanzee on the right hemisphere, Plate XXXVIII, fig. 13. This gyrus, 2, varies as to its extent of development in different individuals. In all the negro brains that I have examined, I found it much simpler than in the white. Below and back of this gyrus, 2, and separated by the fissure surrounding it, we have evidently that part of the brain which corresponds in Man to the smooth or progressively furrowed occipital region of the Simiidae. Prof. Wilder, remarks of Ecker's fissura occipitalis transversa, as follows: "the reputation of Ecker, the clearness of his descriptions, and the simplicity of his figures, with the existence of both English and American translations, have caused his statements and views to be accepted and his diagrams to be generally reproduced, not merely in clinical reports, but in the papers of original observers. But, although as I hope to show in a subsequent paper on the so-called 'ape fissure,' Ecker has clearly explained (pp. 56–60, and note), some of the distinctions between the human and simian occipital lobe, yet his interpretation of the morphological relations of the parts immediately surrounding the dorsal end of the occipital fissure, which forms the natural starting point for the study of this region, is not in accordance with what is indicated by the material examined by me, and not even, as it seems to me, substantiated by his own descriptions and figures. In Ecker's diagram of the dorsal aspect of the cerebrum (fig. 2), the right parietal (interparietal) is made to stop nearly opposite the occipital, and there is a heavy line extending across the base of the lobe, at little caudal of the occipital, and wholly distinct from the parietal; this he calls the sulus occipitalis transversus.

Ecker's interpretation of the relations of the parietal and transverse fissures obviously depends upon the occasional independence of the latter, and I was led to suppose that the small number of human brains accessible to me at the time of the publication of Ecker's work might be more or less anomalous in the occipital region. Recently, however, I have carefully examined all the brains in the Museum of Cornell University, twenty-nine occipital lobes, and all the original

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1 "The Paroccipital, a newly recognized Fissural Integer," Journal of Nervous and Mental Disease (vol. xiii, No. 6, June, 1880).
figures of the cerebrum in the best anatomical monographs and manuals. In no case have I found even an approximation to an independent fissure in the location of Ecker’s ‘transverse;’ on the contrary, in every specimen and in every figure, so far as I can judge, a fissure there situated is joined by what Ecker regards as the extension of the ‘interparietal.’

“Since Ecker’s reputation precludes the idea that the condition of things on the right of the diagram is altogether imaginary, or even based upon an artistic misconception, it may be supposed either that the brain there figured was exceptional, or, what is more probable, that a very different fissure, footed and possibly transitory, has been mistaken for the adult ‘transverse.’ Upon this point I hope to present evidence in another paper. Whatever be the explanation of the difficulty, the ‘transverse occipital’ of Ecker has been almost universally accepted. So far as I know, only three writers have expressed doubts as to its integrity and significance. Edinger reproduces Ecker’s diagram in two places, 21, 22, with only a comment, 23, upon the difficulty of recognizing the ‘regulation pattern’ in the occipital region: ‘Dieser Occipitalappen ist aussen nicht an allen Gehirnen so gleichmassig gefurcht, dass man immer die von den Autoren angegebene erste (obere) zweite (mittere) und dritte (untere) Occipitalwindung leicht und ohne Künstelei wieder finden könnte.’ Clevenger, 21, says that it ‘might be considered and probably is, in many cases, a ramus projected forward (laterad) from the occipital termination of the parietal.’ Pansch holds, 22, that the variability of the ‘transversus’ excludes it from the category of primary fissures.

“The most serious opposition to its acceptance is in the following passage from Wernicke’s paper.1 ‘Dass vorkommen einer durch besondere Constanz oder tiefe auszeichneten queren Furchen (sulcus occipitalis transversus) kann ich nach meinen Befunden am erwachsenen Gehirne nicht bestätigen.’

“There may be room for discussion respecting the propriety of accepting as an integer, a fissure which, like the post-sylvian of the cat and the post-central of Man, is only occasionally independent; but surely we are not called upon to accept without question the integrity of a supposed fissure which, like Ecker’s ‘transverse occipital,’ is independent upon only one side of his own diagram, and which, apparently, no one else has found in that condition.

“My first conclusion is, then, that what is commonly understood as the transverse occipital of Ecker is not a fissural integer, and that the name and its synonyms should be abandoned.

“The second question is as to the relations of the longitudinal zygon to the parietal. Ecker’s view is indicated in all his figures, and specifically stated in the following passages, pp. 58, 38:—

‘In the fetus the two portions of the fissure, the posterior (occipitalis superior) and anterior (interparietalis) [real parietal], arise separately from each other and subsequently unite. The former is nothing but an extension of the latter.’

"On page 38 it is admitted that the fissure is less distinct (manchmal weniger deutlich), because often interrupted, and this more frequently on the right side. Nevertheless on both sides of the diagram, fig. 2, the fissure is made continuous, and his view seems to have been generally accepted.

"After a careful study of all the specimens and figures obtainable, I am led to conclude that this view is erroneous; that the true parietal and the 'superior occipital' do not form parts of one fissure, and that the latter is the principal and primary constituent—zygon—of a paroccipital fissure.

"The evidence is threefold: (1) as admitted by Ecker, the zygous always appears independently in the fœtus; (2) as also admitted, it often remains separate in the adult; (3) when the union does occur, in all cases examined in reference to this point, excepting one, the combined fissure is shallower at the presumed place of junction, and deepener at or near the middle of the two constituents—the true parietal and the paroccipital zygous.

"So far then as reliable evidence is attainable by me at the present time, it appears that Ecker's interparietal is interrupted as often as it is continuous. On page 38 Ecker endeavors to diminish the force of what would be commonly regarded as evidence adverse to his view, by affirming that the interruption of his 'long' parietal occurs no more frequently than, for example, the temporal fissures. Even if this be true, it is by no means certain that the temporal fissures are the integers they are ordinarily admitted to be; they certainly, like all other fissures, need monographic treatment." (Wilder.)

The various opinions expressed above depend, I believe, on the non-recognition of the fact that the fissures of the hemispheres are produced in two entirely different ways. In discussing the evolution of the calcarine fissure and the bridging gyri that often appear in its course, I pointed out the fact that whilst the majority of the cerebral fissures are produced by the sinking or depression of the cerebral surface, due to the general growth of the hemisphere as a whole, other fissures are produced by an exactly opposite process; namely, by the development upward from the floor of previously existing fissures, of local swellings, the so-called bridging or annectant gyri. Evidently the fissures produced in this way will have somewhat different relations to the surrounding parts from those produced originally as depressions of a smooth surface. We have already given sufficient evidence to show that the typical fissures represent the lines of least resistance to the differential action of the pressure forces; and as long as they remain represented as deep and constant fissures, the same revolution of forces must be taking place. As development proceeds and the skull begins to assume a more fixed and rigid shape, new conditions and relations of the growth-forces take place, as a result of which those portions of the cerebral surfaces lying in the depths of some of the fissures, originally produced by depression, are placed under new dynamical conditions. Instead of being situated, as formerly, along lines of resolution of greatest pressure-force and least resistance; they become centres of relatively greatest growth-force as compared with the resolution of pressure-forces. Hence we may expect to find
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

in highly convoluted brains, areas of growth rising from the depths of the original and primitive fissures. In this way we may have developed in certain regions gyri that become characteristic of a genus or a species, or that may even present themselves as individual peculiarities, such as the bridging of the central fissure in the brain of Dr. Fuchs figured by Wagner.

Now the fissura paroccipitalis of Wilder is of this nature. It is simply the remains of a gap made between two separated extremities of a fissure produced by the breaking of the continuity of the original fissure, due to the development of a localized swelling springing from its depths. By examining figs. 18 and 19 from this standpoint, I think the difficulties of the subject entirely disappear. In fig. 18, we have the condition as found in the majority of the Simiidae. The interparietal, i p, parieto-occipital, p o, and Ecker's fissura occipitalis transversa meet together at the margin of the mesial aspect of the hemisphere. Certainly in these forms there can be no doubt of the typical nature of these fissures. In fig. 19, we find coming to the surface a small gyrus. 2, which arises from the depths of the occipital cleft. O, and which can be seen in its concealed condition in Cebus appella, Plate XXXVIII, fig. 12. Evidently, as this concealed gyrus gradually reaches the surface, it will present the appearance as shown in the Chimpanzee, Plate XXXVIII, fig. 13, where Wilder's paroccipital gyrus, the superior external pli de passage, is seen in a condition which is intermediate between the stage as found in the lower Simiidae and Man, and which is almost identical with the arrangement as found in the human fetus toward the end of the ninth month (compare figs. 3 and 4 with 7 and 8, Plate XXXVI). Instead, therefore, of the "transverse occipital" of Ecker being merely the caudal stipe and ramus of the zygion of a new fissural integer the paroccipital, it appears to me that this fissure is merely a communication across a gap in the fissura perpendicularis externa caused by the development of the convolution.

2. Viewed in this light it is not a fissural integer at all, but merely a modification produced in the manner of connection of the originally confluent interparietal and fissura perpendicularis externa, and as such I regard it. It is for these reasons also, that this so-called paroccipital is deepest at its middle point and gradually becomes shallower as it joins the interparietal and backwardly displaced fissura perpendicularis externa, which Ecker, in Man, terms the "transverse occipital." From its mode of development it cannot be considered as a distinct and separate fissural integer comparable with the more important fissures of the cerebral hemisphere. There is no objection, however, to calling the convolution (2) by the name, paroccipital, as it represents a distinct morphological development, the nature of which we shall more fully discuss under the heading of the plis de passage.

It should ever be borne in mind, in comparing the occipital lobe of Man with that of the Simiidae, that whilst the posterior portion of the hemisphere is increasing largely in development, this is due in the human brain principally to growth taking place in the occipito-parietal region. The occipital lobe as it is sharply defined by the perpendicular or so-called "Ape fissure" is becoming relatively smaller, and the primitive simplicity of the primary occipital arch (as we have termed it
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

O¹ O² is becoming greatly modified by being pushed backward and compressed into a much smaller relative space. As a result of these conditions the fissures have a bridged and highly tortuous appearance, assuming, as it were, a rudimentary condition as compared with homologous parts in the monkey and ape brain, the lobe on the whole having the appearance of being crowded into insufficient space. On this point Wilder, in a foot note, remarks, 'may these characteristics be correlated with the fact that the occipital lobe is almost if not quite confined to the Primates, and is, so to speak, a 'new thing in Nature.' The superficial smoothness of the monkey's lobe is only apparent, the poma ('operculum occipitale') really involving a very peculiar and considerable complication which I hope to discuss in a future paper.'

INFERIOR BRANCH, O², OF THE PRIMARY OCCIPITAL ARCH.

We have already discussed the presence and arrangement of this fissure in considering the boundaries of the occipital lobe in the Simiadae. It can be well seen as represented in them in figs. 1, 2, 5, 6, 7, 8, 9, 10, 14, 17 and 18, Plate XXXVII; 1, 2, 4, 5, 8, 11, 12 and 16, Plate XXXVIII; in figs. 3 and 4, Plate XXXIX, as found in the Anthropomorpha, represented by the Chimpanzee. I have termed it the fissura occipitalis inferior or secunda. It has also been known as Wernicke's fissure, exoccipital of Wilder, anterior occipital of Schwalbe and sulcus occipitalis longitudinalis inferior of Ecker.

This fissure, together with the fissura-occipitalis superior or prima, O¹, forming the superior branch of the occipital arch, are the only two fissures that I consider of primary significance as respects the lateral surface of the occipital lobe, and together they cut off and separate it from the rest of the hemisphere forming the morphological boundaries of this lobe. I will endeavor, further on, by a comparison of the fissures and convolutions of this lobe in Man and the higher Simiadae, to give my reasons for this opinion. This inferior occipital fissure is always found well marked in the human brain, as may be seen by examining the various figures given in the plates. These two fissures are rightly identified and their importance recognized, the complexity of the human occipital lobe in a great measure disappears. From this occipital lobe, O², contained within the boundaries of these two fissures, O¹ and O², pass forward both in the monkeys and in Man the fissures and convolutions to the extremities of the occipito-temporal and occipitofrontal or fronto-parietal lobes; whilst posteriorly, the occipital lobe extends around upon the mesial surface and becomes continuous beneath the extremities of the fissures. O¹ and O², with the mesial occipito-frontal and mesial occipito-temporal convolutions, as may be seen in fig. 2, Plates XLII and XLIV (Man), fig. 3, Plate XXXIX (Chimpanzee), and fig. 5, Plate XXXVII (Macacus), etc.

On the lateral surface of the occipital lobe the separation by the fissures, O¹ and O², is also not quite complete, the apex, x, fig. 4, Plate XXXIV, running forward and upward to join the angular gyrus, P ², or posterior portion of the gyrus.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

parietalis inferior, and also merging into the middle occipito-temporal convolution, M.O.T, as can be seen in Plate XXXVII, figs. 1, 2, 8, and 9; Plate XXXVIII, figs. 4 and 11, in the monkeys marked 4; in the Chimpanzee, fig. 13, Plate XXXVIII, x, and in Man, fig. 1, Plate XLII; fig. 1, Plate XLIV; figs. 1, 3 and 4, Plate XLI, and figs. 1 and 2, Plate XLIII, x. It forms the *troisième pli de passage externe* of Gratiolet.

Before passing to the consideration of the morphological type or plan of the occipital lobe as I consider it, it will be necessary to examine the views and nomenclature of previous observers. Ecker distinguishes on the lateral surface of the occipital lobe, another fissure or fissures, besides the fissura occipitalis transversa, O 1, which he calls the fissure or fissura occipitales longitudinales. These fissures, together with the transversa, mark off, according to Ecker, three occipital convolutions. The first one he places above the transverse fissure and calls it the gyrus occipitalis primus. It includes the *erste obere Hinterlappenwindung* of Wagner; the *pli de passage supérieur externe* + the *pli occipital supérieur* of Gratiolet; *obere innere Scheitelbogenwindung* of Bischoff, first external annectant gyrus of Huxley, first bridging annectant or connecting gyrus of Turner. par-occipital of Wilder: the concealed convolution. 2. (see plates) of the monkeys and apes.

The second convolution he calls the gyrus occipitalis secundus. This is included between the transverse occipital and the longitudinal. It represents the *pli occipital moyen* + the *deuxième pli de passage externe* of Gratiolet; the *zweite mittlere Hinterlappenwindung* of Wagner, gyrus medius of Pansch, medio-occipital and second external annectant gyrus of Huxley.

The third or lower occipital convolution Ecker calls the gyrus occipitalis tertius. It represents the *pli occipital inférieur* + the *quatrième pli de passage externe*; the *dritte untere Hinterlappenwindung* of Wagner, gyrus occipitalis inferior of Pansch. With this division of the occipital lobe I cannot agree. In the first place, the gyrus occipitalis primus ought not to be considered, it appears to me, as a distinctly separate part of the occipital lobe at all. We have seen how in the monkeys the fissure O 1 marks off clearly the occipital lobe from the rest of the hemisphere. Now, the convolution which Ecker and others have called the first occipital convolution (gyrus paroccipitalis of Wilder) develops as we have seen from the floor of this occipital cleft, O 1, anteriorly to the proper boundaries of the occipital lobe, and it must, therefore, give rise to confusion to place it in the latter. Before reaching the surface, before interrupting the continuity of the fissure, O 1, and whilst lying concealed in the depths of this fissure, it certainly does not belong to the occipital lobe. Why then should it be considered a part of it when it merely reaches the surface in the higher apes and Man? This late developing gyrus is really only an increased extension and evolution of the gyrus parietalis superior, as may be seen by examining the various plates in which it is shown developed, as in the Chimpanzee, Plate XXXVIII, fig. 13, and in Man, Plate XXXVI, figs. 5 and 6. Huschke appears to be the only one who regards it in this light. He calls this
convolution the obere Zug der hintern Centralwindung; he includes the superior parietal under the name of the posterior central convolution.

MORPHOLOGY OF THE FISSURES AND CONVOLUTIONS OF THE OCCIPITAL LOBE.

As we pass from the lower to the higher Simiads and thence to the Anthropidae or races of mankind, we find that the primitively smooth occipital lobe becomes more and more complicated, until in the higher races it reaches its greatest complexity. The chief and most interesting fact in the morphological evolution of this region is that it takes place according to a regular and symmetrical plan, which follows the lines laid down by the primary occipital arch; and the fissures as they appear are, or may be considered as vegetative repetitions of this primary arch. They are, in fact, in appearance and relations a repetition of the first, and they belong to the third class of fissures according to the classification adopted in this paper. Their relations to the first arch and to the fundamental structure of the occipital lobe are shown in fig. 20, the two branches being marked respectively, $O_1$ and $O_2$. They constitute the secondary occipital arch, and it will be seen that not only is this arch symmetrically related to the primary arch but also to the two extremities of the transverse calcarine fissure, arching around them in a scroll-like manner,—within the position of the scroll-like extremities of the primary occipital arch. These two arches express primitive morphological type of the occipital lobe and by examining with attention fig. 5, Plate XXXVII, it will be seen that on the mesial surface this symmetrically developed posterior extremity of the hemisphere is related in a regular and definite manner to the occipito-frontal and occipito-temporal lobes. In this brain of Macacus nemestrinus the fissures have been opened up in order to display more perfectly the symmetry of this region, and it can be at once seen that the occipital lobe is symmetrically folded around the position of the fissura calcarina, which corresponds to the position of the eminence found within the posterior horn of the lateral ventricle known as the hippocampus minor. From the position of the two extremities of the transverse calcarine fissure, both the primary and secondary arches pass in a scroll or spiral-like turn forward toward the apex of the occipital lobe, the ends of the primary arch being separated from each other on the lateral surface by the small gyrus, $x$, (see fig. 20) or $y$ (see plates), the
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

**troisième pli de passage externe.** The secondary arch runs parallel with the first, and as this arch becomes successively more and more tortuous, the secondary also increases in complexity. On the right side of fig. 20 can be seen the primitive relations of the mesial surface of the occipito-frontal and temporal lobes to the fissures of the occipital lobe, as explained in our previous discussion of this portion of the hemisphere. The morphological plan of the occipital lobe is here expressed in its simplest condition, and it now remains for us to show the various modifications that take place as we advance from the lowest to the highest Primate brains.

In the Lemuridae the occipital lobe is entirely smooth. The superior occipital fissure, O₁, is, however, present, as may be seen in *Lemur nigrifrons*, Plate XXXIV, figs. 16 and 17, also in *Propithecus*, Plate XXXIV, figs. 14 and 23, in *Avahis*, Plate XXXIV, figs. 18, 19, and 20, and in *Indris*, Plate XXXIV, figs. 6, 7 and 8. In *Cheiromys* there is no sign of either arch, the occipital lobe being hardly defined.

In the Marmosets, the whole lateral surface of the hemisphere is smooth, as in *Hapale* and *Midas*, Plate XXXIV, figs. 11, 12, and 13, there being no signs of the appearance of the occipital fissures. In all the Simiidae the primary arch is well developed, and cuts off at first a smooth occipital lobe which gradually become furrowed by the formation of a secondary arch, as shown in *Macacus nemestrinus*, Plate XXXVII, fig. 10. In *Macacus cynomolgus*, figure 20, the occipital lobes are entirely smooth, and the relations of the secondary arch to the primary is well shown by comparing this brain with that of *Macacus nemestrinus*. Sometimes the whole of the secondary arch is not present, and it appears broken up into two or more parts as in another specimen of *M. nemestrinus* shown in Plate XXXVII, fig. 11, where the lower branch is present, but the posterior middle portion is absent with the exception of the most posterior scroll-like portion, which is present. Plate XXXVII, fig. 18, represents an unknown species of Macaque; the same relations obtain as in fig. 11, with the exception that the secondary arch is deeper. The posterior portion of the imperfect upper branch is seen on the left hemisphere. It will also be noticed that the inferior branch, O₂, of the primary arch, the fissura occipitalis inferior, is assuming a slightly undulating course.

Plate XXXVIII, fig. 5, represents the occipital lobe in *Cynocephalus porcarius*. The only noticeable changes are the increasing undulation of the inferior occipital fissure and the appearance of two small sulci, 1 and 2.

It will be noticed that the secondary arch, O₁' and O₂', divides the lateral surface of the occipital lobe, as I have defined it, into three distinct areas, and these I shall call respectively the gyrus occipitalis primus (superior), the gyrus occipitalis secundus (middle), and the gyrus occipitalis tertius (inferior), indicating them as S. Oc, M. Oc and I. Oc. It will be found that these three convolutions, separated by the two branches of the secondary occipital arch, can be traced through all their developments up to the brain of Man, and I think I will be able to show conclusively that if the occipital lobe be viewed in this way, most of the difficulties met with in studying this region in human brains disappear.
In *Ateles ater* we find a brain in which the primitive arches are somewhat modified and assume a tortuous appearance, the relations to the original morphological type can, however, be readily ascertained by comparing, Plate XXXVII, fig. 16, with figs. 15 and 18. The primary occipital arch has been separated in its upper branch, the fissura occipitalis superior, into a mesial, O¹, fig. 17, Plate XXXVII, and a lateral branch, O²; figs. 15 and 18, forming an internal and external (so called) perpendicular fissure, by the development of the superior external *fissure de passage*, 2. This development corresponds with a similar condition of affairs in the Anthropomorpha and in the human brain. Otherwise, the remaining parts are as already described, except, as we have remarked, the fissures assume a more tortuous aspect. Thus, O¹ is the superior occipital fissure; O² is the inferior occipital fissure; the secondary arch is imperfect anteriorly, but its two elements, O³ and O⁴, are easily distinguished separating three occipital gyri, S. Oc., M. Oc. and I. Oc.

The appearance of the portion of the cerebral surface in *Ateles* in front of the occipital lobe is markedly modified by the backward extension of the fissure of Sylvius up to the border of the hemisphere, relating it in this respect to the arrangement as found in *Chrysotrichs sciureus*, Plate XXXVIII, fig. 6, where the Sylvian becomes continuous with the fissura occipitalis superior as it does also in the right hemisphere of this specimen of brain of *Ateles*, figs. 15 and 16, Plate XXXVII.

In the Chimpanzee, as a representative of the Anthropomorpha, the plan of occipital morphology above described is very evident. See Plate XXXVIII, fig. 16. In the left hemisphere, fig. 13, the superior occipital fissure, O¹, is unbridged superficially, but the *fissure de passage supérieur externe*, 2, really exists in this specimen, being only imperfectly concealed. The inferior occipital, O², is well marked, as is also the secondary occipital arch, O³ and O⁴, separating the occipital lobe into three gyri, S. Oc., M. Oc. and I. Oc. In the right hemisphere the convolution, 2, reaches the surface, dividing the fissura occipitalis into a mesial and a lateral portion. (See Plate XXXVIII, fig. 16.)

In Man the complexity of this lobe reaches its highest development, and no two anatomists view it entirely in the same light. It also varies greatly in regard to its complexity in different individuals. In some it will be found comparatively simple, whilst in others, from the excessive development of secondary and tertiary sulci and rami, it assumes at first sight a puzzling appearance. I have always found it, as a rule, simpler in the Negro than in the White. In fact it was mainly through the attentive study of Negro brains that I was able to determine that the arrangement of the occipital lobe in Man is of the same general type as we have found it in the Simiæ; only rendered less distinct by tortuosity, and the development of sulci. I cannot agree with the conclusion of Ecker and others that the arrangement of the fissures in Man is very different from that in the monkeys. I believe that studied from the morphological standpoint advocated in this paper they will be found to be based upon a similar type.
CONVOLUTIONS OF THE OCCIPITAL LOBE IN MAN.

We have represented on Plate XXXVI, fig. 5, the structure of the occipital lobe as found in a Negro brain, and I think it can be clearly seen that the arrangement is similar to that of the Chimpanzee, except that the fissures are tortuous and pushed out of shape. The convolution, 2, is the premier pli de passage supérieur externe which separates, O1, into two separate fissures, the parieto-occipital, P O, or internal perpendicular, and an external portion, O2, the external perpendicular or "transverse" fissure of Ecker. By comparing this brain with that of the Chimpanzee, Plate XXXIX, fig. 4, it will be seen that the fissura perpendicularis externa of the apes is represented by a tortuous fissure which passes around the convolution, 2, and then some distance forward and downward. The posterior portion of the interparietal, i p, is seen joining O across the gap or separation of the walls of the fissures produced by the development of gyrus, 2. The inferior branch of the occipital arch, fissura occipitalis inferior, O2, is well marked off and may be distinctly recognized in fig. 1, Plate XLII and fig. 5, Plate XXXVI. These two fissures, O1 and O2, mark off the occipital lobe in the same manner as in the monkeys, the modifications consisting simply of greater tortuosity of the fissures, and the crowding of the occipital backward and on to the lateral surface. Within the limits cut off by the primary arch, we find as in Cynocephalus, Chimpanzee, etc., a second occipital arch, O' and O', which is in every way identical with the same sulcus found in these brains, and divides in the same manner the lateral surface of the occipital lobe into three gyri, a superior occipital, S. Oc., a posteromedian, M. Oc., an inferior, I. Oc. The primary and secondary arches are well developed, and the only difference between the occipital as thus developed, compared with that of the higher apes, consists in the more marked evidence of crowding of the fissures and convolutions, producing increased tortuosity.

The brain of a mulatto is represented in Plate XXXVI, fig. 6. Here the same type is still followed, except that the secondary arch, O' O', has separated into two parallel-running fissures, the fissurae occipitales longitudinales of Ecker, and posteriorly we have a vertical furrow, t. ca.1, which has developed as a vegetative repetition of the transverse calcarine, t. ca, which, as we have previously pointed out, has been displaced posteriorly by the development of a bridging gyrus, until it appears, as can be seen in Plate XLIV, fig. 1, as a fissure of the lateral surface of the occipital lobe. Otherwise the relations are not markedly changed.

It will be unnecessary to go into further written detail, but an attentive study of the plates of the human brain in which the occipital lobe is shown, will prove conclusively that the arrangement of the fissures and convolutions in this lobe so far from being entirely different from those found in the monkeys, is founded upon precisely the same fundamental morphological type.

Viewed in this light the human occipital lobe assumes an entirely new aspect, and apparently obscure, irregular and unimportant points receive a new interpretation and fresh interest. The occipital lobe is not an irregular and variable de-
velopment as previous writers have affirmed, but is formed upon a distinct and definite plan, and the variations that are met with are but modifications of this plan. The development of the occipital lobe in the human foetus can be traced in Plate XXXV, figs. 8-17, and Plate XXXVI, figs. 1-4, according to the morphological type advocated above, and it will be readily seen, that it is in perfect harmony with the results obtained by a comparative study of different Primate brains.

There still remains for us to discuss, the evolution of the superior mesial occipital surface and the consideration of the relations and connections of the plis de passage of Gratiolet; and it will be found that having once determined the structure of the occipital lobe the difficulties and obscurities that have always attended the study of these portions of the cerebral surface have almost completely disappeared.

**SUPERIOR MESIAL OCCIPITAL SURFACE.**

We will first consider the arrangement and relations of the mesial surface of the occipital lobe as it is found in Man, and afterward compare it with the conditions as found in the Simiææ. The mesial surface of the hemisphere as found in the brain of a Negro is represented on Plate XLII, fig. 2. The calcarine fissure, c a, will be seen extending backward to the end of the hemisphere where it expands into a transverse calcarine portion or extremity. By means of this fissura calcarina the mesial surface of the brain is divided into two portions: an upper, which proceeds anteriorly to the end of the frontal region, and a lower, which proceeds to the anterior extremity of the temporal. The portion below the calcarine fissure or mesial occipito-temporal surface is found in Man similar to the same region in the monkeys, the type of which we have already described, and need not, therefore, consider at present.

Above the calcarine fissure, however, and back of the position of the mesial portion of the fissura occipitalis superior, we find in Man and some of the more highly developed Simians, an increased development of what exists in the majority of the monkeys as a far less developed portion of the mesial cerebral surface. This is the wedge-shaped piece, c n, Plate XLII, fig. 2, the so-called cuneus of Huschke, Ecker, and others. It is the lobule occipitale of Gratiolet, the internal occipital lobule of Huxley, gyrus occipitalis primus, erste obere Hinterhauptlappenwindung of Wagner, and the oberer Zwischenscheitelbeinlappen of Huschke. It represents the mesial portion of the gyrus occipitalis superior as defined by the writer. It is limited in Man by the parieto-occipital or mesial portion of the occipital fissure uniting at an acute angle with the fissura calcarina. Its exact meaning may be understood by a comparison of this region in a series of monkey brains and applying the conclusions thus reached to the condition as found in Man and the higher Simiææ. In Chrysothrix sciuereus, Plate XXXVIII, fig. 8, a definite cuneus cannot be said to exist unless we consider the scroll-like folding of
the posterior mesial portion of the gyrus occipitalis superior represents it. It only becomes evident as we ascend toward Man, in whom it attains its highest development. This evolution of the cuneus appears, according to my observation, to take place as follows. We have seen that in the monkeys a small convolution, 2 develops from the floor of the first occipital fissure, O₁, and if figs. 5, 7, 14, 17, Plate XXXVII, and fig. 12, Plate XXXVIII, be compared, it will be seen that besides this convolution there is growing from the posterior walls of the occipital cleft, in front of the scroll-like portion of the gyrus occipitalis primus (superior), a small swelling marked en. This is the cuneus, and through its development we have the fissura occipitalis interna pushed forward, in the same manner, that on the lateral surface its outer continuation the fissura occipitalis externa (transversa of Ecker), has been pushed backward by the development of the gyrus, 2, the \textit{pli de passage supérieur externe}. Thus we see that even in many of the lower Simiads the external and internal perpendicular fissures are not entirely continuous but are more or less separated in the depths of the occipital cleft, O₁, by the concealed convolution, 2, fig. 12, Pl. XXXVIII. The external portion of O₁ has been displaced backward to some extent, which displacement, as in the human brain, can be seen when the sides of the fissure are widely separated. Thus in the brain of \textit{Macacus nemestrinus}, fig. 5, Pl. XXXVII, the internal extremity of the upper branch of the occipital arch may be seen ending at O₁, back of the internal portion, po, or parietal occipital, and separated from it by the posterior root of the convolution, 2, the further development of which becomes, as we have seen above, the cuneus, and I have marked upon it Cn. as showing its relation to the same part in the human brain. In another brain of \textit{Macacus nemestrinus}, Pl. XXXVII, fig. 7, we find the same condition of affairs only farther advanced. In this brain the relations that I have indicated are distinctly seen in the natural and undisturbed condition of the hemisphere. The backward prolongation of the fissura occipitalis superior is indicated by O₁, whilst its anterior wall is seen marked po. The walls of the primitive fissure have evidently been pushed aside and a gap produced which is filled up by the developing cuneus and \textit{plis de passage}, a condition similar to that taking place on the lateral surface by means of which the so-called gyrus and fissura par-occipitalis of Wilder have been produced. By comparing figs. 5 and 7, Pl. XXXVII, and fig. 12, Pl. XXXVIII with fig. 5, Pl. XXXVI, it will be seen the parieto-occipital fissure is really a new fissure of the same type as the par-occipital fissure of Wilder, being produced in the same way, namely, by the development upward from the floor of a deep fissure, of an arched gyrus, and in Pl. XXXVII, fig. 16 can be seen the way in which the parieto-occipital is actually formed. It is marked po., and is really a new development, formed only in those brains where the convolution, 2, exists (the superior external \textit{pli de passage}), which, when it reaches the lateral surface, arches around its lateral extremity. In this condition it is not confluent with the calcarine fissure, as it is in Man, but an indication of forces at work which will eventually produce such a connection can be seen in small furrows found in this region in many brains (fig. 5, Pl. XXXVII. A somewhat different condition is present in fig. 14, Pl. XXXVII,
the nature of which we will discuss under the heading of the *plis de passage*. In *Ateles*, fig. 17, Pl. XXXVII, the parieto-occipital assumes more the conditions as found in the human brain, following an oblique direction forward and downward instead of being directed perpendicularly. In the Chimpanzee, Pl. XXXIX, fig. 3, a slight obliquity can also be discerned.

Primitively, therefore, the occipital lobe, as marked off by the primary occipital arch, lies farther back on this upper mesial surface, exhibiting the relations as found in *Chrysothrix*, Pl. XXXVIII, fig. 8, and it attains its greatest size and development in the higher monkeys and Man by the development of swellings within the superior occipital cleft or fissure.

The gap and the developing convolutions can be seen in the human foetal brain, Pl. XXXVI, figs. 2 and 4, during the ninth month.

We have at various times spoken of certain small connecting, bridging or annectant gyri, passing from the occipital to the temporal and parietal lobes, which Gratiolet has distinguished as the *plis de passage*, and to these we shall now direct attention.

**PLIS DE PASSAGE.**

Gratiolet attaches great importance to these *plis de passage* as points of diagnosis in different brains, and he distinguished altogether six of these transition gyres: four external and two internal. The four external pass from the lateral portion of the occipital lobe to join the parietal and temporal lobes. He named the uppermost of these the first or superior external *pli de passage*, and the others the second, third and fourth respectively. The two internal transition gyres he named the superior internal and the inferior internal *plis de passage*. These, according to him, connect the cuneus with the precuneus. Rolleston in this connection also remarks "in one part of the brain, where two of the five great brain masses, into which its convoluted surfaces may be mapped out, abut upon each other, what are but connecting spurs in the ape's brain, overhung and concealed by the beetling parietal and occipital lobe, rise in Man to the dignity of connecting table-lands, filling up and bridging over at level what is a valley, or rather a chasm, in most simious encephala."

The superior and inferior internal *plis de passage* are shown as developed in many monkeys in Pl. XXXVII, fig. 14, marked 1 and 2.

The four external *plis de passage* pass from the lateral portion of the occipital lobe to join the convolutions of the parietal and temporal lobes. They are the first or superior external *pli de passage*, the deuxième *pli de passage externe* and the troisième et quatrième *pli de passage externe*.

Of these the superior or first is the gyrus, 2, of which we have given the manner of development and connections when describing the separation of the fissura occipitais prima superior into its two divisions, the mesial and the lateral. The second is generally concealed under the operculum and joins the angular gyrus or posterior parietal gyrus, only developing completely to the surface in the human brain. The third is the gyrus marked 4, fig. 8, Pl. XXXVII, and passes forward from the apex
of the occipital lobe into the second or middle occipito-temporal convolution. It separates the fissura occipitalis prima or upper branch of the primary occipital arch, O', from the lower branch, the fissura occipitalis secunda, O". The fourth, Y, lies below this and passes into the third temporal convolution. Bischoff has asserted\(^1\) that the superior external and the superior internal \textit{pli de passage} are identical. As regards this observation I have found that in some monkey brains they together form a single gyrus, whilst in others two can certainly be distinguished; so that to a certain extent the statements of Gratiolet, Ecker, the English anatomists and some others must be modified.

Ecker, opposing Bischoff's interpretation, remarks\(^2\) as follows: "Bischoff is of the opinion that this convolution (superior internal \textit{pli de passage}) is homologous with the first outer transition convolution of Gratiolet, our gyrus occipitalis primus and hence is wanting where the latter is developed, and vice versa. I regret to be obliged to oppose this view. Not only do we find, as I will more particularly describe in another place, in the brain of various apes (\textit{Cercopithecus, Cynocephalus}, etc.) both convolutions most clearly developed together, but we also not infrequently find in Man a convolution which, arising at the posterior extremity of the precuneus with the gyrus occipitalis primus (Ecker), runs backward in an arch convex inward and downward, while the former (gyrus occipitalis primus, Ecker), as is known, makes an arch outward. In the cuneus the two convolutions again coalesce. This convolution is regularly sunk into the depths of the fissura parieto-occipitalis, and only becomes visible on pulling apart the borders of this fissure; but sometimes it also comes to the surface and causes there a very unusual appearance of this part of the cerebral surface."

I think I shall be able to show conclusively, that Bischoff is at least thus far correct in his observation and identification that in some monkey brains the condition as he has described it exists, whilst in others, the conclusions which Ecker draws from his experience represent the true condition of affairs. This will show the reason for their disagreement and at the same time will completely reconcile the two opposed opinions as held by them. A glance at the mesial surface of \textit{Macacus nemestrinus}, Plate XXXVII, fig. 5, will render this clear. An inverted S-shaped convolution, 2, will be seen passing from the precuneus, P.C., backward to join the occipital arch. The anterior arch, a, of this inverted S-shaped gyrus is directed downward and inward, whilst the posterior arch, b, is directed upward and outward.

Ecker has apparently not met with this condition, where evidently a and b form together a single gyrus as is so plainly indicated in the figure. They are, however, not always so plainly differentiated as in this specimen of \textit{Macacus nemestrinus}, and a comparison of many monkey brains of different genera and species has enabled me to understand the objection of Ecker to Bischoff's obser-

\(^1\)Die Grosshirnwindungen des Menschens, etc.
\(^2\)Cerebral Convolutions of Man, Edes transl. Note, p. 75.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS

vations, and how in some cases this gyrus, 2, 2', has been described, sometimes as one and sometimes as two distinct convolutions. In some specimens of *Macacus cynomolgus* and *M. nemestrinus*, I have been able to note this convolution as single whilst in other cases in the same species the part of the convolution marked x was not completely separated from the cunens, thus giving rise to the appearance of two separate convolutions (compare fig. 14, Plate XXXVII, with fig. 12. Plate XXXVIII, and fig. 5, Plate XXXVII), a superior internal *pli de passage*, 2', and a superior external *pli de passage*, 2. In some this connection with the cunens was very slight and in others better developed, and a perfect series could be traced as we advanced from the lower to the higher apes in which, in some cases, the tendency was to differentiate into a single gyrus and in others two distinct gyri were found, as in fig. 14, Plate XXXVII, where the superior external *pli de passage* lies concealed within the occipital cleft and the superior internal is shown extending between the cunens and precunens, 2'.

The condition in *Cebus apella*, Plate XXXVIII, fig. 12, is identical with that found in *Macacus nemestrinus*, Plate XXXVII, fig. 5, except that in the latter brain, as drawn, the occipital cleft has been widely expanded. A more highly developed condition is seen in Plate XXXVII, fig. 7. The singleness of the convolution is, however, still evident. Ecker distinguishes the anterior arch, a, Plate XXXVII, fig. 5, as Gratiolet and others have done, as a distinct gyrus, which it often is, (the superior internal *pli de passage*), and the outwardly directed or posterior arch, b, as another distinct and separate gyrus, which he calls the gyrus occipitalis primus, and which Gratiolet and other writers have described also separately under the name of the superior external *pli de passage*, the annunct, bridging or connecting convolution of the English anatomists Rolleston, Turner, Marshall and Huxley. In some cases at least, these two separate gyri differentiate or conjoin to form a single convolution corresponding with the observations and description as given by Bischoff and as illustrated on Plate XXXVII, figs. 5, 7 and 14 and Plate XXXVIII, fig. 12.

In *Ateles*, Pl. XXXVII, figs. 15 and 17, the separation of the two arches is pushed still further, for in this brain the anterior arch of the gyrus is concealed within the fissure, O', whilst the posterior makes its appearance on the lateral surface of the brain as the convolution, 2, thus separating the fissure O' into two portions, as is the case in *Man*, the Chimpanzee, etc.

The following may, therefore, be considered as representing the exact state of the case: there are usually in this region two separate and distinct gyri as claimed by Ecker, Gratiolet and others but in some cases but a single convolution can be found, which represents, however, in its arches the combined superior external and internal *plis de passage*.

The inferior internal *pli de passage* is well developed in the Simiidae. It passes from the apex of the cunens forward and joins the convolution M.O.F., the mesial occipito-frontal (gyrus fonicatus). It may be seen in the figures marked l, and is the gyrus which in the Simiidae separates the mesial portion of the first occipital or

42 JOURN. A. N. S. PHILA., VOL. X.
parieto-occipital from the calcarine fissure. Ca. It has been asserted that this separation of the parieto-occipital from the calcarine is a characteristic of the Simian as distinguished from the human brain, and that in Man the parieto-occipital is directly continuous with that fissure. Huxley, however, has shown that in the brain of Ateles paniscus the parieto-occipital and the calcarine join each other, and he says that the inferior internal pli de passage is absent in this monkey. Bischoff claims, however, that it is present in Ateles, only pushed down and concealed in the depths of the fissure. He also describes the same condition as occurring in Hylobates; but in all the monkeys with a few exceptions, the parieto-occipital is completely separated from the calcarine. Bischoff states, and with this I agree, that this gyrus is always present in the brain of Man but that it is deeply sunk within the depths of the parieto-occipital fissure. Ecker also describes it as represented in Man by a deeply concealed convolution under the name of the gyrus cunei. In Ateles ater. Pl. XXXVII, fig. 17, the parieto-occipital does not communicate with the calcarine as found by Huxley in Ateles paniscus, but is distinctly separated by a bridging gyrus, 1. The confluence of the parieto-occipital with the calcarine fissure is a characteristic which is not always found in the human brain. Pl. XLII, fig. 2. This represents the negro brain in which so many ape-like peculiarities have been pointed out. The gyrus, 1, can be seen distinctly extending from the cuneus, entirely superficial and completely separating the two fissures precisely as occurs in the brain of the apes and monkeys. As far as I am aware this is the first human brain in which this superficial and ape-like development of the gyrus cunei has been observed, and this, in connection with the many other ape-like peculiarities previously pointed out, stamp it as probably the most Simian-like of human brains yet figured and described. A thorough study of a large number of negro brains, as we have already remarked, would undoubtedly throw much light upon the comparison of the ape and human brain and render interesting many points which at present appear unimportant and obscure.

Nothing of special interest is determined regarding the remaining plis de passage, on the external surface, by a comparison of the human and ape brain.

The true significance of the plis de passage seems to me not to have been pointed out by previous observers, and I shall now endeavor to explain their morphological relations to the type of convolutional configuration as developed in this paper.

In describing the development of the superior external pli de passage we made mention of the fact that Huschke called this gyrus the obere Zug der hintere Centralwindung. He included the superior parietal with the posterior central convolution under one name. I believe this is the correct view, and that the so-called plis de passage are nothing but the posterior extremities of the occipito-frontal and the occipito-temporal convolutions, which, checked in their development by the evolution of the occipital lobe in the Primates, lie concealed in the majority of them by the overhanging operculum, whilst in the higher forms, through a renewed growth in this region, as we have seen in the case of the convolution, 2, they finally reach the surface,
displacing in their turn the operculum, and pushing it backward. On reaching the
surface they then appear in their true light as posterior portions of the convolutions
situated anteriorly.

We have already expressed the opinion that of all the morphological theo-
ries which thus far have been advanced to explain the convolutional configura-
tion of the human brain, Huschke's approaches most nearly the truth. Through
his studies in embryology and comparative anatomy he believed that in the brain
there are three or four ground convolutions which arch in the form of a horse-
shoe backward around the upper horizontal branch of the fissure of Sylvius and
extend downward into the temporal lobe to the borders of the same. While
these ground convolutions are more or less recognizable in the brains of the lower
orders of mammals, in Man and the ape they are split by the development of
the fissure of Rolando or central fissure and its accompanying convolutions, the
relations being as follows: In the middle of the hemisphere we have the central
fissure with its accompanying convolutions. In front of these there are three fron-
tals, running longitudinally: the first, second and third; back of these are like-
wise three which run backward and toward the end of the hemisphere but only the
upper two reach the same, the lower running around the Sylvian fissure and
extending into the temporal lobe, which is also formed by the upper and middle
convolutions after they have reached the back end of the hemisphere proceed-
ing forward. These posterior convolutions coil themselves more than the frontal
and form, therefore, lobules; and in truth three upper lobules; the lobulus parie-
talis superior or Vorzwinkel, the cuneus or Zwinkel and a third the end lobule
(medio-posterior occipital of writers). The middle and lower convolutions which
are considered as one, also show three lobules. Whilst the non-recognition of
a distinct occipital lobe rendered this view of Huschke's faulty and imperfect.
It still contained, I believe, germs of a true theory and correlates, in a gen-
eral way, the convolutions of the Primate brain with those of other existing
orders of mammalia, especially the carnivora. The arrangement as found in the
fox, etc., is shown in Pl. XLV, figs. 1 and 2, etc., indicating that the type of fis-
suration in these animals consists of three or four primitive lateral arching con-
volutions separated from each other by a fissure corresponding to the Sylvian
and two arching fissures similar to three more or less confluent occipito-frontals
and occipito-temporals. A comparison with the brain of Cheironyx, Pl. XXXIV,
fig. 24, will show some decided resemblances. Evidently the structure of the
occipito-temporal and the frontal portion of the occipito-frontal in Man and the
Simiidae is due to similar growth conditions, and if we add to the carnivorous
type of brain a distinct occipital lobe, meeting and cutting off the posterior con-
nections of the two upper lateral occipito-frontals from the two lower lateral
occipito-temporal convolutions, we shall have the type, which more or less im-
perfect and modified we find in the Lemuridae; and which is still retained and fur-
ther modified in the Simiidae by the separation and formation of the fissura cen-
tralis in a manner previously described.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

It will be seen from this that the identification which some writers have made in comparing the crucial fissure, Cr. of the carnivora to the fissure of Rolando is morphologically incorrect. The crucial fissure is really a vertical and lateral development of a fissure of the mesial surface, whilst the fissure of Rolando morphologically is a displaced and modified portion of a lateral superior occipito-frontal fissure.

It is due, therefore, to the development of a distinct occipital lobe, and the enormous expansion of the fronto-parietal region that we have produced the peculiar fissural conformation of the Primate brain, as distinguished from that of the other mammalian orders. Such development and antero-posterior elongation in a confined space must necessarily modify the primitive longitudinal arrangement, and as a result we have produced the deep occipital cleft, O1, with its overhanging operculum, the central fissure, the precentrals and post-central, the inferior occipital and, finally, the secondary occipital arch and special transverse markings.

The occipito-temporal lobe retaining its more primitive growth relations, becomes only slightly modified, but is separated from the developing occipital lobe by the inferior occipital fissure (inferior branch of the primary occipital arch O2).

If these views are correct, then the plis de passage which we have claimed above as being only the developed posterior portions of the occipito-frontal and occipito-temporal convolutions concealed by the largely developed operculum of the Simians, should correspond in number and position with these convolutions, and the facts seem to bear out the theory.

From this standpoint we will now examine the relations of these annectant folds, which have caused so much confusion and introduced so much complexity into the nomenclature of the cerebral convolutions.

MORPHOLOGY OF THE PLIS DE PASSAGE.

1. The superior external pli de passage, 2, Fig. 21, connects the gyrus parietalis with the occipital lobe.

2. The deuxième pli de passage externe, 3, Fig. 21, usually lies hidden beneath the operculum, but occasionally rises to the surface, giving this region an unusual appearance. It connects the conjoined gyrus parietalis inferior and the gyrus occipito-temporalis superior with the occipital lobe.

3. The troisième pli de passage externe, 4, Fig. 21, separates the fissures, O1 and O2, of the primary occipital arch and passes from the apex of the occipital lobe into the second occipito-temporal convolution.

4. The quatrième pli de passage externe, Y, Fig. 21, passes into the third or inferior occipito-temporal convolution.

5. The pli de passage supérieur interne, 2', Fig. 22, when it exists as a distinct and separate development, passes into the mesial surface of the superior occipito-frontal convolution.
6. The \textit{plis de passage inférieur interne} (gyrus cunei), Fig. 22, passes from the cuneus to join the mesial occipito-frontal convolution, and corresponds morphologically to the posterior portion, \textit{Z.} of the mesial occipito-temporal convolution, \textit{M.O.T.}, which should also be considered as a passage fold if the others are to be regarded in that light. The accompanying diagrams will show that there are seven of these roots of origin of the anterior convolutions of the occipital lobe similarly related to the occipital lobe on the one hand and to the occipito-frontal and temporal on the other.

\textbf{Fig. 21.} \textbf{Fig. 22.}

The \textit{deuxième pli de passage externe}, 3, unites the arch of the conjoined superior occipito-temporal and inferior occipito-frontal, whilst each of the others connects the remaining corresponding convolutions with the occipital lobe. They are thus intimately related with the morphological type developed in this paper and take their place as curiously developed parts of elements entering into this plan.

\textbf{LOBULUS CENTRALIS.}

Most writers, as we have seen, consider this under the title of the central lobe, but its structure and relations are manifestly so different from those of the other lobes, that I prefer to consider it under the name, lobulus centralis, or central cortical nucleus. It is closely related and is in direct connection with the great ganglionic mass of the hemisphere, the corpus striatum, and is symmetrically placed in its relations with the three lobes of the hemisphere. It is well shown in its relations and external appearance in fig. 1. Plate XXXIX, as it occurs in the human brain. It appears to be peculiar to the Primate brain or at least it is but feebly represented in the brains of other orders of mammals. In Man it contains three or four short convolutions or rather swellings, the gyri breves of Gall and Arnold. It is concealed by the operculum in the brain of the Caucasian and Mongolian, as far as observation has shown, but is partly exposed in the brain of the Negro, a foetal peculiarity also shared by some specimens of the Anthropoid apes, but absent in the Simiadae generally.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

Spitzka, as quoted by Clever, contributes to the nomenclature and general aspects of the insula. He objects, and I consider his objection well sustained, to naming the shallow groove of a turtle's or serpent's brain, island or fossa although homologous with the insula, and applies the term "fovea centralis" to the condition as found in birds and reptiles, "fossa centralis" for its further development in Rodentia, Insectivora and Marsupialia, and "lobus centralis" where the surrounding convolutions overlap the retracted area.

Pansch considers that in Cheiromys we have no fossa Sylvii in the same sense as in the apes; that is, no island covered by an overgrowing mantle. In any case this formation is very different from what it is in the apes, and is closely connected with the development of the olfactory lobes lying opposite it. In Cheiromys the development takes place in the same manner as in the Carnivora, no overgrowing of the hemisphere taking place, and he believes from these facts that Cheiromys belongs to a separate group from the Primates, which is principally constituted by Carnivores, to which, however, perhaps all other Mammals with furrowed brains may be referred.

In the Simiidae the insula is as a rule perfectly smooth. In Cynocephalus I found it divided into two equal parts by a deep and well marked furrow, running from its anterior extremity backward a distance of nearly half an inch. In Ateles there were indications of two slight diverging furrows.

A brief résumé will now be given of the relations and conclusions respecting the morphological type of convolutional configuration in the Primates which the writer has adopted as the result of his observations and comparisons.

GENERAL CONCLUSIONS.

From the results of my observations I believe that all of the fissures of the hemisphere may be divided into five classes:—

1. Fundamental primary or typical fissures.
2. Secondary fissures: those giving special character to the type of convolutional configuration.
3. Vegetative repetitions of the secondary fissures, which increase the complexity of the cerebral surface and which may be termed sulci.
4. Sulculi; which give special characteristics to particular groups of brains and are usually repetitions of sulci, or small and apparently irregular fissures.
5. Rami; constant branches of fissures or sulci.

The fundamental or plan fissures are few and simple and constitute the scaffolding or plan around which the secondary type fissures are arranged, bearing precise and symmetrical relations to them, and to the structure of the hemisphere itself. They include in the Primates:

1. The fissura Sylvii.

1 Journal of Nervous and Mental Diseases, July, 1879.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

2. The mesial arched fissure.
   1. Fissura callosalis.
   2. " hippocampi.
3. The fissura calcarina.

These fissures are closely related to the three lobes of the brain. The Sylvian divides the hemisphere anteriorly into the occipito-frontal and occipito-temporal lobes; whilst the remaining three found on the mesial surface (and constituting the fissura triradiata of the writer) are symmetrically related to the three horns of the lateral ventricle, which in its turn forms a tri-radiate cavity corresponding to the three lobes of the tri-radiately developed hemisphere.

The secondary fissures include in their fully developed state three occipito-frontal fissures and three occipito-temporal. Of these two are lateral and one mesial, in both the occipito-frontal and occipito-temporal lobes, and mark out in each a mesial occipito-frontal or temporal and three lateral occipito-temporal or frontal convolutions. Separating these from and marking off the boundaries of the occipital lobe we have the primary occipital arch, O't, O't'.'

These fissures include all the fissures that I would include in this second group, but some of these divide as we have already seen into two or more important fissures which have received distinct and separate names. Figs. 5 and 6, Plate XLII, gives the ideal type of arrangement; figs. 7 and 8, as found in Man; figs. 9 and 10, in the Chimpanzee; and figs. 3 and 4, Plate XLIV, in the brain of the human fetus toward the close of the ninth month.

The names of these fissures and convolutions, with those of their component parts when they become separated, are as follows:

I. OCCIPITO-TEMPORAL LOBE.

1. Superior or first occipito-temporal fissure, o. t.'
2. Middle or second " " " o. t."
3. Mesial " " " m. o. t.

These form separate occipito-temporal convolutions which preserve the same relations when completely developed, throughout all the Primates.

1. Superior or first occipito-temporal convolution. O.T.'
2. Middle or second " " " O. T."
3. Inferior or third " " " O. T."
4. Mesial occipito-temporal or gyrus hippocampus M. O. T.

II. OCCIPITO-FRONTAL LOBE.

1. Superior or first occipito-frontal fissure, o. f.'= Superior frontal f.' + fissura centralis c.
2. Middle or second occipito-frontal fissure, o. f.2=Middle frontal f.2 + the interparietal fissure i. p.
3. Mesial occipito-frontal fissure, m. o. f.=Callosomarginal fissure.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

These separate, according to the view held in this paper, a number of distinct convolutions:

1. Superior or first occipito-frontal convolution. O. F. includes or rather divides into F₁ superior frontal + anterior central A. C.
2. Middle or second occipito-frontal convolution. O. F₂ includes F₂ middle frontal + posterior central P. C. + gyrus parietalis superior P₁.
3. Inferior or third occipito-frontal convolution. O. F. includes F₃ inferior frontal + gyrus parietalis inferior P₂ P₂ (which equals P₂ supra marginal and P₃ angular gyrus).
4. Mesial occipito-frontal convolution, M. O. F.=Mesial occipito-frontal convolution or gyrus fornicatus.

OCCIPITAL LOBE.

The occipital lobe is either entirely smooth, possessing, according to the classification of fissures adopted, no other fissures belonging to the second class, or it becomes fissured by the formation of a secondary occipital arch Oᵋ Oᵋ, which is a repetition of the primary and belongs, therefore, properly speaking, to the third group or sulci. (Owing to the important nature of this arch and its usual form, it may be regarded as a whole and termed the sulcus occipitalis tri-radiatus). It is well shown in the Chimpanzee, Pl. XXXVIII, fig. 16, in Man, Pl. XXXVI, fig. 5, and in the Simiadae, Pl. XXXVII, figs. 10 and 13, and Pl. XXXVIII, fig. 5. It often separates into two portions which may be called sulcus occipitalis primus and sulcus occipitalis secundus, Pl. XXXVI, fig. 6, Oᵋ Oᵋ and Oᵋ Oᵋ. These separate three occipital convolutions:—

1. Gyrus occipitalis superior, S. Oc.
2. " medius, M. Oc.
3. " inferior, I. Oc.

In the third division of fissures, the sulci, we find such furrows as the sulcus pre-centralis, sulcus post-centralis, sulcus temporalis inferior of Ecker, etc. These fissures as a rule, repeat the lines of fissuration of some secondary fissure, that is run parallel with, and are of the nature of vegetative repetitions of it, produced no doubt by the action of the same component forces as give rise to the line of direction of the original fissure. They serve to give increased surface and a special marking to the important and typical convolutions and so called lobules. They may be of primary or of secondary importance according to their constancy of form and position.

The fourth division or sulci are usually repetitions of the lines of the sulci or are small and inconstant fissures. The division included under the term rami comprises branches of varying value, as for instance the ramus ascendens of the Sylvian and constant branches of other important fissures.

With regard to the manner of arrangement of the fissures and convolutions around the fundamental furrows I have arrived at the following conclusions:

1. The secondary fissures are related in a symmetrical manner to the primary.
2. The posterior portion of the hemisphere becomes marked off into a distinct lobe by the symmetrical arching around the ends of the transverse calcarine, of the superior or first occipital fissure, O₁; above, and the inferior or second occipital, O₂, below.

3. The fissures of this occipital lobe, when they are present, follow the lines of the primary arch and are related in the same symmetrical scroll-like manner to the two extremities of the transverse calcarine, as are the posterior ends of that arch.

4. The occipital lobe as a whole is formed by a regular scroll-like infolding around the fissure of the posterior horn of the lateral ventricle, the calcarine, Plate XXXVII, fig. 5.

5. From this single symmetrically developed occipital lobe eight convolutions separated by six fissures pass forward to the two anterior extremities of the divided cerebral hemisphere. These are split by the Sylvian fissure into two groups, equal in the number of fissures and convolutions composing them and similarly related,—an occipito-frontal and an occipito-temporal lobe.

6. Of these two lobes the occipito-temporal always retains its primitive simplicity, but the occipito-frontal group owing to its greater antero-posterior extension is exposed to pressure forces that tend to produce a vertical fissuration, as a result of which we have the production of the fissura centralis with its vegetative repetitions, the post-central and precentral fissures in the parietal region, whilst anteriorly the type remains unchanged.

7. The so-called plis de passage of Gratiolet, the bridging, annectant convolutions, etc., of other writers, are merely developments of parts that were at first suppressed and altered by the evolution of the occipital lobe. They represent the occipital origins and connections of the occipito-frontal and occipito-temporal convolutions and correspond in number and relations, as we have seen, with their posterior modified extremities.

In other words in the Primates each hemisphere, with respect to its convolutions, is a symmetrical bud, arranged around the point of entrance, the cerebral crus; its posterior portion involuted in a regular and symmetrical manner around the fissure of the posterior horn of the lateral ventricle (fissura calcarina), whilst the anterior portion is split by the fissure of Sylvius into two symmetrical halves, consisting of the same number of similar fissures and convolutions in each division. Of these the occipito-frontal division or lobe is related to the upper branch of the fundamental mesial arched fissure (fissura callosalis), and the occipito-temporal in a corresponding manner to the inferior branch (fissura hippocampi), the relations of which to the ventricle have already been pointed out.

We thus come to the conclusion that the occipito-frontal and occipito-temporal lobes, together with their corresponding fissures and convolutions are morphologically homologous to each other.

The mesial surface of the occipito-frontal and occipito-temporal retain their primitive and exact similarity throughout all the Primates and the lateral surface...
of the occipito-temporal is little disturbed in all its different stages of development. The occipito-frontal, however, undergoes as we have seen, marked morphological changes; still the primitive similarity, the different stages of the changes and the forces at work to produce the disturbance are quite evident, and we are still able to point out and compare the further evolved and more differentiated portions of the parietal region with the original potential type, and thus with the corresponding portions of the occipito-temporal lobe.

I have, therefore, in Plate XLIV colored the homologous portions with the same tints; at once the perfect symmetry of the convolutional configuration is evident to the eye, and the entire morphological type or plan proposed in this paper can be readily applied to the study of the fissures and convolutions as represented in the various plates.

Viewed in this way, the arrangement of the convolutions in Man and the Simiææ becomes so clear, that at a glance one can see, recognize, and remember the entire cerebral conformation of any individual brain that may be under examination, and any special peculiarities that may exist at once become marked and prominent. Without the aid of this morphic conception the cerebral surface presents a confused mass of isolated convolutions, lobules, fissures, sulci and sulcali, which it is impossible to put together as a whole. It will thus be seen, that so far from the convolutions being a bundle without a system as was thought by anatomists, even up to quite recent times, and due to an irregular mechanical packing as one would crumple a surface simply as a convenience for storing it away, they are produced by the action of forces that are perfectly fixed, definite and regular. In other words, the cerebral hemispheres are nervous buds, and like all other organic buds they develop symmetrically, and the type of fissuration is due to the resultant forces produced by the interaction of the growth forces of the hemisphere combined with the pressure forces of the less rapidly expanding but symmetrically developing cavity of the skull. The question as to which of these two series of forces is most potent in its differential action in producing fissuration it is hard to answer, but it would appear that during the earlier and even to the quite late stages of development it is the brain which modifies the shape and structure of the skull rather than the reverse, and that finally, as the skull grows more and more rigid, its influence is shown by the increasing tortuosities and pushing out of place of previously existing parts. Evidence corroborative of this is shown in the structure of the occipital lobe, which being a late evolution is exposed to a more rigid environment during the progress of its final differentiations.

NOMENCLATURE.

The nomenclature, as given by preceding writers, can still be retained, the relations to the naming of the elemental parts entering into the morphological type as advocated in this paper, being as follows, and may be readily compared by referring to Plates XLII and XLIV.
The mesial occipito-frontal convolution, M.O.F., = the gyrus fornnicatus + the internal inferior pli de passage.

The mesial portion of the superior occipito-frontal convolution, O F¹, = the mesial surface of the superior frontal, F¹, + the paracentral lobule + the lobulus precentralis + the internal superior pli de passage where this is present.

The lateral surface of the superior occipito-frontal convolution, O F¹, = the lateral surface of the first or superior frontal + the anterior central convolution.

The middle or second occipito-frontal convolution, O F², = the middle or second frontonal convolution, F², + the posterior central + the superior parietal + the superior external pli de passage.

The inferior or third occipito-frontal, O F³, = the third frontal + the inferior parietal convolution, P² P³, + the deuxième pli de passage externe.

The mesial occipito-temporal convolution, M O T, = the lobulus lingualis + the gyrus hippocampi.

The inferior occipito-temporal convolution, O T³, = the lobulus fusiformis (of some writers) + the third temporal convolution + the quatrième pli de passage externe.

The second or middle occipito-temporal, O T², = middle temporal + the troisième pli de passage externe.

The superior occipito-temporal, O T¹, = superior temporal convolution + the deuxième pli de passage externe (in common with O F³).

The plis de passage are considered the connecting folds passing from the convolutions to the occipital lobe, the reasons for which we have already pointed out.

The relations of the fissures of the occipito-frontal and temporal lobes are as follows:

The mesial occipito-frontal fissure, m. o. f, = the calloso-marginal + the fissures of the paracentral and quadrate lobules + the fissure between the internal superior and inferior plis de passage (when it exists).

The superior or first occipito-frontal fissure, o F¹, = the first frontal + the central or fissure of Rolando.

The inferior or second occipito-frontal fissure, o F², = the inferior frontal + the fissura interparietalis.

The relations to the nomenclature of the occipito-temporal lobe are not altered.

The mesial occipito-temporal fissure, m. o. t, = the occipito-temporalis inferior or collateral fissure.

The superior occipito-temporal, o t¹, = the first temporal.

The inferior occipito-temporal, o t², = the second temporal.

In the occipital lobe:

The superior occipital fissure, o I, = fissura occipitalis.

The inferior occipital fissure, o i, = ex-occipital fissure.

As regards the fissures and convolutions of the occipital lobe itself these have been considered in such a different light from that of most previous observers that it is not possible to strictly compare them.
The nomenclature as derived from the morphological views advanced in this paper will be seen to be exceedingly simple. It forms a connected and systematic whole; whilst, at the same time, the various synonyms can be readily compared with it.

CEREBRAL CONVOLUTIONS OF THE CARNIVORA, UNGULATA, ETC.

Thus far we have considered only the convolutional configuration of the cerebral surfaces of the Primates. We now propose to review in a brief way some of the conclusions derived from a study of the convolutions and fissures as they are found in some of the other orders of mammalia. We shall be compelled to confine ourselves to pointing out merely the general results attained, without entering into the details, which, although they have proved interesting, would prolong this dissertation to an unreasonable length. I have, however, found that the general arrangement of the fissures and convolutions in these animals indicates the action of the same general laws that govern their formation in the Primates. The absence of an occipital lobe reduces the complexity of the relations and as a result, whilst many of these animals possess brains even more highly convoluted than in Man, the type or plan upon which they are built is of a much simple recharacter, bringing into play the principle of vegetative repetition to account for their origin and numbers. All are constructed upon a fundamental morphological type and this type is a regular and symmetrical one. The conditions of growth, owing to simpler and similar relations, produce types that are more nearly related to each other, as a rule, than they are to the structure of the convolutional conformation of the Primates. The development of the occipital lobe and the enormous relative growth of the fronto-parietal region produce in the latter animals a type which even in its moderately developed condition stamps it as sui generis.

We have at various times expressed the opinion that many of the sulci and sulculi of the brain are only repetitions of lines of fissuration already formed, due to prolonged action of the same dynamical conditions. In studying the brains of the Carnivora, Ungulata, etc., this relation is specially prominent and it appears to me that many of the fissures found in these brains must be regarded in this light, that is, as vegetative repetitions. Viewed in this way many of the difficulties in regard to the identification of homologous fissures in different brains disappear. According to the mechanical theory a deep and distinct fissure having been formed, after reaching its limit of depth, there would be a tendency to produce other fissures following the same general direction, having the same general appearance and depending for their formation on the one originally laid down. According to the view that fissures are the result of retarded cerebral growth, we may expect to find, especially in lower forms of brains in which much fissuration exists, vegetative repetitions of the same lines of growth. In either case the fissures which appear after the original fissure, and which follow its general contour, should be considered as belonging to one group with that fissure, and to be of secondary importance in relation to it. Hence in many cases, instead of seeking fissures separately homolo-
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

...ous to each other, we will be obliged to consider certain groups to be homologous to certain other groups, the number of separate fissures of which may be more or less numerous. Owen, in founding his nomenclature of the cerebral fissures in the Carnivora and Ungulata, gave a distinct and separate name to each fissure, and he endeavored to point out the homologue of each of these in different brains. If, however, we are to regard that at least some of the fissures are entirely secondary and to be considered merely as vegetative repetitions, then we must not expect to seek, nor is it possible to find, homologues for each separate fissure even in closely related brains. This view of the subject of cerebral fissuration is important in connection with the question of new fissural integers to which Wilder has given much attention.

We shall first consider the arrangement of the fissures and convolutions as found in the brain of the Carnivora, and for this purpose we shall take as a type of these relations the brains of the ocelot, lion, leopard and domestic cat, Plate XLV, figs. 6, 7, 14, 15, 16, 17, 18 and 19.

The fissure of Sylvius is represented by a well-marked fissure, s s, which separates the lateral inferior portion into two distinct parts which might be termed the parieto-frontal and parieto-temporal lobes. The posterior horn of the ventricle not being developed there is no distinct occipital lobe, and the cerebral hemisphere is confined to the region covered by the parietal bone. The convolutions are arranged in their least modified condition in the form of four horse-shoe-like arches surrounding the upper end of the Sylvian fissure, and separated by three lateral arched fissures, Plate XLV, fig. 1. In many forms the first arched fissure immediately surrounding the calcarine is broken in two portions, the connecting arched portion being absent. These have been termed respectively (Krueg, Wilder) the fissura anterior, f a, and the fissura postica, f p, Plate XLV, figs. 6, 10, 16, 19 and 21.

The second or middle arched fissure following the same writers is the fissura supersylviana, s s, its posterior portion being termed the postasylviana, p s. The third or upper arch is known as the fissura lateralis, l, its posterior portion as the fissura medilateralis, m l. A deep transverse cleft is formed upon the frontal lobe, extending from the position of the fissura longitudinalis transversely outward. It is the extremity of one of the mesial fissures, and is known as the fissura cruciata, c r. A transverse fissure which is often connected with the fissura lateralis is called the ansate fissure, a n, whilst a fissure which in many cases arches around the fissura cruciata is known as the coronal, c o r. The arrangement of these fissures varies considerably in different genera and species, according to their relative length and degree of development. Running antero-posteriorly near the lower border of the hemisphere we have a deep and well-marked furrow, the fissura rhinalis, r h, the posterior portion of which is known under the name of the fissura postrhinalis, p r h. Other fissures are the superorbitalis, s o, and the diagonalis, d g.

On the mesial surface of the brain, Plate XLV, figs. 3, 8, 17, 18 and 20, we find situated posteriorly a more or less wedge-shaped lobule, P, from which are di-
rected forward the two principal fissures of the mesial surface. This lobule appears to be constant in position and relations, not only throughout the Carnivora but also in the Ungulata, and I propose for it the name of tentorial lobule. It is included between the posterior extremities of the fissura splenialis, s p, and the posterior rhinal fissure, p r h.

The mesial arched fissure, m a, is well marked. Its superior branch, the fissura callosalis, at first sight appears to be separated from the inferior or hippocampal, by the backward extension of the splenium corporis callosi. A distinct fissure can, however, be distinguished connecting them together. There will be perceived the mesial parieto-frontal surface, besides the fissura splenialis, one or two other fissures, Plate XLV, fig. 8, which are simply vegetative repetitions of the splenialis, which evidently corresponds with the mesial occipito-frontal of the Primates. Of these the upper is called the fissura marginalis, m r. They should be regarded, I believe, as vegetative repetitions of the fissura splenialis. We have in the same figure of the brain of the lion a vegetative repetition of the fissura postrhinalis, p r h.

CONVOLUTIONS OF THE UNGULATE BRAIN.

The convolutions of the Ungulata, whilst quite complicated in detail, are constructed upon a relatively simple general plan. A fissure of Sylvius, or at least a vertical fissure that takes its place in position, is present in some, Plate XLVII, fig. 2, whilst in other cases no signs of its presence, at least in the adult, can be detected, Plate XLVI, figs. 2 and 6, Plate XLVII, fig. 8. The fissures pursue on the lateral surface a longitudinal or more or less arcing position, and may be compared with the corresponding fissures as found in the brain of the Carnivora. These convolutions of the lateral surface appear to be thrown into more or less similar secondary folds on each side of the position of the Sylvian fissure, very much as the folds of a coat sleeve assume a more or less symmetrical or balanced character on each side of the elbow joint when the arm is bent. This is well seen in the brain of the giraffe, Plate XLVI, fig. 11. On each side of the Sylvian fissure are seen two small arched gyri, a, and beyond these on each side, two more less pointed ones may be seen, b. From the extremities of these, two lobules, c, proceed, one of which reaches the posterior extremity of the hemisphere, the other the anterior, where they become continuous with the two ends of a convolution which arches over the whole course of the lower. The same general tendency may be traced in the brains figured on Plate XLVI, figs. 2, 6, and 8 and Plate XLVII, figs. 2 and 8.

The plan of the mesial surface is identical with that found in the Carnivora. There is no posterior horn to the lateral ventricle, and therefore no occipital lobe; but the wedge-shaped lobule, lobulus tentorii, or tentorial lobule as we have termed it, is constantly present, having the same general appearance and preserving the same relations to the fissures found in this region as in the, carnivorous brain. It may be seen as found in the peccary, Dicotyles labiatus, Plate XLVI, figs. 1 and 3, in the caribou, Plate XLVII, fig. 3. By comparing fig. 3, Plate XLVI with fig. 8,
Plate XLV, it will be seen that the fissures are identical with those found in the carnivorous brain. Just as in this order we found a tendency to vegetative repetition in these fissures, so we find even to a more marked extent the same process taking place in the Ungulata, and indeed in these animals the lines of repetitive fissuration extend out upon the lateral surface of the hemisphere; and a series may be traced on which, from a single fissure visible on the lateral surface, as in the peccary, Plate XLVI, figs. 4 and 5, we may gradually distinguish as many as four or five distinct fissures. Thus, in the tapir and sheep, Plate XLVIII, fig. 4 and Plate XLVI, fig. 7; two may be seen, in the caribou, giraffe and llama, Plate XLVII, fig. 1, Plate XLVI, fig. 10, and Plate XLVII, fig. 7, three; whilst in the horse, I have counted as many as four or five.

Owen has considered each of these fissures as typical, and he has endeavored to point out their homologues on the lateral surface of the carnivorous brain. Evidently the four or five fissures of the horse, taken together as a group, are equivalent to the three as found in the caribou, giraffe and llama, to the two of the tapir and sheep, and these in their turn to the single fissure as found in the brain of the peccary.

When these fissures are compared, therefore, they should be taken together as a group, and we should not expect nor is it possible to determine, from the adult brain alone, what fissures are homologous to each of these separate fissures, in different brains.

A good illustration of the extent to which fissuration may be carried by means of vegetative repetition, without increased complexity, is exemplified in the brain of the dolphin, Delphinus, Plate XLVIII, figs. 1 and 2, whilst in the manatee, another aberrant aquatic mammal, the brain remains entirely smooth, Plate XLVII, figs. 10 and 11 and Plate XLVIII, fig. 3.

MECHANICS OF THE FORMATION OF CEREBRAL FISSURES.

In order to explain the formation of the fissures I have adopted a theory which has for its basis the interaction of two sets of forces; namely, the growth forces of the expanding brain combined with and modified by the resisting forces due to pressures produced by the bony environment; and we have further found that in the early stages of development the relations of these forces are of a relatively simple character, producing an arrangement of primary furrows which at certain epochs have definite mathematical relations to each other. Plate XXXV, fig. 4, illustrates a foetal brain in which the fissures are related to each other in multiples of an angle of 60°. Thus O₁ and O₂ are inclined to each other at an angle of 120° meeting the calcarine at the same angle anteriorly and being bisected by it posteriorly into angles of 60°, text fig. 2. It will be also noticed in studying many of the sulci, as for instance the one named sulcus triradiatus of the occipital lobe, Plate XXXVIII, fig. 16, that in their early and least disturbed condition they present a triradiate appearance, the rays diverging from a common centre at angles of 120° to each other, or so closely
approaching these relations as to indicate some quite regular adjustment of the causative forces at work in their production. This tri-radiate type of fissuration can be found cropping out all over the cerebral surface, and in those brains where the lines of furrowing are straight and not interfered with by the action of secondary causes, producing curvilinear deflections and tortuosities, the mathematical relations to an angle of 120° is plainly evident. Indeed, even in those cases where secondary and tertiary disturbing factors come into play, traces can still be determined of the fundamental forces at work and in many cases the nature and relations of the interfering elements can be determined.

Another type of fissuration which is even more widely diffused than the tri-radiate type is that to which Wilder has applied the name of zygal. The orbital fissure often presents this arrangement. We might also consider these zygals as formed by two tri-radiate fissures joined by a common stem. On fig. 14, Plate XXXVIII, are shown the orbital fissures of the chimpanzee, indicated by the letters a, b, c, d, e. In fig. 15 of the same plate an anterior view of the frontal region is given and the same tendency to the zygal form of fissuration is quite evident. Often fissures that are primitively simple and continuous lines break up in the course of their development into a number of distinct and separate or more or less connected portions, which assume the zygal type. Especially is this the case with the mesial occipito-frontal. In the lower Simians this is usually a single fissure, but as we advance toward the Anthropomorpha, Plate XXXIX, fig. 3, it becomes quite complex and in Man assumes the appearance as found on Plate XLII, fig. 2, etc.

A close examination of the structure and mode of arrangement of these tri-radiate and zygal types of fissuration will at once impress the mind with the idea that the fundamental causes at work must have relatively simple relations to each other, and the question arises is it possible to discover the mathematical centres and surfaces together with the relative strength of the forces at work necessary to produce the observed results. Of course such a theory must of necessity be of the most general character, but if the fundamental principles concerned in the formation of these types of fissuration can be determined their application is a question of mere detailed study; that is, an accurate observation of the action of the modifying causes at work in any special case.

I believe that such a theory can be formulated by applying the principles deduced by Plateau.

1 On page 4 of his paper, "The Par-occipital Fissure," he defines these fissures as follows: "Zygal fissures (F. zygales), H-shaped fissures, quadradiate fissures—a general name proposed for fissures which, like the par-occipital, present a pair of branches at either end of a connecting bar or yoke (zygon). When the earliest condition of the fissure resembles a U, the rami constituting the sides of the U may be called stipes, and the others rami. To carry out the comparison with letters, the complete or typical condition of a zygal fissure is like two Y's joined by their stems, or, viewed from the side, like an expanded H.

2 Ecker, Edes transl., 33.

In this paper Plateau discusses the laws of the formation of partitions formed by spherical liquid films such as are formed by the meeting of two or more soap bubbles. Evidently as far as regards a general mathematical discussion the expanding liquid films may represent the expanding cerebral substance as it aggregates around certain centres of growth, whilst the partitions as formed by the meeting of the liquid films will indicate the planes of fissuration. A brief outline of the theory of Plateau will serve to show how the application may be made and also as to whether, by means of it, any advance may be hoped for in establishing a mathematical theory to explain the convolutional configuration of the cerebral surface.

Plateau's experiments were made with soap bubbles floating on water or brought together when attached to a glass plate. Everyone is familiar with the peculiar partition structures produced by inflating a number of bubbles of different sizes upon the surface of some cohesive liquid, such as a mixture of soap suds and glycerine. In a somewhat similar way we may consider the cerebral convex as consisting of numbers of swellings growing from different centres, when the fissures will represent the partition planes produced by their joint meeting. Of course the conditions are vastly more complex in the case of the brain surface than in those involved in the union of hemispherical liquid films, still the fundamental relations of the forces, leaving out secondary and tertiary complications is of the same general nature; and we shall be surprised to find the general uniformity in results produced in some of the least interfered with regions of the cerebral surface.

Plateau first considers the case of two spheres of unequal size meeting each other.

Let \( \rho, \rho' \) and \( r \) be the radii of the spheres to which respectively appertain the larger film, the smaller film and the partition, and let \( p, p' \) and \( q \) be the respective pressures which they exert, in virtue of their curvatures, on the air which bathes their concave faces. These pressures being \( r \) in the inverse ratio of their diameters and consequently of the radii, we shall have \( \frac{p}{q} = \frac{r}{\rho} \) and \( \frac{p'}{q} = \frac{r}{\rho'} \), but according to what has been seen above it is necessary for equilibrium, that we should have \( q = p' - p \); whence, \( \frac{p'}{q} = \frac{p}{q} \). Substituting for this last equation the above values of \( \frac{p'}{q} \) and of \( \frac{p}{q} \) and solving for \( r \), there results
\[
r = \frac{\rho \rho'}{\rho - \rho'} ,
\]
a formula which gives the radius of the partition when we know those of the two films. If, for example, these two films pertain to equal spheres, we have \( \rho = \rho' \), and the formula gives \( r = \infty \); that is to say the partition is then plane, as we have already found it to be. If the radius of the smaller of

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1 5th Series II, 22 and 28
44 JOURN. A. N. S. PHILA., VOL. X.
the two films is half that of the larger, in other terms, if we have $\rho' = \frac{1}{2} \rho$ the formula gives $r = \rho$. In this case consequently the curvature of the partition will be equal to that of the larger film.

In order to complete the study of our laminar system it remains only to inquire under what angles the two films and the partitions intersect one another. With this view, let us remark that the small mass of the junction which prevails along the entire common edge of these angles, and which was spoken of in the preceding paragraph, must of itself have its equilibrium of figure. Now as it has three surfaces, it is necessary that the curvatures of these should have to one another a ratio which permits of this equilibrium. Hence it is evidently requisite, for the equilibrium of the small mass, and consequently for the whole system, that if we conceive this small mass cut by a plane perpendicular to its axis, the three concave arcs which will limit the section shall be closely identical. Now from this near identity it necessarily results that the two films and the partition terminate at the small mass under angles either strictly equal or very nearly so—angles consequently each of 120°, or which will differ from this value by an unappreciable quantity. By considering liquid films as stretched membranes we should equally arrive at the equality of the angles between three films which join one another by the same liquid edge. We shall presently see this result and those of the preceding paragraph verified by experiment.

We have seen that the radius $r$ of the partition is determined, when we know the radii $\rho$ and $\rho'$ of the two films, by considering the relative value of the pressures respectively exerted by these three portions of spherical caps on the two quantities of included air. On the other hand, the consideration of the conditions of equilibrium of the small mass of junction has led to this consequence, that the two films and the partition must intersect one another under angles of exactly or very near 120°; and it is evident that this necessity of intersecting each other under angles of 120° may equally serve to determine the radius of the partition. Now no relation between the two principles which serve as the basis of these two determinations is to be seen a priori, and it may be asked whether the two results coincide; this I propose to examine.

I will suppose two films forming originally two complete spheres, spheres which have afterwards partially penetrated each other so as to give rise to a partition, and shall imagine this whole system intersected by a plane passing through the centre of the two films: it is clear that the centre of the sphere to which the partition pertains will be found on the right line which contains the two above centres.

This being premised, it is plain that if the angles under which the two films and the partition meet are of 120°, the radii of the two films brought to a point of the line of intersection of the latter will form between them an angle of 60°, and it will be readily seen that the radius of the partition brought to the same point will also form an angle of 60° with that of the two others to which it is nearest.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

Let p, Fig. 23, be one of the two points at which terminate the three arcs, along which the two films and the partition are cut by the plane in question, and let \( p \, c = \rho \) be the radius of the larger film.

Draw the indefinite lines \( p \, m \) and \( p \, n \) in such manner that the angles \( c \, p \, m \) and \( m \, p \, n \) shall be each of 60°. On \( p \, m \) let us take \( p \, c' \) equal to \( \rho' \)—that is to say, the radius of the smallest film; let us join \( c \, c' \) and prolong the right line until it meets at \( d \) with \( p \, n \). The three points, \( c, c' \) and \( d \), will evidently be three centres, and \( p \, d \) will be the radius, \( r \), of the partition, so that if from these three centres and with these three radii we trace three portions of circumferences terminating on the one hand at the point \( p \), and on the other at its symmetrical \( q \), we shall have as the figure shows, and still on the hypothesis of angles of 120°, the section of the system of the two films and of the partition. Let us seek now to determine the radius of this partition in a function of the two others. For this take \( p \, f = p \, c' \) and join \( c' \, f \), the angle \( c \, p \, c' \) being 60°, the triangle \( f \, p \, c' \) will be equilateral, and we shall consequently have \( f \, c' = p \, c' = \rho' \); for the same reason, the angle \( f \, c' \, p \) will be 60°, like the angle \( c' \, p \, d \), whence it follows that the right lines \( f \, c' \) and \( p \, d \) will be parallel; we may therefore assume \( \frac{p \, d}{f \, c'} = \frac{p \, c}{f \, c} \); by then substituting, in this formula, for \( p \, d \), \( f \, c' \) and \( p \, c \) their respective values \( r \), \( \rho' \) and \( \rho \), and observing that \( f \, c = \rho - \rho' \), we shall deduce \( r = \frac{p \, \rho'}{\rho - \rho'} \); being identically the value given by the first method, thus two laws, apparently independent, conduct to the same conclusion.

If a third spherical laminar cap joins itself to two others already united, the system will evidently have three partitions, namely, one proceeding from the union of the first two films, and two from the union of each of these films with the third. These three partitions will necessarily terminate at the same arc of junction, and supposing that they still have spherical curvatures, it will result that at three lines of junction of each of them with two of the films the angles will still be of 120°; it will result, moreover, for reasons already given, that at the arc of junction of the three partitions with each other the angles will be also of 120°. This being premised let us see by what means we can trace the base of a system of this kind, as we have traced, Fig. 23, that of a system of two films. After having described, Fig. 24, the bases of the first two films, bases having for centres \( c \) and \( c' \), and for radii the lengths given which we will again designate \( \rho \) and \( \rho' \), let us take commencing
at the point s, where these two bases meet, and on the radii s c and s c', two lengths s f and s f, equal to one another and to the radius f" of the third base, then from the points c and c' as centres, and with the lengths c f and c' f' as radii, let us trace two arcs of a circle, their points of intersection on c" will be the centre of the base of the third film, a base which we will then describe with the radius f". Let us in effect suppose the problem solved and this base traced. If we draw from the point n where it terminates in one of the former the right lines n c and n c", which will be respectively equal to p and p", these lines will make between them an angle of 60°, like the right lines s c and s c'; whence it follows that the triangle c n c" will be equal to the triangle c s f, in which s c and s f are also respectively equal to p and p", and thus cc" will be equal to c f, for the same reasons the triangle c' v c" will be equal to the triangle c' s f', and consequently c' c" will be equal to c' f'. Let us propose now to trace the bases of the three partitions. Those of the three films being described, Fig. 25, after the preceding outline we determine as in Fig. 23 the centre d of the partition pertaining to the first two films, and commencing from s, by drawing s d making with s c' an angle of 60°, until it meets at d, with the line c c' prolonged ; we determine likewise the centre f of the partition pertaining to the first and the third film by drawing u f, making an angle of 60° with c-u, until it meets at f' with c c" prolonged ; finally we determine by the same process the centre g of the third partition. There remains then only to describe from the points d, f and g, as centres, and with the radii d s, f u and g v, arcs of three circles beginning respectively, at the points s, u and v, and directed toward the middle of the figure; these arcs will be the bases of the three partitions, on the hypothesis, however, that these partitions are portions of spheres. If the figure has been constructed with care, we shall recognize, 1st, that the three arcs just spoken of all terminate at the same point o; 2d, that the three centres, f, d and g are disposed in a right line; 3d, that if we join the point o to these three centres, the angles f o d and g o d are equal and each of 60°.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

If we imagine that a fourth spherical cap unites itself with the system of the three preceding ones, we can conceive two different arrangements of the assemblage besides that in which the fourth cap should so place itself as to be united with but one of the others. One of these arrangements would contain four partitions uniting by a single edge, and the other would contain five uniting by two edges. To simplify the question and the graphic constructions, I will suppose the four caps to be equal in diameter, in which case all the partitions will evidently be plane. Then, it may be conceived, in the first place, that the four caps unite in such a way that their centres shall be placed like the four middle points of the sides of a square, which will give the system whose base is represented by Fig. 26, where there are four partitions terminating at the same edge under right angles; this system is evidently one of equilibrium, since everything in it is symmetrical. It may be conceived, in the second place, that three caps being first united the fourth unites itself with two of them; in this arrangement, the four centres will be at the middle points of the sides of a lozenge, and we shall have the system whose base is represented in Fig. 27, where there are five partitions. This system is also, by reason of its symmetry, evidently a system of equilibrium; but here not more than three partitions terminate at the same edge, forming between them angles of 120°. Now if we attempt to realize on the glass plate the first of these systems, Fig. 26, we shall either not succeed, or, if produced at all, its duration will be inappreciable, and it passes rapidly into the second. The second system, Fig. 27, is obtained directly without difficulty and persists. Hence we may conclude that in the former system the equilibrium is unstable, and it thus becomes probable that four partitions terminating at the same edge cannot coexist.

Any change of volume or form produced by compression or distortion is called a "strain," and their treatment is entirely a kinematical question, until we come to regard them as produced in physical bodies and consider their cause. The system of forces which is said to produce a strain is called a "stress." But just as we study velocity as a preparation for the discussion of the effects of force in a free body, so we study strains as a preparation for the discussion of the effects of stress. Every action between two bodies is a stress. When we pull one end of a string the other end of which is fixed, we produce a tension, when we push one end of a fixed rod we produce pressure, and this merely amounts to saying that there is stress.
across every transverse section of the string or rod. But in the string the point of the stress is a pull, in the case of the rod it is a push, and in this way we have produced tension or pressure or transference of energy in any form. If one body presses or draws another, it is pressed or drawn by this other with an equal force in the opposite direction. If anyone presses an object with his finger, his finger is pressed with an equal force in the opposite direction by the object. Now, in the case of partitions formed by the union of liquid films we have tension producing the observed results, whilst in the case of the modelling of the cerebral surface we have fissuration produced by pressures exerted by expanding central growths of a plastic substance, confined in a limited space.

The surface tension of the film of a soap bubble has been investigated by Maxwell, who indicates a method of determining the tension of such films. A soap bubble is simply a small quantity of soap-suds spread out so as to expose a large surface to the air. When by means of a tube we blow air into the inside of a bubble we increase its volume, and therefore its surface, and at the same time we do work in forcing air into it, and thus increase the energy of the bubble.

That the bubble has energy may be shown by leaving the end of the tube open. The bubble will contract, forcing the air out, and the current of air blown through the tube may be made to deflect the flame of a candle. If the bubble is in the form of a sphere of radius \( r \), this material surface will have an area

\[
S = 4\pi r^2. \quad (1)
\]

If \( T \) be the energy corresponding to a unit of area of the film, the surface energy of the whole bubble will be

\[
ST = 4\pi r^2 T. \quad (2)
\]

The increment of this energy corresponding to an increase of the radius from \( r \) to \( r + dr \) is therefore

\[
TdS = 8\pi r T dr. \quad (3)
\]

Now this increase of energy was obtained by forcing in air at a pressure greater than the atmospheric pressure, and thus increasing the volume of the bubble. Let \( \Pi \) be the atmospheric pressure, and \( \Pi + p \) the pressure of air within the bubble. The volume of the sphere is

\[
V = \frac{4}{3} \pi r^3. \quad (4)
\]

and the increment of volume is

\[
dV = 4\pi r^2 dr. \quad (5)
\]

Now if we suppose a quantity of air already at the pressure \( \Pi + p \), the work done in forcing it into the bubble is \( p dV \). Hence the equation of work and energy is

\[
pdV = TdS. \quad (6)
\]

or

\[
4\pi r^2 dr = 8\pi T dr. \quad (7)
\]

or

\[
p = 2T \frac{1}{r}. \quad (8)
\]

This, therefore, is the excess of the pressure of the air within the bubble over
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

that of the external air, and it is due to the action of the inner and outer surfaces of the bubble. We may conceive this pressure to arise from the tendency which the bubble has to contract, or in other words, from the surface tension of the bubble.

If to increase the area of the surface requires the expenditure of work the surface must resist extension, and if the bubble in contracting does work, the surface must tend to contract. The surface must, therefore, act like a sheet of India-rubber when extended, both in length and breadth, that is, it must exert surface-tension.

The intensity of this surface-tension is measured by the stress which it exerts across a line of unit length. When two spherical films meet therefore, the partition must also constitute a portion of a sphere, for it falls within the same conditions as the other two films; that is to say, it has, like the latter, for limits the small mass of junction and the water of the vessel. As regards its curvature, this evidently depends on the difference of the action exerted on its two faces by the two portions of imprisoned air. If these two portions of air are equal, the two films will pertain to equal spheres, which will press the two volumes of air with the same intensity, and consequently the partition, exposed on its two faces to equal actions will have no curvature, or in other words, will be plane; but if the two quantities of air are unequal, in which case the two films will pertain to spheres of different diameter, and will therefore press these two quantities of air unequally, the partition subjected on its two faces to unequal actions will acquire convexity on the side where the elasticity of the air is least, until the effort which it exerts, in virtue of its curvature on the side of its concave face, counterbalances the excess of elasticity of the air which is in contact with that face, which relation as we have seen is given by the formula \( r = \frac{\rho_1 \rho_2}{\rho - \rho_1} \) which gives the radius of the partition when we know those of the two films.

In Fig. 28 the diameters of the two films are equal, and as a result the partition is a plane. In Figs. 29 and 30 they are in the ratio of 2 to 1 and 3 to 1,

![Fig. 28, Fig. 29, Fig. 30.](image)

and as a result the partitions are curved and the radius of curvature can be determined from the formula given above. Thus when the surface is curved, the effect of the surface-tension is to make the pressure on the concave side exceed the pressure on the convex side by \( T \left( \frac{1}{R_1} + \frac{1}{R_2} \right) \) where \( T \) is the intensity of the surface-tension and \( R_1 \) and \( R_2 \) are the radii of any two sections normal to the surface and
to each other. From this we readily perceive that if three surfaces come in contact the surfaces of separation meet in a line straight or curved. Let O, Fig. 31, be a point in this line, and let the plane of the paper be supposed to be normal to the line at the point O. The three angles between the tangent planes to the three surfaces of separation at the point O are completely determined by the tensions or pressures of the three surfaces. For if in the triangle a b c the side a b is taken so as to represent on a given scale the tension of the surface of contact of a and b, and if the other sides, b c and c a, are taken so as to represent on the same scale the tensions of the surfaces between b and c and between c and a respectively, then the condition of equilibrium at O for the corresponding tensions R, P and Q is that the angle R O P shall be the supplement of a b c, P O Q of b c a, and, therefore, Q O R of c a b. Thus the angles at which the surfaces of separation meet are the same at all parts of the line of concourse. When three films of the same liquid meet, their tensions are equal, and, therefore, they make angles of 120° with each other.

Now whilst the conditions of growth of the cerebral surface are variously interfered with by secondary or tertiary displacements, producing undulations and tortuosities, the general action of the fundamental forces at work can be seen displayed in the various types of fissuration found. For the surface tension of films we must substitute the pressure forces produced by cerebral swellings aggregating around certain centres, the peripheries of which meeting each other within a confined space produce the various lines of fissuration. In brains where the complexity of fissuration is not excessive we find marked regularity and constancy as regards the length, depth and inclination of the different fissures, as the following measurements will indicate. They are taken from the brains of four monkeys, two of the same species, Macacus nemestrinus, compared together; and two of different genera, Macacus cynomolgus and Cercopithecus callitrichus. The measurements were made on both hemispheres of the brain and it was found that they were alike. These have been placed in columns for convenience of comparison. The brains were hardened in chloride of zinc and then transferred to alcohol, the conditions of preservation being as nearly similar as possible.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

<table>
<thead>
<tr>
<th>Macacus nemestrinus</th>
<th>Macacus nemestrinus</th>
<th>Macacus cynomolgus</th>
<th>Cercopithecus callithrix</th>
</tr>
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<tr>
<td><strong>INCHES.</strong></td>
<td><strong>INCHES.</strong></td>
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<tr>
<td>Distance from cc to po</td>
<td>1/4</td>
<td>1/4</td>
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</tr>
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<td>&quot; po to ca</td>
<td>1/4</td>
<td>1/4</td>
<td>1/4</td>
</tr>
<tr>
<td>Length of Sylvian fissure</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>&quot; ext. perpendicular fissure</td>
<td>1/4</td>
<td>1/4</td>
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</tr>
<tr>
<td>&quot; 1st temp.</td>
<td>1/4</td>
<td>1/4</td>
<td>1/4</td>
</tr>
<tr>
<td>Distance from upper extremity of Sylvian to lower extremity of central</td>
<td>1/4</td>
<td>1/4</td>
<td>1/4</td>
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<tr>
<td>Distance from upper extremity of Sylvian to upper extremity of cc</td>
<td>11/16</td>
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<tr>
<td>Length of interparietal</td>
<td>11/16</td>
<td>11/16</td>
<td>11/16</td>
</tr>
<tr>
<td>Angle of cc with fissura longitudinalis</td>
<td>60°</td>
<td>60°</td>
<td>60°</td>
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The above measurements would seem to indicate that the primary fissures are not as variable, at least in the monkeys, as many have supposed, and furnishes additional evidence that the fissures are the result of determinate laws of growth. I have recently been accumulating observations on convolutional measurements made on the brain immediately after removal, but as yet these are not extended enough to enable proper comparisons to be made. Complete triangulation of the brain surface and careful measurement of the depths of the various fissures, both in the adult and embryonic stages, of different animals will undoubtedly lead to valuable results, not only as regards general morphology, but also in anthropology and medicine. Such careful and elaborate work will, however, require months or years for its thorough and satisfactory accomplishment. A few facts of this kind, as regards the depth of the fissures, have been supplied by Jensen.1

The following facts seem to be indicated by a careful study of the fissures of the cerebral surface. The fissura Sylvii unlike all the other fissures of the hemisphere represents an area of retarded or slow cerebral growth, as represented in its earlier stages by the fovea centralis; whilst the insula is produced by a localized swelling or growth taking place upon its surface. It is finally converted into a fissure by the over-growth of the occipito-frontal and temporal lobes, due to their enlargement within a confined space. The great longitudinal fissure in the same way is produced by the flattening of the two mesial surfaces of the prosencephalon, due also to confined growth.

With the appearance of the primary radiating furrows we have indications of direct involutions into the cavity of the ventricles, due to pressure forces produced by the more slowly expanding skull. In the same manner the primary and fundamental furrows of the mesial surface, the mesial arched and the calcarine are due to

45 JOURN. A. N. S. PHILA., VOL. X.
a tri-radiate involution into the three horns of the lateral ventricle. The three primitive occipito-frontal and temporal fissures follow the same arching lines as the mesial arched and are repetitions of the same lines of depression indicating the continuance of the interaction of the same general relation of forces. This plan of evolution is illustrated in the brains of the Carnivora, in *Cheiromys* and some of the Lemuridae. Finally, with the evolution of the occipital lobe and the enormous antero-posterior expansion of the parieto-frontal region is introduced a new system of pressure forces and as a result a new type of fissuration, shown by the production of the fissura centralis and repititions of its line of direction in the fissure, precuneus, postcentralis, etc.; whilst the occipital lobe itself is strongly marked off from the rest of the hemisphere by the formation of the primary occipital arch, O1 O2, and its surface furrowed by the production of lines of fissuration respectively parallel to O1 and O2, the secondary occipital arch O2 O2.

Thus the type of fissuration of the Primate brain is due to the direct interaction of the pressure forces resulting from the differential strains produced by the expanding brains, compounded with the resisting forces of the more slowly expanding skull.

These relations of forces produce the fundamental morphological type and this is now modified by local differentiations due to processes of growth taking place in the cerebral cortex itself.

In the earlier stages of evolution the hemispherical mass develops as a whole, but as differentiation progresses local peripheric swellings commence to make their appearance, and it is by the meeting of these local outgrowths that the fundamental type becomes variously modified in the different families, genera, species and even individuals. In the earlier stages these local outgrowths are not sufficiently differentiated to produce any marked results, but as the brain mass finally approaches its limit of surface growth, and the skull becomes a more and more rigid environment these swellings assume a more and more prominent aspect as causative elements in producing the generic, specific and individual convolutional conformations characterizing particular brains. It is in this field that the application of the principle of the formation of partitions by expanding spherical films can be applied to the explanation of the formation of the complex sulci, rami and extremities of the various primary and secondary fissures, and also to the markings of the various so-called lobuli and convolutions. We have found that the character of these partitions can be determined by the relative surface-tensions of the expanding spheres, and that these can be determined by the formula \( r = \frac{\rho \rho'}{\rho - \rho'} \) that is, the surface-tension or pressure produced is inversely as the radii. Hence we have produced, when the pressures are equal and two surfaces meet, a plane, Fig. 28, or curved partitions whose radius of curvature depends on the relative relations of the radii of the expanding spheres, Figs. 29 and 30. When three surfaces meet they produce a tri-radiate partition the angles of which are 120°, the length of the individual partitions depending on the relative length of the radii of the spheres, Fig. 24. When four surfaces meet we have a quadradiate type produced. Fig. 26.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

Whilst the conditions producing the sulci that give detail to the cerebral surface undoubtedly develop according to much more complicated arrangements of forces than is the case in the production of partition films, still growing plastic, and more or less spherical or ellipsoidal form of outgrowths of the cerebral cortex, would tend to produce lines of fissuration following the same general laws. And, in fact, when we come to examine the details of cerebral fissuration in highly complicated brains, we find as a result types of sulci which correspond in every respect to the types of laminar partitions as produced by conjoined liquid films, more or less modified by the different physical conditions under which they are produced; and no other types are found except such as would be produced by the meeting of the peripheries of masses that are developing around some centre of growth.

In this way we have produced the triradiate and H-shaped or zygial fissures which are so characteristic of highly convoluted brains. An examination of the details of fissuration in different brains, especially in the orbital and frontal regions, will make this evident. As examples may be studied Plate XXXVIII, figs. 13, 14 (a, b, c, d, e, f), 15, 16; Plate XLII, fig. 2 (1, 2, 3, 4, 5) and elsewhere. By accurate measurements of the angles, curvatures and lengths of the component parts of these sulci, it is possible to locate the centres of growth or centres of the pressure forces. Certainly important results can be reached by pursuing this line of investigation, and indeed, already some very curious relations are apparently pointed out by observations made in this line of study.

FROMMORPHOLOGY.

Just as the physiologist constantly seeks, remarks Geddes, to interpret the phenomena of function in terms of mechanical, physical and chemical laws, so the morphologist is tempted to inquire whether organic as well as mineral forms are not alike reducible to simple mathematical law. And just as the crystallographer constructs an ideally perfect mathematical form from an imperfect or fragmentary crystal, so the morphologist has frequently attempted to reduce the complex curved surfaces of organic beings to definite mathematical expression. Canon Moseby¹ succeeded in showing, by a combination of measurement and mathematical analysis, that the curved surface of any turbinated or discoid shell might be considered as generated by the revolution about the axis of the shell, of a curve, which continually varied its dimensions according to the law of the logarithmic spiral. For Goodsir this logarithmic spiral, now carved on his tomb, seemed a fundamental expression of organic curvature and the dawn of a new epoch in natural science—that of the mathematical investigation of organic form—and his own elaborate measurements of the body, its organs, and even its component cells seemed to yield, now the triangle and again the tetrahedron as the fundamental form. But such supposed results, savoring more of the naturphilosophic than of sober mathematics, could only serve to discourage further inquiry and interest in that direction.

¹ Phil. Trans., 1888.
Thus we find that even the best treatises on botany and zoology abandon the subject, satisfied with merely contrasting the simple geometrical ground-lcm of crystals with the highly curved and hopelessly complicated lines and surfaces of the organism.

But there are other considerations which lead up to a mathematical conception of organic form, those namely of symmetry and regularity. These, however, are usually but little developed, botanists since Schleiden contenting themselves with throwing organisms into three groups:—first, absolute or regular; second, regular or radiate; third, symmetrically bi-lateral or zygomorphic— the last being capable of division into two halves only in a single plane, the second in two or more planes, the first in none at all. Burmeister, and more fully Bronn, introduced the fundamental improvement of defining the mathematical forms they sought, not by the surface but by axes and their poles; and Haeckel has developed the subject with an elaborateness of detail and nomenclature which seems unfortunately to have impeded its study and acceptance, but of which the main results may, with slight variations, due to Jaeger, be found in the Lehrbuch der Zoologie, I. 283. The sciences of organic and mineral form would thus, as Haeckel points out, become thoroughly analogous, for as promorphology develops the crystallography of organic form, so mineralogy, in the study of such phenomena as those of pseudomorphism or of mineral development, becomes parallel to morphology. The present paper has been an attempt to study the convolutional configuration of the cerebral surface from the stand-point of the physical sciences. Promorphology has thus shown that the reigning dogma of the fundamental difference of organic and mineral forms is false, and that a crystallography of organic forms is possible.

The material on which these investigations were made was prepared, and the figures are from photographs taken, by the author. Except where otherwise stated in the explanation of the plates, the figures are original.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

EXPLANATION OF PLATES.

PLATE XXXIV.

Fig. 1. Fissures, 2. F. Sylvii; 3. occipitalis; 6. Rolando; 7. parietalis; 8. precentralis; 9. frontalis sup.; 10. frontalis inf.; 11. temporalis sup.; 12. temporalis med.; 17. occipitalis trans.; 19. occipitalis longitud. inf. Gyres, I. G. frontalis sup.; II. frontalis medius; III. frontalis inf.; IV. Rolandicus ant.; V. Rolandicus post.; VI. parietalis sup.; VII. parietalis inf.; VIII. temporalis sup.; IX. temporalis med.; X. temporalis inf. a. operculum; b. supra-marginalis; c. angularis; d. occipitalis primus; e. occipitalis secundus; f. occipitalis tertius.

Fig. 2. Fissures, 3. F. occipitalis; 4. calcarina; 5. hippocampi; 6. Rolando; 14. collateralis; 16. calloso-marginalis; Cal. callosum. Gyres, XI. G. marginalis; XII. forniciatus; XIII. cuneus; g. uncinatus; h. dentatus; j. paracentralis; k. precuneus; l. descendens.

Fig. 3. Fissures, 4. F. calcarina; 3. occipitalis; 12. temporalis media; 13. temporalis inf.; 14. collateralis; 15. olfactoria; 18. orbitalis. Gyres, XII. G. forniciatus; XIII. cuneus; XIV. occipito-temporalis media; XV. occipito-temporalis lateralis; X and IX. temporalis medius et inferior; m. rectus; n. orbitalis medius; o. orbitalis lateralis. (Figs. 1, 2, 3 are from Clevenger, Ecker.)

Figs. 4 and 5. Brain of Macacus nemestrinus.

Figs. 6, 7, 8, 9, 10. Brain of Indris (from Milne Edwards et Grandidier's Hist. de Madagascar, 1875).

Fig. 11. Brain of Midas (from Owen).

Figs. 12, 13. Brain of Hapale (from Flower, Phil. Trans., Vol. 152, 1862).

Figs. 14, 15. Brain of Propithecus Edwardsii (from Milne Edwards et Grandidier, loc. cit.)

Figs. 16, 17. Brain of Lemur nigrifrons (from Flower, Phil. Trans., Vol. 152, 1862).

Figs. 18, 19, 20. Brain of Avalis (from Milne Edwards et Grandidier, loc. cit.).

Figs. 21, 22, 23. Brain of Propithecus diadema (from Milne Edwards et Grandidier, loc. cit.).

Fig. 24. Brain of Aye Aye (from Owen).

Fig. 25. Brain of Gibbon (from Owen).

Fig. 26. Brain of Callithrix (from Owen.)

Figs. 27, 28. Brain of foetal Cebus apella (from Ecker).

PLATE XXXV.

Figs. 1, 2. Human foetal brain at three months.

Figs. 3, 4. Human foetal brain at three and a half months.

Figs. 5, 6. Human foetal brain at five months.

Fig. 7. Human foetal brain at five and a half months.

Figs. 8 and 9. Human foetal brain at six months (from Bischoff).

Figs. 10 and 11. Human foetal brain at six and a half months (from Bischoff).

Figs. 12 and 13. Human foetal brain at seven months (from Bischoff).

Figs. 14 and 15. Human foetal brain at seven and a half months (from Bischoff).

Figs. 16 and 17. Human foetal brain at eight months (from Bischoff).
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

PLATE XXXVI.
Figs. 1 and 2. Human foetal brain at eight and a half months (from Bischoff).
Figs. 3 and 4. Human foetal brain at not quite nine months (from Bischoff).
Fig. 5. Brain of Negro, showing especially structure of occipital lobe.
Fig. 6. Brain of Mulatto, showing especially structure of occipital lobe.
Fig. 7. Brain of Chimpanzee, left lateral surface.
Fig. 8. Brain of Chimpanzee, right mesial surface.

PLATE XXXVII.
Figs. 1, 2, 3, 4, 19, 20. Brain of Macacus cynomolgus.
Figs. 5, 6, 7, 8, 9, 10, 11, 12, 13, 14. Brain of Macacus nemestrinus.
Figs. 15, 16, 17, 18. Brain of Ateles ater.

PLATE XXXVIII.
Figs. 1, 2. Brain of Macacus nemestrinus.
Figs. 3, 4, 5. Brain of Cynocephalus porcarius.
Figs. 6, 7, 8, 9. Brain of Chrysothrix sciuereus.
Figs. 10, 11. Brain of Cercopithecus callitrichus.
Fig. 12. Brain of Cebus apella.
Figs. 13, 14, 15, 16. Brain of Chimpanzee.

PLATE XXXIX.
Figs. 1, 2. Brain of Negro (1 showing lobulus centralis).
Figs. 3, 4. Brain of Chimpanzee.

PLATE XL.
Figs. 1, 2. Brain of Negro.

PLATE XLI.
Figs. 1, 2. Brain of Negro.
Figs. 3, 4, 5, 6. Brain of Chinaman (from Mills and Parker).

PLATE XLII.
Figs. 1, 2. Brain of Negro.

PLATE XLIII.
Figs. 1, 2, 3, 4. Brain of White Man (murderer, from Mills).
Figs. 5, 6. Diagram of ideal arrangement of fissures.
Figs. 7, 8. Arrangement of fissures in Man.
Figs. 9, 10. Arrangement of fissures in Chimpanzee.

PLATE XLIV.
Figs. 1, 2. Brain of Mulatto. Morphologically related areas are colored alike.
Figs. 3, 4. Arrangement of fissures in human fetus close to nine months. Colors as in figures 1 and 2.
MORPHOLOGY OF THE CEREBRAL CONVOLUTIONS.

Plate XLV.

Figs. 1, 2. Brain of Fox (from Leuret).
Figs. 3, 4. Brain of Marten (from Leuret).
Fig. 5. Brain of Wolf (from Leuret).
Fig. 6. Brain of Ocelot.
Fig. 7. Brain of Lion (from Leuret).
Figs. 8, 9, 10. Brain of Lyon.
Figs. 11, 12, 13. Brain of Macropus major.
Fig. 14, 16, 17. Brain of Felis pardalis.
Fig. 15, 18, 19. Brain of Felis domesticus.
Figs. 20, 21, 22. Brain of Coati.

Plate XLVI.

Figs. 1, 2, 3, 4. Brain of Dicotyles labiatus.
Figs. 5, 6. Brain of Dicotyles torguatus.
Figs. 7, 8, 9. Brain of Ovis aries.
Figs. 10, 11, 12. Brain of Giraffa camelopardalis.

Plate XLVII.

Figs. 1, 2, 3. Brain of Caribou.
Figs. 4, 5, 6. Brain of Manatee.
Figs. 7, 8. Brain of Llama.
Fig. 9. Brain of Delphinus (from Leuret).
Figs. 10, 11. Brain of Manatee.

Plate XLVIII.

Figs. 1, 2. Brain of Delphinus (from Leuret).
Fig. 3. Brain of Manatee (from Vimont).
Fig. 4. Brain of Malay Tapir.
Fig. 5. Brain of Bear (from Leuret).
CRANIA FROM THE MOUNDS OF THE ST. JOHN'S RIVER, FLORIDA:
A STUDY MADE IN CONNECTION WITH CRANIA FROM OTHER PARTS OF NORTH AMERICA.

By Harrison Allen, M. D.

Introduction.

Out of thirty-three crania collected by Mr. Clarence B. Moore from prehistoric Indian graves in Florida and presented by him to the Academy, five were found in sufficiently good condition to describe. The numbers of these skulls in the catalogue are as follows: 1,784, base of mound at Ginn's Grove; 1,781 and 1,782, Thursby Mound; 1,783, base of mound near Tar Landing; and 1,789, mound at Hitchen's Creek, Volusia County. These numbers will be used to designate the specimens in this essay.

The specimens were almost entirely without animal matter, if one could so conclude by their fragility, peculiar lightness and pot-like resonance. Mr. Moore had carefully coated the skulls with shellac varnish, which, while serving to protect them, concealed the texture in some degree.

I propose in the first place to describe these skulls; in the second place to compare them with others from remote parts of North America; in the third place to draw such conclusions as the subject admits and to explain the novel terms which have been used in the descriptions.

While the section last named follows those which deal with descriptions it is well, by way of introduction, to make a few remarks upon the subject of the technical words themselves. No one can deplore more than myself the necessity of introducing new terms in anatomy; yet I could not with justice to my own convictions continue the use of words which have ceased to be accurate, or confine myself to inadequate phrasology from mere dread of innovation. An adequate term strengthens the sentence in which it is employed; obscurities of expression are thus avoided and definitions more easily framed.

Notwithstanding the length of time that human craniology has been a well defined field of study, the methods employed have not appealed to the judgment of all students. Respecting the taking of measurements as at present interpreted, I

have found that suggestions come to the mind in studying the results of sums total that are not apt to arise from observation alone; and while one must acknowledge that the number of these suggestions is not so great or the importance of the results obtained always commensurate with the labor implied, still it is difficult to suggest a method which can readily be substituted for it. The value of taking measurements can be seen in the following: In studying the "Seminole" skulls it was found that two out of twelve skulls, namely Nos. 456 and 726, possessed unusually prominent foreheads and the impression was received that measurement would show the minimum frontal diameter to be far above the average. This average in ten skulls is 94 mm., but that of the exceptional skulls is 98 mm. and 95 mm., respectively, a difference in reality very slight.—In No. 456 the transverse frontal arc is 310 mm. In No. 725 the same arc is 300 mm. This comparison is of interest since it shows the difference in a general way in the sizes of the frontal bones themselves. It is seen (Table IV) that the specimens Nos. 456 and 726 have the minimum frontal diameters greater than any of the facial diameters, and it is not surprising to see the transverse frontal arcs of these specimens measure 310 mm. and 300 mm., respectively, while the average are measurement is 292, the minimum being 269 mm. Meigs, while classifying No. 456 as a sphaerocephalic skull and No. 725 as an archcephalic, acknowledges that the former is a transitional form from the latter.—That the length of the pyramidal process of the palatal bone can be measured with advantage is evident from the epitome here-with given. In all the skulls from the western portion of North America including those from the Santa Barbara Islands, the process measured but 4 mm.; in the Seminole skulls, 5 mm.; in the Moore series, 9 mm.; in fifteen Esquimaux skulls the same; while in forty-one Sandwich Island crania it measured 13 mm. Thus in fifty crania of North American Indians it measured but 8 mm., and each of the localities was distinct. The average was nearly one-half less than the length of the process in the Sandwich Island skulls.—Interesting correlations of measurements are sometimes noted. Thus in the Seminole skulls we have the basi-nasal length averaging 101 mm., the minimum frontal 94 mm., the bimalar 97 mm., and the least facial diameter 99 mm. The mean of the last three measurements is but slightly less than the basi-nasal length. The value of such a conclusion in studying fragments of the skull must be conceded.

But in many particulars a skull when exhaustively measured remains undescribed, and the measurements themselves are arbitrary numbers, which, no matter how valuable they may be in the study of race, may have slight value in increasing our knowledge of the skull itself. The rates of change which take place in the skull of the adult as compared to that of the child; the equivalent rates which go on from the time of maturity to old age; the harmonics which are established between the different parts of the skull in all the great divisions of life, are unnoted by the mere taking of measurements. Even the variations of the forms of skulls when due to exceptional conditions of development and of sex are neglected. Thus we are told that the skulls of the immature and of the aged, of women, those with
CRANIA FROM THE MOUNDS OF FLORIDA.

persistent frontal suture, or exhibiting premature union of the larger sutures, and specimens showing the consequences of artificial compression, must be excluded from the series on which ethnic measurements are based. The result is that elaborate memoirs embracing results which are conclusive so far as mere measurements are concerned, are inconclusive, for the thoughtful anatomist, of many interesting facts.

The ratio of variation expressed in an index may be exact, so far as race peculiarities are concerned, but tell us nothing of the value of the specimens at the extremes of measurement. It will be noted (Appendix III) in what degree these extremes in the skulls of North American Indians suggest forms absolutely unlike those which make up the bulk of the proportions of the external nose. The most careful analysis, by measurement of the skull of Australians, does not prepare us for the small and apparently weak malar bones.

As a consequence I have thought it important to describe the specimens in the Moore series as well as to measure them; and to include therein the skulls of two females. I have endeavored to frame a definition of each skull as though the object in view were to identify thereby the specimen itself. The terms employed by J. Aitken Meigs (see Appendix II) in outlining the general shapes of skulls have been preferred to others.

In taking measurements a conformity to number and kind as established by authors has not been attempted. I have followed in the main those in use by English craniologists; but in some instances I have ventured upon a number of my own, the reasons of attempting which are given at their appropriate places.

I.—The Moore Series of Crania.

1,784 x (Pls. XLIX, L, LI, LII). Aged 45 years,—subglobular, archencephalic, phoxocephalic.

Glabella and supra-orbital ridge marked, 6 mm. Forehead low, broad, ample; outer part of orbital arch scarcely inclined downward, 30°.—Nasal bones synostosed, acutely arched, slightly concave above downward; frontal portion 3 mm.; maxillary and premaxillary portions 20 mm.; radix 7 mm.; salient 16 mm.—Alveolar line marked.—Nasal vestibule microlophic, prenasal fossa faintly defined (7 mm. wide); incisor crest and spine marked; inferior turbinal ledge near floor of the nose; alveolus high (21 mm.); teeth vertical.—Hard palate hyperbolic nearly U-shaped, deep; high alveolus (22 mm.), no anterior declivity; pre-torus present. —Pterygo-sphenous union on both sides; spinous process enormous, but not overlapping petro-sphenoidal fissure.—No interruption of temporal ridge at stephanion; temporal ridge at lambdoidal suture heavily moulded, harmonic near asterion; deep groove on temporal bone between post-squamosal and ecto-petrosal portions. 2 Slight

1 Burial ground Ginn's Grove, 2½ feet down, partially imbedded in shell base.
2 This groove is of great interest since it indicates the line of union between the squamosal and petrosal elements.
break only between pre-squamosal and post-squamosal portions.—Scarcely any flange at end of temporal ridge.—Occiput not protuberant, inion marked; no break in occipito-parietal curve, i.e., curve of inion continuous with that of supra-inion. The skull rests on the posterior border of the foramen magnum, i.e., the concept- tacula cerebelli are small.—Malar bone with conspicuous marginal process and suture-trace.—Sconce smooth, scarcely pitted, 122 mm. wide; highest point back of bregma; obelion with foramina.

Lower jaw. The condyloid process inflated, scarcely angulated, the lateral facet two-thirds inclined downward, the median facet one-third. Third molar in advance of coronoid; high alveolus, no trace of bicuspid hyperostosis. Masseteric impression concave, the angle scarcely inclined outward; on right side; mental foramen between second premolar and first molar, on left side on line of second premolar; genio-glossus spine single, prominent, crest small but defined. Teeth much worn. Upper third molar in position.

No. 1,784 bears a close resemblance to No. 1,782.

1,782 £ (Pls. LIII, LIV, LV, LVI, LVII). Aged 50,—sutures closed, excepting about squamosa; globular, archencephalic inclined to phoxocephalic. Greatest transverse diameter bisquamosal.

Glabella and supra-orbital ridges marked, 6 mm.; upper half of frontal bone showing median elevation; forehead broad, ample; sutures closed in outer wall of orbit; outer part orbital arch scarcely inclined downward, 25°.—Nasal bones synostosed, abruptly arched, projecting, concave from above downward; frontal part nil; maxillary part 25 mm.; premaxillary part 2 mm.; radix 6 mm., 80°; salient 19 mm., 20°. Nasal vestibule microlophic with incisor eminence small, oblique ridge to spine present; alveolar line produced slightly beyond the ridge but inconspicuous; spine single and incisor crest marked; prenasal fossae rudimental. —Alveolus high; inter-premaxillary suture not produced. Small pretorus.—Hard palate U-shaped, almost parabolic, no anterior inclination, alveolar height 13 mm.—Spinous process overlapping petro-sphenoidal fissure; petrosa inflated; alve of vomer below plane of presphenoid; foramen lacerum medium open. Temporal ridge everywhere distinct, interrupted at stephanion 26 mm.; no trace of coronal, fronto-sphenoidal or parieto-sphenoidal sutures; parieto-temporal crest heavily moulded, projecting posteriorly making parieto-occipital suture harmonic near asterion; no break between post-squamosa and ecto-petrosa. Occiput abruptly narrowed from the side; supra-occipital thickened, but no break in the occipito-parietal curve; skull rests on posterior border of foramen magnum.—Scone rugose, much pitted, 100 mm. wide; sagitta carinate at bregma.

Lower jaw massive; third molar in advance of base of coronoid process; masseteric impression scarcely concave, angle but slightly inclined outward; prognoidal tubercle large; condyloid process thick, everywhere inflated, no division into facets, the inner part inclined downward; on the left side mental foramen

1 From base of Thursby’s Mound.
between premolars, on right side between second premolar and first molar; genio-glossal spine double; genio-hyoid crest scarcely seen.—Teeth much worn, cuspidation lost; upper incisors vertical; third molar absent; the first molar with lateral roots projecting from the sockets.

1,781† (Pls. LVIII, LIX, LX, LXI, LXII). Aged 35 years,—sutures open; subglobular, platycephalic.

Glabella and supra-orbital ridge small, 2 mm.; outer part of orbital arches scarcely inclined downward, 25 mm.; forehead ample yet frontal eminences approximate; interfrontal suture persistent; symmetrical vascular grooves near temporal ridge.—Nasal bones low arched, synostosed; markedly concave from above downward; radix 30°; salient 20°; ascending process maxilla nearly at right angles to inner wall of orbit. Nasal vestibule microlophic with incisor, eminence small, alveolar line indistinct; crest high; inter-premaxillary suture of alveolus carinate; alveolus high; inferior turbinal crest near floor.—Hard palate U-shaped, hyberbolic, no declivity in front, high alveolus.—Vomer depressed below plane of basisphenoid; choana with base wider than apex; spinous process overlapping petro-sphenoidal fissure; petrosa inflated; middle meatus concave at palatal bone; pterygoid process narrow.—Malar bone with scarcely any marginal process on right side, but quite large on left; suture-trace present; tuberosity marked; the bone enters into the formation of the sphenomaxillary fissure.—Temporal crest faint, interrupted at stephanion 22 mm.; at occipito-parietal union temporal crest is heavily moulded; suture near asterion almost harmonic; abrupt break between post-squamosa and ecto-petrosal right, but none on left; at upper parieto-temporal union, the linea semi-circularis, is not visible on the right, but the upper part defined on the left, and occupied on both sides by vessel-grooves.—Lachrymal bone small; bullae ethmoidales large.—Arms of longitudinal curve as follows: inio-opisthonic; inio-intertuberal; intertubernal. The supra-occipital projects slightly beyond lambda.—Sconce rugose in inio-intertuberal part, 144 mm. wide.—Occiput broad rounded.

Lower Jaw. Line of coronoid intersects condyloid at outer third; the external facet of condyloid process one-third of the articular surface,—the downward inclined internal facet two-thirds not angulated; the left external pterygoid impression the least defined. Third molar well in advance of base of coronoid process; the masseteric and internal pterygoid impressions about equal, the angle not deflected; mental foramen symmetrical between the second premolar and first molar; molar ridge scarcely reaching first molar; tubercle in advance of pregonial fossa; genio-glossus spine single; genio-hyoid crest nil.

1,783‡ (Pls. LXIII, LXIV, LXV, LXVI). Aged 25 years,—globular, fragmentary; sutures open.

Glabella none; supra-orbital ridge none.—Hard palate U-shaped; high alveolar

1 Thursby's Mound, Valusia Co., original burial on base.
2 Mound near Tar Landing.
process 15 mm.; no declivity.—Alae of vomer depressed below level of basisphenoid; spinous process not overlapping petro-sphenoidal fissure; foramen lacerum medium open, both medianly and laterally; petrosa inflated; choanae small, pædomorphic. The tympanic bone opposite spinous process, on the right is large (6 mm.), but on the left side is almost nil. The tegmen tympani on the right large; left almost nil. The oval foramen on the right is large; on the left small and nearly round. The jugular foramen on the right is small, on the left large. The left ecto-petrosal portion of the temporal bone is intact; on left side a venous foramen is seen in exoccipital at the lambdoidal suture; the right ecto-petrosal portion with large mastoid foramen; upper part right and left ecto-petrosal serpiginous.—Temporal impression feeble, no posterior moulding; surface of temporal fossa between tuber and ecto-petrosal flat, high, inclined; skull resting on occiput. Angle and parts of sagitta to intertuberal vertical. Occiput pædomorphic. Muscular impressions faint, yet the supra-inion convexity marked. Upper half of occipital squamosa and the interval between parietal tubera vertical.

**Lower Jaw.** Condyloid process with facets.—the median abruptly declined; third molar in part concealed by the base of the coronoid process; angle inclined inward; mental foramen right and left between the premolars; coronoid line intersecting outer border of the condyloid process; molar ridge to anterior border of first molar; mentum scarcely projecting; genial spine and crest almost nil.

The latitudinal index less than altitudinal. This confirms Weisbach's opinion that the female skull, in proportion to its length, is much narrower than the male.

1,789? (Pls. LXVII, LXVIII, LXIX, LXX). Aged 45 years,—fragmentary; sutures open; globular tending to subangular.

Glabella and supra orbital ridges small; outer part orbital arch much inclined, 50 mm. Metopic carination; vascular groove on right side frontal bone. Alae of vomer depressed from plane of presphenoid.—Spinous process overlapping petro-sphenoidal fissure; petrosa inflated; foramen lacerum medium very small on right, closed on left.—Temporal ridge faint; abrupt change in level of post-squamosal and ecto-petrosal parts; bregma elevated. Malar bone enters spheno-maxillary fissure; marginal process small. Skull rests on posterior border foramen magnum. Conceptacula well developed. Occiput broad, round;inion marked; no break in occipito-parietal curve; five large occipito-parietal Wormian bones; depression at obelin marked. General outline rhomboid with narrow anterior segment.  

**Lower Jaw.** Fragmentary without teeth in molar range; genio-glossal spine double; genio-hyoid crest double; all parts well defined. Inner side of ramus beneath molar ridge occupied by an oblong convex eminence; angle absorbed, body much inclined; condyloid articular surface not faceted. inner part inclined upward.

1 Archiv. f. Anthropol. 1868, III.
2 Burial mound Hitchen's Creek, Volusia Co., original burial from base.
3 Skull well filled, no interruption in curves from highest point of sagitta to lowest points of conceptacula.
All the crania gave the impression of belonging to a vigorous race. The alveolar height was conspicuous and in the three males, at least, the nasal bones were synostosed. The contrasts between the male and female were great and about what is mentioned by travellers (see next section). In these respects the Moore skulls differ widely from those marked Seminole.

Résumé.—Dolichocephalic, female, one. Brachycephalic, male, three; female, one. Orthognathous, female, one. Mesognathous, male, two. Leptorhine, male, three. Mesosyme, male, one. Macrosyme, male, two; female, one. Microcephalic, female, two. Megacephalic, male, two.

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p Bi-parietal. s Bi-squamosal.
II. A Comparison of the Skulls from the Florida Graves with (a) Those Marked Seminole in the Collection of the Academy of Natural Sciences; (b), Those from North America (Mainland) West of the Rocky Mountains; and (c) Those Found on the Santa Barbara Islands.

(a) Seminole Skulls.—It is desirable to compare the skulls obtained by Mr. Moore with those of the Indians inhabiting Florida during the historic period.

The Indians named Seminole were probably not of a pure stock, if we can rely upon the statements of Chas. C. Jones Jr. This writer states that "of the Indian nations east of the Mississippi River, occupying and living adjacent to this territory about the beginning of the eighteenth century the dominant people were the Uchees, Lower, Middle and Upper Creeks,—constituting the formidable Muscogee Confederacy,—the Yamases, the Cherokees, the Chickasaws, the Choctaws, the Natchez and the Seminoles. East of the Savannah River resided the Catawbas, the Savannahs and the Westoes" (p. 1). "The Yamases and their Confederates were in 1715 routed by Governor Craven and driven across the Savannah River into the arms of the Spaniards of Florida.—The Uchees also contended themselves after this signal discomfort with a residence in Florida (p. 3).

"Of the Creek Confederacy by far the most numerous and powerful nation was the Muscoge. The Hitchittees, who resided on the Chattahoochee and Flint Rivers, although a distinct tribe, spoke a dialect of the Muscoge. The Seminoles, or Isty-senole (wild men) inhabiting the peninsula of Florida, were pure Muscogees, 1

1 Antiquities of the Southern Indians, particularly of the Georgia Tribes. New York, D. Appleton & Co., 1873.
CRANIA FROM THE MOUNDS OF FLORIDA. 375

and received that name because they subsisted principally by hunting and devoted but little attention to agriculture" (p. 4).

Bartram, in his travels through North and South Carolina, Georgia, etc., London, 1792, states that the Muscogulgee women, "though remarkably short of stature, are well formed; they are seldom above five feet high, yet the men are of gigantic stature, many of them above six feet." This description will, I believe, comprehend the Muscogulges, except some bands of the Seminoles, Uches and Savannueas (p. 481).

It will be thus seen that at least some of the Indians of Florida, after the settlement of the Atlantic coast by Europeans, embraced the Seminoles and remnants of tribes of Georgia which had been driven into the peninsula by conquest of their lands above the Savannah River by the whites, and also that the Seminoles were of the same stock with the Indians who occupied elsewhere the land between the Mississippi River and the sea-coast.

It is probable, therefore, that the skulls of the Moore series were of the same stock called by Jones "Muscogee," a probability which is strengthened by the statement of Bartram regarding the large stature of the males and the small stature of the females of the Muscogee people. The most casual observer of the Moore series will be struck with the disparity in the size of the male and female skulls.

Of the skulls in the Morton collection marked "Seminole" little is known beyond the fact that they were for the most part collected in Florida during or about the time of the Seminole war. Some of them may be from distinct tribes which had been driven South, but it is improbable that they belong to other than members of the Muscogee group. That the Moore series differ notably from the skulls marked Seminole is of considerable interest. But the entire number of specimens examined is too small to make any broad deduction.

In Plate IV, fig. 1, of Jones Antiquities, etc., a skull of a Creek Indian exhibits characters which closely resemble No. 1,784 and No. 1,782 of the Moore series. The prominent glabella and supra-orbital ridges, the coalescent nasal bones, and the high incisor crest are here present. The skull is sub-globular.

Twelve "Seminole" skulls are available for study.

733* 9, aged 40,—cymbecephalic.

Glabella moderate; no supra-orbital ridge; forehead psedomorphic; outer part of orbital arch inclined 40°. Nasal bones arched, narrow; ascending process of maxilla compressed; the frontal portion nil; maxillary portion 22 mm.; premaxillary 2 mm.—Nasal vestibule analophic, but with a ridge extending from spine to ascending limb of the premaxilla; alveolus 19 mm. high.—Hard palate hyperbolic; choane and pterygoid processes psedomorphic. Foramen lacerum medium almost obliterated; spinous process not overlapping petroso-sphenoidal fissure.—Temporal crest not interrupted at stephanion; lambdoidal suture serrate near asterion. Malar bone with small marginal process; suture-trace present.—interval between zygomatic

The sutures are unusually open, but the jaws show signs of middle life.

47 JOURN. A. N. S., PHILA., VOL. X.
process and maxilla 10 mm. long; bone in sphenomaxillary fissure.—Sconce 112
mm. wide.

Lower jaw. Pregonium¹ large; condyloid facets equal, internal half inclined.
Mental foramen between second premolar and first molar on the right side, and on
line of second premolar on the left side; the genial spine and genial crest equal, but
almost nil.

Skull rests on basion and opisthion, a curve of low convexity from opisthion to
inion; a second from inion to intertubera, without depression at the lambda or
obelion. The type so far as the parietal bone is concerned, therefore, is as in the
"cut-off" variety, but no interruption exists at the lambda because of the constricted
proportions of the occipital bone.

698 ¢, aged 40,—phoxocephalic.

Glabella rudimentary 4 mm.; supra-orbital margin 40°.—Nasal bones arched;
frontal portion 3 mm.; maxillary portion 20 mm.; premaxillary portion 3 mm.; radix
7 mm., 90°; salient 24 mm., 30°; ascending process maxilla compressed.—Nasal
vestibule microlophic; incisor eminence high, with ridges reaching to the simple
spine; alveolar line defining conspicuous fossa, 4 mm. wide; hamular process (right
and left) rudimentary, not concealing bulla; on right side almost nil; on left side
larger, but laminar.—Hard palate parabolic; alveolar process 15 mm. high; choanae
paedomorphic.—The left petrosa inflated; spinous process enormous and overlapping
fissure on right, paedomorphic on left; tympanic process small; tegmen
projecting as an independent spine overlapping fissure on left.—Temporal ridge
interrupted at stephanion 15 mm., the lambdoidal suture harmonic near the asterion;
crest of inferior turbinal extended almost to the internal pterygoid plate; foramen
lacerum medium open medially, closed laterally.—Left lachrymal bone with broad
hamuló-maxillary union; bulla ethmoidalis rudimental.—Malar bone with large
marginal process; not in sphenomaxillary fissure; suture-trace present; ecto-petrosal
portion of temporal bone small right and left.—Occiput moderately paedomorphic.—
Sconce 130 mm. wide.—Skull rests on opisthion; first curve from opisthion to inion,
second from inion to lambda, third from lambda to intertubera.

Lower jaw. Body short, third molar partly concealed by coronoid process;
teeth much worn; mental foramen on line of second premolar on the right and
between this tooth and the first molar on the left. Genio-glossal spine double; genio-
hyoid crest marked; condyloid lateral facet two-thirds, median facet one-third; the
left with much the smaller external pterygoid impression; angle of jaw inflected.—
Upper molars 4–4¯—; lower molars 2–2–2–.

1,105 ¢, aged 40,—phoxocephalic.

Glabella not prominent.—Nasal bones arched; frontal 4 mm.; maxillary
portion 22 mm.; premaxillary portion 2 mm.; radix 7 mm. long, 80°; salient 18 mm.;

¹ The "pregonium" is a term proposed by the author to denote the recess on lower margin of the
body in advance of the angle. (Towner Lecture, Smithsonian Institution, 1889).
CRANIA FROM THE MOUNDS OF FLORIDA.

40°; ascending process of maxilla compressed.—Nasal vestibule macrophoric; right incisor eminence small,—with ridge reaching simple, large spine; incisor eminence nil on left with ridge. Alveolar line marked on both sides defining small prenasal fossa, 3 mm.; incisor crest high, complete.—Alveolus short (15 mm.) with conspicuously carinate suture.—Hard palate parabolic; high alveolar process 16 mm.; choanae pantomorphic.—Spinous process on right side mutilated and extends between squamosa and the tympana; on left it is enormous and articulates with the tegmen.—Petrosa inflated.—Foramen lacerum medium open.—Temporal ridge interrupted at stephanion 17 mm.; lambdoidal suture serrate almost to asterion on the right, but nearly harmonic on the left.—Malar bone with enormous marginal process; suture-trace present.—Sconce 110 mm. wide.—Lachrymal bone ample, hamular process uniting with maxilla. Upper molars 4-3-0.—Ethmoid disease on left side; ascending plate of the palatal bone convex toward the nasal chambers in the middle meatus.—Skull rests on opisthion; a continuous curve from opisthion to lambda; skull much depressed from lambda to intertubera.

1,286 ♂, aged 30,—archencephalic.

Glabella and supra-orbital arches scarcely discernible; outer part of orbital arches much inclined, 50°.—Nasal bones arched; frontal portion 3 mm.; maxillary portion 22 mm.; premaxillary portion 2 mm.; radix 13 mm., 90°; salient 15 mm., 50°.—Nasal vestibule analphic; incisor eminence none; alveolar line trenchant. Incisor crest rudimental; confined to posterior part; nasal spine produced, simple.—Hard palate hyperbolic, shallow; alveolar process height 13 mm. Choana wider at base than at apex 15 mm. diameter.—Spinous process and tympanic process small, subequal, no overlapping; foramen lacerum medium open.—The temporal ridges faintly marked and not interrupted, while the lambdoidal suture near the asterion is faintly serrate.—Marginal process of malar bone is rudimental; suture-trace 9 mm. long.—Posterior-inferior angle of parietal rests in part on the occipital bone.—Skull rests on opisthion.—The condyloid facets are marked, the median abruptly declining. —Occiput with inion prominent.—The curve of the occipital squamosa (supra-inial portion) not continuous with the intertubero-lambdal, but a distinct depression is noted at the obelion, thus constituting the “cut-off” skull of Cleland.—The squamosa is convex on right; flat on left.

Lower jaw. Third molar back of base of coronoid; condyloid process small, compressed.—The mental foramen on line of second premolar on right side, but between the premolars on the left; the genial spine and crest rudimentary. A modern looking, though “ill-filled” skull.

732 ♂, aged 40,—phocecephalic.

Glabella and supra-orbital ridge rudimental, 3 mm.; outer part orbital arch scarcely inclined, 30°.—Nasal bones arched, not depressed; frontal portion 2 mm.; maxillary portion 25 mm.; premaxillary portion 3 mm.; radix 5 mm., 60°; salient
CRANIA FROM THE MOUNDS OF FLORIDA.

7 mm., 40°.—Nasal vestibule analophic with incisor eminence raised nearly to the top of the small incisor crest. The spine is connected with the incisor eminence by trenchant ridges, alveolar line rudimentary.—Alveolus 18 mm.—Hard palate hyperbolic, alveolar process 15 mm.; choanae, base wider than apex.—Foramen lacerum medium open; spinous process enormous, overlapping sphenoido-tympanic suture; petrosa inflated.—The temporal ridge interrupted at the stephanion 19 mm.; lambdoidal suture near asterion harmonic.—Malar bone with marginal process; suture-trace present.—Scowce 86 mm. wide.

Lower Jaw. Third molar in advance of base of coronoid process. Lateral facet of condyloid process much worn, median scarcely inclined; mental foramen on line of second premolar right and left. Genial spine and genial crest slightly developed. The skull rests on basion and opisthion; the curve from opisthion to transverse occipital torus unbroken; a second curve from the torus to the intertubera is entire, though the obelion is slightly depressed.—Upper molars 4-4-3; lower molars 3 2 2.

1,840 ♂, aged 40,—phoxocephalic.

Glabella and supra-orbital ridge faint not measurable; supra-orbital margin 40°. Nasal vestibule macrophic, alveolar line subtrenchant; crest ending on simple produced spine.—Alveolus short, 15 mm.—Hard palate parabolic deep, alveolar height 13 mm.—Spinous process large; but scarcely overlapping fissure; tegmen enormous.—Foramen lacerum medium open.—Malar bone with large marginal process; suture-trace present.—Temporal crest not interrupted at stephanion, while the lambdoidal suture is harmonic near asterion.—Upper molar 4-4-0.—Skull rests on the conceptacula. The curves of the brain-case disjunct, the opisthio-inion, the supra-inion and the lambdo-intertuberal being separate. The lambda and obelion are depressed, thus constituting the "cut-off" skull.

604 ♂, aged 45,—coronal and sagittal sutures obliterated,—phoxocephalic. Slightly deformed, the right parietal bone being more convex than the left.

Glabella and supra-orbital ridge, 3 mm.; outer part orbital arch, 40°.—Nasal bones scarcely convex, depressed; frontal portion nil; maxillary portion 25 mm.; premaxillary portion 5 mm.; radix 9 mm., 80°; salient 21 mm., 30°; ascending process of maxilla transverse to plane of inner wall of orbit. Nasal vestibule analophic; incisor eminence discernible with faint alveolar line and fossa; spine simple, crest none; the entire vestibule, therefore, padomorphic; alveolus small, 15 mm.—Hard palate hyperbolic; choanae, base broader than apex.—Foramen lacerum medium almost closed.—Ptérygo-spinosal junction.—Enormous spinous process uniting with tegmen and overlapping sphenoido-tympanic suture.—Petrosa inflated.—Malar bone with large marginal process, and marked suture-trace; bone enters spheno-maxillary fissure.—Lachrymal bone sutures between os planum and maxilla obliterated.—Temporal ridge well developed; no interruption at stephanion, but the second stadium of the ridge as well developed on the frontal as on the temporal
bone. This arrangement is unusual. The lambdooidal suture harmonic near asterion with Wormian bone. Upper molars 4-4-0.—Sconce 140 mm. wide.—Skull rests on conceptacula, yet is nearly platybasic.—Curves three in number: first, opisthio-inion; second, inio-lambdoidal; third, lambdo-intertuberal. Skull markedly "cut-off."

456 3, aged 40.—sphaerocephalic.

Glabella full, supra-orbitals, 2 mm.; supra-orbital margin much inclined, 40°.—Nasal bones convex, scarcely depressed; frontal portion nil; maxillary portion 21 mm.; premaxillary portion 6 mm.; radix 7 mm., 90°; salient 20 mm., 40°; ascending process of maxilla nearly on plane of inner wall of orbit. Nasal vestibule microlophic; alveolar line trenchant, incisor crest and nasal spine moderately developed; alveolus 12 mm.—Hard palate hyperbolic; alveolar height 12 mm.; choanae 15 mm., broadly oval.—Foramen lacerum medium open; spinous process overlapping sphenoido-typanic suture; attempt at pterygo-spinosal union.—Temporal ridge without interruption at stephanion; lambdooidal suture serrate near asterion.—Malar bone with small marginal, but marked suture-trace.—Sconce 128 mm. wide.—Skull rests on conceptacula.—An almost continuous curve from intertubera to opisthion, a slight depression only occurring at the lambd and at the occipital torus.

708 3, aged 30.—archencephalic.

Glabella and supra-orbital ridge nil; outer part of orbital arch greatly inclined, 50°.—Nasal bones convex; frontal portion 2 mm.; maxillary portion 20 mm.; ascending process of maxilla on plane with inner wall of orbit.—Nasal vestibule microlophic; incisor eminence small, ridge extending to bifid spine; alveolar line rudimentary, yet yielding a small fossa.—Alveolus small, 15 mm.—Hard palate parabolic right, hyperbolic left.—Large overlapping spinous process; projecting tegmen on left.—Foramen lacerum medium small, but open both medianly and laterally.—Petrosa inflated.—Temporal ridge interrupted at stephanion; lambdooidal suture serrate near asterion.—Ecto-petrosal portion of temporal bone serpiginous, with several small Wormian bones.—Malar bone with marked marginal process; suture-trace present; maxillo-zygomatic interval 5 mm. long.—Lachrymal bone large; hamulo-maxillary union.—Os planum large; bulla small.—Upper molars 4-3-4-3.—Skull rests on conceptacula; large transverse occipital torus.—The brain-case well-filled; a continuous curve from bregma to opisthion. Width of sconce 130 mm.

726 2, aged 35.—archencephalic.

Glabella and supra-orbital ridge nil; forehead paedomorphic, outer part of orbital arch inclined 40°. Nasal bones low, arched, concave; frontal portion nil; maxillary portion 17 mm.; premaxillary portion 1 mm.; radix 8 mm., 80°; salient 12 mm., 40°; ascending process of maxilla nearly transverse to inner wall of orbit.—Nasal vestibule analophic; alveolar line nil. Alveolus 17 mm. high.—Hard palate hyper-
bolic left, parabolic, right; alveolar process 13 mm. high; choanae with produced basal angle.—Foramen lacerum medium open. Spinous process not overlapping sphenoido-tympanic fissure.—Petrosa inflated.—Epipiotic bone on right side; a Wormian bone on right side in lambdoidal suture near asterion and at mid-lambda.
—Temporal ridge without interruption at stephanion, the lambdoidal suture serrate to asterion. Upper molars 4–3–0.—Scone 158 mm.—Malar bone with marginal process almost nil. Suture-trace evident, 5 mm. long.

Lower jaw. Third molar almost concealed by the coronoid process; mental foramen opposite second premolar; condyloid process angulated, the facets about equal, the internal inclined downward; angle deflected; genio-glossus spine double; genio-hyoid crest distinct.—Skull rests on opisthion; occipital curves continuous, but interruption at lambda between the occipital and the parietal back of the intertubera, thus constituting a “cut-off.”—Entire skull remarkably paedomorphic.

707 δ, aged 30,—archenecephalic, slightly deformed,—the left parietal bone being flattened.

Glabella small, supra-orbital ridge slight; outer part of orbital arch inclined, 40 mm.—Nasal bones convex; frontal portion 3 mm.; ascending process of maxilla nearly on plane of inner wall of orbit. Nasal vestibule mutilated; incisor eminence, alveolar line marked, prenasal fossa 5 mm. Alveolus small, 12 mm.—Hard palate left side hyperbolic, right side parabolic; alveolar height 17 mm.; choanae with base wider than apex.—Spinous process not overlapping sphenoido-tympanic fissure. Foramen lacerum medium open, medianly and laterally; left petrosa inflated.—Temporal ridge with interruption at stephanion of 21 mm.; lambdoidal suture harmonic near asterion.—Left side of head the smaller.—Epipiotic bone present on left side.—Upper molars 4–3–0–3.—The scone 94 mm. wide, coarsely porose on either side near the temporal ridge.—Malar bone with large marginal process; not in sphenoo-maxillary fissure.

Lower jaw. Third molar not concealed by the coronoid process.—Molars 20–30–20; genio-glossus spine double; genio-hyoid crest nil; mental tubercles large.—Mental foramen on line with second premolar on right side, between premolars on left.—Skull rests on conceptacula, thus the curve from opisthion to inion is distinct. The curve from the inion to the bregma uninterrupted at the lambda or obelion.
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CRANIA FROM THE MOUNDS OF FLORIDA.
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See Section III on Metopism.

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In reviewing the Seminole crania it is observed that all were males but two. This disparity is probably explained by the fact that the specimens were in the main obtained from battle-fields. The glabella and supra-orbital ridge were faintly developed, the maximum being 4 mm. and six being nil. An average of five specimens (in which the parts were measurable) was 3 mm., in this regard they are contrastable with the Moore crania. The degree of inclination of the supra-orbital margin is about 40°.—The nasal bones showed but slight disposition to project above the level of the fronto-maxillary suture—namely 3 mm.; while in five it did not project at all. In nine specimens the maxillary portion of the bone was 21 mm. long, being about the same as in the Moore series. The length of the nasal radix was about 8 mm. and the angle 80°, while the salient was 18 mm., and subtended an angle of 40°, nearly.—The nasal vestibule was macrolophic in two; microlophic in three, showing a small fossa; while five were analophic. The alveolus was 15 mm. high, thus being about the same as in the Moore series.—The hard palate was for the most part hyperbolic, there being but two examples of the parabolic form, though in three other specimens (Nos. 708, 726, 707) right side was parabolic, while the left was hyperbolic.—The height of the alveolar process was 10 mm.—In four specimens the choanae was paedomorphic, all the others exhibiting a base which was wider than the apex.—The foramen lacerum medium was open in all, but two showed closure along the line of the groove for the Eustachian tube.—In six specimens the spinous process of the sphenoid bone was large and overlapped the sphenoidotympanic suture.
CRANIA FROM THE MOUNDS OF FLORIDA.

In the region of the origin of the temporal muscle the temporal ridge was interrupted in seven examples, and not interrupted in three; two of these being females. In this series, therefore, the interruption at the stephanion in the curve of the temporal ridge was a good sex character; indeed, better than the marginal process of the malar bone, which, while present in one female, was absent in the other and was almost absent in two males (Nos. 456, 1,286).—The lambdoidal suture as it approached the asterion became harmonic in seven (all males) and serrate in five, two of which were females.—The interval between the temporal ridges at the sconce had a minimum of 86 mm. and a maximum of 158 mm., an average of 122; omitting the two females the average was 112 mm., which is greater than that of the Moore series.—A remarkable feature in which the Seminoles agree with the Moore skulls is the horizontal groove on the inner side of the malar bone, which was present in all the specimens. In six crania the malar bone entered the spheno-maxillary fissure; in four it did not.

The lower jaw was present in seven of the skulls. The condylloid process was angulated in all, the median facet being inclined. The base of the coracoid process concealed the third molar in whole or in part in three; one of these (No. 1,286) was a female. The mental foramen opened between the premolars in four on both sides, in one as above on the left side, but opposite the second premolar on the right side. In two specimens only (Nos. 733, 698) the foramen lay between the second premolar and the first molar. The teeth were well developed, only two specimens showing the second upper molar with less than four cusps, and the second lower molar with less than five.

Résumé.—Dolichocephalic, female, one. Mesaticephalic, male, seven. Brachycephalic, male, three; female, one.—Orthognathous, male, four. Mesognathous, male, five; female, two. Prognathous, male, one.—Leptorhine, male, two. Mesorhine, male, eight; female, one. Platyrhine, female, one.—Microsene, male, one; female, one. Mesosene, male, two; female, one. Megasene, male, seven. —Microcephalic, male, four; female, two. Mesocephalic, male, two. Megacephalic, male, four.

(b) Description of a Series of Skulls of North American Indians Collected West of the Rocky Mountains (Mainland). After the Florida crania had been studied it was determined to compare them with a group as remote as possible both in geographical and ethnographical range. For this purpose the skulls of Indians from the Pacific Coast were included with those collected from localities as far east as the Rocky Mountains. While this enormous territory is occupied by tribes differing greatly among themselves, it is true, that in the California "Digger," the Shoshoni and the Pawnee the lowest point in skull conformation in the Indian is reached, while the variations in structural details throughout are more striking than in skulls from other parts of North America. Unless specially stated the specimens are to be found in the collection of the Academy.

Journ. A. N. S., Phila., Vol. X.
CRANIA FROM THE MOUNDS OF FLORIDA.


Glabella and supra-orbital ridge faint; supra-orbital margin, 40°. Nasal bones concave scarcely narrowed at bridge; frontal portion 2 mm., maxillary portion 15 mm.; radix 5 mm., 90°; salient 20 mm., 40°. Nasal vestibule microlophic; incisor eminence nil.; spine double, pedomorphic, with marked ridges; alveolar line discernible.—Alveolus high. —Hard palate parabolic 10 mm.; choanae pedomorphic; spinous process scarcely overlapping petroso-sphenoidal fissure.—Foramen lacerum medium open. Petrosa inflated.—Temporal ridges not marked; parietal bone with mortise at post-squamosa; occipital squamosa projecting slightly beyond lambda.—Sphenes 60 mm.

Lower Jaw. The third molar in advance of base of coronoid process; mental foramen between second bicuspid and first molar; angle everted; genial spine and ridge both rudimental; condylid process massive, angulated; hyperostosis on inside of lower jaw at premolars. Teeth are much worn, cuspidation obscure.

Sitka 8. Princeton College. Aged 60 years,—sphærocephalic; slightly deformed, much mutilated.

Glabella and supra-orbital ridge nil.—Palate hyperbolic; outer half of the supra-orbital border slightly inclined.—Spinous process not overlapping sphenoido-typanic fissure. Skull "cut-off."


Glabella and supra-orbital ridge rather prominent.—Nasal bones coalesced; frontal part 3 mm.; maxillary part 15 mm. Narrow saddle moderately depressed. —Nasal vestibule narrow, small, analophic. No nasal eminence or alveolar line. Spine single, prominent, with sharp ridge extending into the chamber; alveolus high.—Anterior wall of maxillary sinus greatly depressed.—Hard palate hyperbolic. —Sphenoido-typanic fissure greatly overlapped; petrosa not inflated; occiput deformed by softening. Occipital condyles small.—Marginal process of malar moderately developed. Suture-trace marked; bone enters into spheno-maxillary fissure. The fronto-temporal crest well defined, interrupted from the parieto-temporal at the stephanion. The parieto-presquamosal suture falls off sharply to near posterior end, where it forms a long mortise on the parietal; parieto-post-squamosal well defined; post squamoso-ecto-petrosal suture discernible.—Lambda obliterated; muscular impression weak; occiput artificially flattened; obelial foramina open. —Lachrymal bone small; lachrymo-planal suture irregular. Hamular process unites with maxilla in orbit; an ossicle intercalated on right. Skull platybasic, rests on opisthion.

1 This skull and the next in order were kindly loaned by Prof. Wm. Libbey.

Permission to examine this and other specimens from Columbia University was courteously extended by Prof. Geo. S. Huntington.
Lower Jaw. Deflected angle; condyle process angulated; genial spine and ridge present; hyperostosis of molar and premolar region conspicuous; mylohyoid ridge lost in it.

2.154 1  ♀, Kotzebue Sound, Alaska, Dr. Benjamin Sharp. Aged 50 years,—ooidocephalic, cyanbecephalic.

Glabella and supra-orbital ridges rudimental. 2 mm.; supra-orbital margin slightly inclined 10°. Frontal portion nasal bone 4 mm. long; maxillary portion 15 mm.; premaxillary portion 2 mm.; radix 12 mm., 80°; salient 13 mm., 50°.—Nasal vestibule analophic.—Alveolus 22 mm. high.—Hard palate U-shaped. Torus palatinus present.—Choanae paedomorphic. Pyramidal process 18 mm. Spinous process overlapping sphenoido-tympanic fissure on right side.—Foramen lacerum medium nearly closed.—Temporal ridge with fault at stephanion. Mortise on right side.—Malar bone with marginal process; suture-trace evident. Skull rests on conceptacula.

659 ♀, Assinaboïn. Aged 40 years,—eurycephalic.

Glabella and supra-orbital ridge marked, 4 mm.—Nasal bones narrow at bridge; frontal portion expanded, 5 mm.; maxillary portion narrow, 25 mm.; premaxillary portion 4 mm.; outer half orbital margin greatly inclined. Nasal vestibule macrolophic; incisor and eminence and crest high, compressed; spine mutilated, prominent. Alveolar line discernible, defining fossae between it and the incisor eminence.—Alveolus high, scarcely inclined. The premaxilla small in horizontal limb, teeth vertical.—Hard palate parabolic, deep; external pterygoid plate very wide.—Sphenoido-tympanic fissure not overlapped by the spinous process.—Petrosa scarcely inflated.—Symmetrical Wormian bones at asterion. Parietal slightly mortised at post-squamosa.—Skull rests on conceptacula. Platybasic. Tapeinocephalic.

1.230 ♂, Assinaboïn. Aged 24 years,—eurycephalic.

Glabella and supra-orbital ridge almost nil; supra-orbital margin scarcely inclined.—Nasal bone 24 mm. long; moderately depressed at bridge, not narrowed; frontal portion 3 mm.; maxillary portion 18 mm.; premaxillary 5 mm. Nasal vestibule macrolophic; incisor eminence nil; spine marked, simple, with small ridges; alveolar line defined; incisor crest high.—Hard palate parabolic shallow; sphenoido-tympanic fissure not crossed by spinous process. Petrosa inflated; tapeinocephalic.

Lower Jaw. Third molar partially concealed by the base of the coronoid process; genial spine and crest nil. Upper molars 4-4-0. lower molars 2 2 2 2.

649 ♀, Arickaree.—cyanbecephalic.

Glabella and supra-orbital ridge faint; supra-orbital margin, 40°.—Nasal bones 25 mm. long; frontal portion 3 mm. long; maxillary portion 19 mm.; premaxillary

1 This skull was received after the table of measurements was finished.
CRANIA FROM THE MOUNDS OF FLORIDA.

3 mm.; radix 8mm., 80°; salient 30°.—Nasal vestibule analophic; incisor eminence rudimental; incisor crest almost nil; small posterior process and conspicuous spine. Spinal crest conspicuous not trenchant. Alveolar line nil.—Hard palate with pronounced alveolar process 20 mm.; choanae pseudomorphic. Lambdoidal suture serrate near asterion.—Marginal process of malar bone conspicuous; bone in spheno-maxillary fissure; suture-trace evident.—Epipiteric bone on right side; fronto-sphenoidal and other sutures closed in left temporal fossa, but open on right. Many parieto-occipital Wormian bones.—Lachrymal bone confined entirely to plane of os planum and has small part in lachrymal duct. This is a hylobatean feature. The hamular process united to maxilla; lachrymo-planal suture 6 mm. long.

748 ə, Arickaree. Aged 45 years,—cymbecephalic.

Glabella and supra-orbital ridge rudimental; superior orbital margin inclined, 40°.—Nasal bones compressed; mutilated; frontal part 4 mm. Nasal vestibule analophic; incisor eminence none, spinal crest salient, alveolar border trenchant. Alveolar line not extending beyond canine eminence. Spine single conspicuous.—Alveolar process everywhere produced, parabolic.—Foramen lacerum medium, small 6 mm.; spheno-typanic suture not overlapped.—Upper margin alisphenoid process 40 mm. long; mortise present at post-squamosa; occipito-squamosal suture obliterated; platybasic; greatest transverse diameter bi-squamosal. Malar bone marginal process marked; not in spheno-maxillary fissure; suture-trace present.

213 ə, Nasqua (Nans), Fort Simpson. Aged 40 years,—eurycephalic.

Glabella and supra-orbital ridge marked, 3 mm.; orbital margin scarcely inclined; supra-orbital canal far above orbital margin.—Nasal bones 28 mm.; frontal part 6 mm., remaining portion 29 mm., acutely arched; radix 11 mm., 90°; salient 14 mm., 50°. Nasal vestibule analophic; incisor eminence and alveolar line none. Spinal ridge sub-trenchant, limiting spine conspicuously; alveolus high.—Lachrymal bone with hamular process joining maxilla.—Hard palate hyperbolic; choanae scarcely wide at base. Spinous processes enormous, overlapping the petroso-sphenoidal fissure. Petrosa markedly asymmetrical, the left being the larger. Fronto-temporal crest prominent. Parieto-temporal ridge and transverse occipital torus unite for 20 mm. at asterion to form a nearly harmonic suture.—Malar bone widely flanging; suture-trace on outer side left, marked on inner side right and left; marginal process conspicuous.—Sconce 56 mm. only; the smallest observed in the series. Phenozygomatic.—Skull rests on conceptacula. The torus transversus occipitalis well developed, reaching within 47 mm. of asterion;inion prominent.

This heavy, large skull with prominent glabella and supra-orbital ridge, narrow nasal aperture, high alveolus, large spinous processes, enormous hard palate and strong, closely approximated temporal ridges appears strangely out of place with the smaller, smoother browed specimens elsewhere from the Pacific Coast. The shape of the nose recalls the Alaskan forms, while the broad low post-tuberal region of the occipital norma is the same as the other skulls of the series.
CRANIA FROM THE MOUNDS OF FLORIDA. 387

214 ♀. Nasqua (Naas), Fort Simpson. Aged 20 years.—stenocephalic.

Glabella and supra-orbital ridges faint, outer part of upper border of orbit almost straight.—Nasal bones 27 mm. long, no frontal portion, greatly narrowed at the low arched bridge, frontal bone carinated; radix 11 mm., 80°; salient 13 mm., 50°. Nasal vestibule microlophic; small incisor eminence; nasal spine simple, large. Spinal ridge subrenchant, limiting.—Hard palate paedomorphic.—Choanae with base wider than apex. Petrosa asymmetrical, the left the larger.—The sphenoido-tympanic fissure overlapped by the enormous spinous process.—Temporal crests faintly defined, mortise at post-squamosa conspicuous.—Malar bone with large marginal process on right side 7 mm.—Lachrymal bone with hamular process joining maxilla.—Skull rests on conceptacula, phaeozygomaticous.

The skull is barely mature. The third upper molar is just erupted. Hence the muscular impressions are weak, but the marginal process of the malar bone enormous, as are also the spinous processes. The occipital norma is moderately paedomorphic and slightly “cut off.”

457 ♂, Chinook, Columbia River. Aged 60 years.—eurycephalic.

Glabella and supra-orbital ridge, 1 mm. Supra-orbital margin scarcely inclined, 50°.—Nasal bones 25 mm. long; frontal part 4 mm. long; radix 8 mm. long, 90°; salient 18 mm., 40°.—Nasal vestibule microlophic; incisor eminence of alveolar line rudimentary; spinal line present on left only. Incisor crest inconspicuous.—Septal foramen large.—Alveolus high.—Hard palate shallow, indeterminate; wider at base than apex. Spinous process overlapping sphenoido-tympanic suture left. Foramen lacerum medium nearly closed.—Malar bone marginal process nil; suture-trace none; bone enters into spheno-maxillary fissure.—Skull rests on conceptacula; phaeozygomaticous.

This is a good example of a skull of a female passed middle life. The jaw is nearly edentulous. The muscular power was low for the temporal impressions are weak and the parieto-temporal crest not raised near the lambdoidal suture. A continuous curve passes from the post-bregma to the opisthion, hence the skull is “well-filled.”

578 ♂, Chinook slave. Aged 35 years.—eurycephalic.

Glabella and supra-orbital ridge, 3 mm.; supra-orbital margin, 40°.—Nasal bones mutilated.—Nasal vestibule analophic with slightly raised alveolar line. Alveolus 16 mm.—Hard palate hyperbolic.—Alveolar process 13 mm. high.—Choanae wide, paedomorphic.—Foramen lacerum medium nearly closed; spinous process overlapping sphenoido-tympanic suture.—Temporal ridge interrupted at stephanion; parieto-temporal ridge raised at lambdoidal suture, which is harmonic near asterion; transverse occipital torus well developed.—Malar bone with large marginal process; it is lodged in the spheno-maxillary fissure; suture-trace conspicuous.—Sconce 130 mm.—Skull rests on opisthion; curves in occipital norma two.—one from opisthion to inion and another from inion to intertubera; yet the skull is “cut-off.”
The skull with its small glabella would appear to be a female, but the temporal ridge is well developed, and the marginal process of the malar bone large. The styloid process is also nearly embraced by the tympanic bone. The post torus is very large. A small parieto-occipital process is seen on the left side; the right side at the same place is mutilated. The serpiginous part of the ecto-petrosal portion of the temporal is conspicuous.

557♀, Pawnee, Columbia University. Aged 35 years.—artificially deformed.
Glabella and supra-orbital ridge almost nil.—Nasal bone long, 26 mm.; frontal portion 3 mm.; maxillary portion 20 mm.; premaxillary portion 3 mm.—Nasal vestibule microlophic; incisor eminence none, very high trenchant alveolar ridges, nasal spines double.—Hard palate hyperbolic.—Alveolar process 11 mm. high.—Choanae with base much wider than apex.—Spinous process small, not overlapping sphenoido-tympanic suture.—Foramen lacerum medium closed laterally.—Temporal crest faintly marked, but interrupted at stephanion. A Wormian bone in left stephanion. A right K-suture. Two epactal bones on the left side. Mortise symmetrical.—Malar bone small, weak; rudimental marginal process; suture-trace evident on inner side.—Lachrymo-planal suture small, 7 mm.— Rudimental bulla ethmoidalis on both sides.—Scone 110 mm. wide.

Lower jaw. Condyloid process without angulation. Mental foramen on line of second premolar. Teeth much decayed, many lost and point to modern influence, as also do the deep canine fossa.—Skull rests on opisthion; two curves present,—one from opisthion to inion, one from inion to intertubera.

The skull is remarkable for the modern character of the external nose and palate, the presence of a Wormian bone at stephanion and K-suture on the right side, and two epactal bones (one of them indeed a fronto-sphenoidal), and the lambdoidal suture maintaining its serrate character to the asterion notwithstanding the well marked temporal ridges. The lower jaw is weak and the condyloid process without facets.

556♂, Pawnee, Columbia University. Aged 60 years.—eurycephalic.
Glabella and supra-orbital ridge well marked, 4 mm.; supra-orbital margin, 50°; frontal portion of nasals bones 3 mm.—Nasal vestibule microlophic; incisor crest high. Nasal spine prominent; high trenchant alveolar line; high alveolus 18 mm.—Hard palate parabolic.—Choanae large, pedomorphic.—Spinous process enormous, overlapping sphenoido-tympanic suture. Foramen lacerum medium closed.—Malar bone with large marginal process; extends in sphenoido-maxillary fissure; no suture-trace.—Lachrymal bone with large pre-dacyral surface.—Scone, 108 mm.

CRANIA FROM THE MOUNDS OF FLORIDA.

The union of nasal bones with the maxilla, the frontal bone, and with one another, and the closed foramen lacerum medium, are remarkable. The styloid process is 40 mm. long. Extensive disease of ethmoid bone is present.

1,043 ♀, Pawnee, Fort Wolla, Arkansas. Aged 25 years.—cymbecephalic.

Glabella and supra-orbital ridges rudimentary, 1 mm.; outer half of superior orbital margin slightly inclined 40°.—Nasal bones 24 mm.; frontal portion 1 mm.; maxilla, premaxillary portion 25 mm.; bone narrowed and low arched at bridge. —Nasal vestibule microlophic; alveolar line defined, and is in plane of highest position of the palatal aspect of the premaxilla; spine single, conspicuous, as is also the nasal crest.—Hard palate hyperbolic, shallow, 10 mm. high.—Choanae much wider at base than apex.—Foramen lacerum medium open. Petrosa inflated.—Sphenoidal tympanic suture overlapped by enormous spinous process. Rudimental paramastoid processes present. The lachrymal bone with hamular process articulating with an ossicle which intervenes between the process named and the maxilla.—Scone 69 mm.—Temporal ridge with interruption at stephanion. The cymbecephalic is of high grade. The skull rests on the opisthion; the most posterior part of the skull is the transverse occipital torus.

540 ♀, Pawnee. Aged 25 years.—eurycephalic.

Glabella and supra-orbital ridge small, 1 mm.; supra-orbital margin 40°.—Nasal bones mutilated.—Nasal vestibule microlophic.—Alveolus short, 11 mm.—The hard palate hyperbolic on left side and slightly parabolic on the right.—The temporal crest is interrupted, and the lambdoidal suture is harmonic within 10 mm. of the asterion.—A mortise is present on line of the post-squamosal portion of the temporal bone.—Scone 106 mm. wide.—The skull rests on the opisthion and conceptacula.—Malar bone with a small marginal process; it enters into the sphenomaxillary fissure; a suture-trace is evident on inner side of the bone.—The teeth are absent from the jaw.—The skull is prognathic.

1,447 ♀, Shoshoni. Aged 40 years.—angularly oblong.

Glabella and supra-orbital ridge moderate; supra-orbital margin, 50°.—Nasal bone, frontal portion 3 mm.; maxillary portion 17 mm.; premaxillary portion 3 mm.; radix 8 mm., 90°; salient 9 mm., 30°.—Nasal vestibule analophic; incisor crest none. Nasal spine small. Alveolus 16 mm. high.—Hard palate parabolic. Alveolar process 12 mm. high.—Choanae small, predemorphic; the left slightly the smaller.—Foramen lacerum medium closed.—Spinous process notably overlapping sphenoidotympanic suture. Small parieto-sphenoidal suture. Mortise present. Temporal ridge interrupted at stephanion. Lambdoidal and sagittal sutures closed.—Malar bone narrow, small marginal process bone enters into the sphenomaxillary fissure; suture-trace present.—Lachrymal bone small, reaches maxilla through hamular process.—Rudiment of a transverse occipital suture present.—Skull rests on the
conpectacula.—Scone 88 mm. wide.—Teeth were all in position during life. They closely resemble those of No. 1,783, Moore series. Upper molars 4–34–3.

The skull is exceptional for the obliteration of the sutures of the vertex, yet the teeth are but little worn. Skull prognathic 13 mm. Middle turbinated bone with marked sulci visible from in front. The narrow malar bone recalls No. 557, Pawnee.

1,448 ♂, Shoshoni. Aged 50 years.—archencephalic. Fragmentary.

Glabella and supra-orbital ridge prominent.—Nasal bones mutilated; frontal part projecting 3 mm. above the maxillary.—Nasal vestibule analorphic.—Hard palate hyperbolic.—Sphenoido-tympanic fissure not overlapped by the spinous process.

—Foramen lacerum medium nearly closed laterally, open medianly.—Sagitta carinate.

—Malar bone with large marginal process; the bone enters the sphen-o-maxillary fissure; distinct suture-trace.—Skull rests on conceptacula.—Scone 99 mm.—The skull is very heavy and massive.

1,449 ♀, Shoshoni. Aged 30 years.—stenoccephalic.

Glabella and supra-orbital ridges small, 2 mm.; outer half of orbital margin much inclined.—Nasal bones 26 mm. long; frontal portion nil; maxillo-premaxillary portion 26 mm.; radix 5 mm., 40°; salient 21 mm., 11°. Nasal vestibule macrolophic; spine simple, marked, spinal ridge trenchant limiting margin of anterior nasal aperture; vomer overriding incisor-crest. No incisor eminence or alveolar line. Septum markedly deflected to the left.—Hard palate parabolic.—Foramen lacerum medium open.—Petrosa not inflated. Spinous process enormous, overlapping sphenoido-tympanic process.—The temporal ridge markedly interrupted at stephanion. The lambdoidal suture near asterion, harmonic. Malar bone without marginal process; the bone not in the very narrow sphen-o-maxillary fissure; no suture-trace.—Skull rests on the conceptacula.—Scone 110 mm.—Teeth, excepting one molar, have been lost posthumously. The permanent canines and lateral incisors have never been erupted. Two teeth are encysted in the hard palate back of the incisor range.

The lambda occupied by a Wormian (interparietal) bone. The skull is very small and ovoid, yet well filled. The modern characters of this interesting skull are everywhere evident.

1,887 ♀, Moqui. Aged 60 years.—subglobular. Occiput artificially deformed.

Glabella none, supra-orbital ridge rudimentary; orbital border at outer half scarcely inclined.—Nasal bone, 23 mm. long; frontal part, 3 mm. long; maxillary part 16 mm.; premaxillary part 3 mm.—Nasal vestibule microlophic; incisor eminence small. Alveolar line trenchant, limiting the anterior nasal aperture inferiorly; alveolus 12 mm.—Hard palate hyperbolic; choana with base scarcely broader than apex.—Spinous foramen imperfect.—Sphenoido-tympanic fissure overlapped. Petrosa inflated, left most marked.—Foramen lacerum medium open.—Temporal ridge faint. Lambdoidal harmonic near asterion.—Malar bone marginal process none; bone enters into sphen-o-maxillary fissure; suture-trace present.
Lower jaw. Condyloid process much wider on right than left, where it is not angulated. The left angle is also the weaker and more deflected. Spines double almost nil, no genial crest. The space above the genial spines is pitted; between this pit and the alveolus the bone is convex, thus forming an exceptional variation and recalling the primitive form of the bone. Teeth much worn, jaws nearly edentulous. A characteristic small skull. The forehead unusually convex. Slight artificial deformation of the parietal bone back of intertubera.

1,833 δ, Apache. Pecos River, New Mexico. Aged 50 years.—archencephalic. Glabella and supra-orbital ridge scarcely discernible. Supra-orbital margin inclined, 30°.—Nasal bones nearly co-ossified; frontal portion 4 mm.; maxillary portion 21 mm.; premaxillary portion 3 mm.; radix 8 mm., 80°; salient 10 mm., 50°.—Nasal vestibule macrolophic.—Hard palate hyperbolic, left most oblique. Alveolar process 11 mm.—Spinous process not overlapping sphenoid tympanic fissure. —Choma wider at base than at apex.—Petrosa inflated.—Temporal crest without break at stephanion.—Parieto-temporal porcellaneous near asterion, harmonic.—Malar bone with marginal process moderate; open in sphenoido-maxillary fissure; no suture-trace.—Scone 106 mm.—Skull rests on opisthion. The skull is modern in appearance, and is unusually heavy.

563 δ, Shasta Co., California.1 Aged 30 years,—cymbecephalic. Glabella small, supra-orbital ridges faintly marked, yet measures from ophryon 4 mm., owing to the receding type of forehead.—Nasal bones depressed at middle third; frontal portion 4 mm.; maxillary portion 20 mm.; premaxillary portion 2 mm.; radix 9 mm., 70°; salient 13 mm., 40°.—Nasal vestibule analophic; the incisor eminence nil; alveolar line faint; the spine obtuse.—Hard palate parabolic; choanae wider at base than apex. The pyramidal process small; the foramen lacerum medium obliterated; the sphenoid petrosal fissure not overlapped by the spinous process; the petrosa not inflated.—The foramen magnum small. General appearance of the occipital bone irregular, narrow and asymmetrical.—Fronto-temporal ridge faint, an enormous break at stephanion; parieto-temporal also faint, but posterior part heavily moulded. Parieto-postsquamosal suture differentiated from the parieto-presquamosal. Serpiginous portion of ectopetrosal with numerous grooves. Most prominent part of the occiput the large transverse occipital torus.—Scone 120 mm.—The skull rests on conceptacula.—Malar bone intact only on the right side. No marginal process, bone enters into sphenoid-maxillary fissure; suture-trace present. Lachrymal bones are small, symmetrical.—Hamular process uniting with maxilla.—Middle turbinals inflated, symmetrical. Bulla ethmoidalis rudimental; palatal bone in nasal chamber inflated.

Lower jaw. Condyloid process present only on right; it is well worn on lateral half. Single large genial spine and small genial crest. Mental foramen

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1 Columbia Univ., Med. Dept. The left condylid process, right coronoid process and the right zygomatic arch wanting.

49 Journ. A. N. S., Phila., Vol. X.
opposite second premolar; angle incurved. Slight alveolar hyperostosis opposite premolar and molar. Third molar in advance of coronoid process.

This is a remarkable skull in many respects. The closed foramen lacerum medium, the level palatal aspect of the premaxilla, the rudimental incisor crest, the parabolic hard palate and the occiput at the transverse torus projecting beyond the inion, are all pedomorphic characters. The skull is also very flat and slightly artificially deformed on the left side of the occiput. The absence of the marginal process of the malar bone and of the vaginal process about base of the styloïd process would denote the sex to be female, yet the forehead is not rounded, and the temporal fossa is unusually prominently marked at the stephanion and near the lambdoidal suture.

566 δ, "Digger," California. \(^1\) Aged 45 years.—archencephalic.

Glabella and supra-orbital ridge prominent, 5 mm.; outer half superior orbital margin inclined outward and downward. External angular process of the frontal bone thickened, but this thickening is independent of the supra-orbital ridge.—Forehead ample, with metopic elevation.—Nasal bones mutilated, but anterior nasal aperture narrow. Nasal vestibule microlophic; incisor eminence and alveolar line almost nil. Spine single, prominent, with lines extending into chamber to incisor eminence.—Alveolus 13 mm.—Hard palate hyperbolic. Alveolar process 16 mm.—Pretorus present; pyramidal process small. Sphenoido-temporal fissure overlapped by spinous process on right side only.—Petrosa moderately inflated.—Fronto-temporal ridge faint. Crest between it and the parieto-temporal at stephanion. The posterior part at lambdoidal suture pronounced and heavily moulded. Sagitta carinate. Auditory passage with exostosis, most marked on the left.—The malar bone with large marginal process; the bone enters spheno-maxillary fissure; the suture-trace present. In the lachrymal bone the hamulo-maxillary union present. The skull rests on the opisthion.—Scone 92 mm.

The lower jaw is massive; condyles mutilated; third molar in advance of the base of coronoid process; the mental foramen between the premolars. Genial spine double and, together with the genial crest, rudimentary.

It would be difficult to accept this skull as a member of the same group with No. 565 if a similar contrast had not been noted in the Shoshoni. In the narrow, yet prognathic premaxilla (10 mm.) a resemblance is seen between it and the skull just named, while the general character of the bone is distinct.

1,835 δ, California. Presented by George Davidson. Aged 40 years.—stenocephalic.

Glabella and supra-orbital ridge very large, 4 mm.—Nasal bones mutilated; frontal portion nil; bridge narrowed; radix 6 mm., 80°; salient 15 mm., 40°. slightly carinate.—Nasal vestibule microlophic; nasal eminence nil; spine mutilated; spinal crest sharply limited with small fossa.—Alveolus 18 mm. high.—Hard palate

\(^1\) Columbia University, Medical Department.
highly hyperbolic; alveolar process 13 mm. high; external pterygoid plate wide. Spinous foramen imperfect. Spinous process not overlapping sphenotympanic suture.—Choanae very broad at base.—Malar bone mutilated, but enters sphenomaxillary suture; suture-trace present.—Lachrymal bone co-ossified with the maxilla on both sides. Temporal ridge marked, not interrupted at stephanion; heavily moulded posteriorly. Sagitta carinated.—Sconce 116 mm.—Skull rests on opisthion; it is of low grade if one can judge by the narrow high occiput. The hyperbolic hard palate and the high alveolar processes are modern characters.

1,838 ?, Mare Island, California. Aged 40 years,—subglobular.
Glabella and supra-orbital ridges nil; outer half orbital margin scarcely inclined; forehead rounded.—Nasal bones mutilated, the frontal part marked, 4 mm., bridge concave, moderately arched.—Nasal vestibule analophic.—Hard palate hyperbolic.
—Alveolar process 10°.—Choanae much wider at base than apex.—Foramen spinosum imperfect on left side. Foramen lacerum medium open.—Petrosa moderately inflated; sphenoido-tympanic suture not overlapped by the spinous process.—Malar bone with no marginal process; bone enters into sphenomaxillary fissure; suture-trace present.—Skull rests on conceptacula.—Sconce 122 mm.

Marked male, this rounded female skull resembles No. 1,783 of Moore series. Rudimentary parasamoids present. The occiput is rotund.

Glabella and supra-orbital ridges prominent, 3 mm.; outer part of orbital margin moderately inclined, 40°.—Nasal bones mutilated, co-ossified. Length of outer margin 29 mm.; frontal 4 mm.—Nasal vestibule macrolophic; incisor eminence small; incisor crest high; nas al spine nil. Alveolar line discernible.—Hard palate parabolic.—Alveolar process high.—Petrososphenoidal fissure overlapped by long spinous process. Small exostoses in both auditory meatus.—Foramen lacerum medium open, large. Scarcey any parietal mortise at post-squamosa.—Temporal crest marked, greatly interrupted at stephanion. A small epipletic on left side. Skull rests on conceptacula.—Sconce 82 mm., markedly porose.

The skull closely resembles the foregoing, but is flatter. The width of sconce is the narrowest in the series. The alveolar process is remarkably high.

In these Indians the glabella was small, measuring between 2 mm. and 3 mm. —The nasal bones were large, measuring 26 mm.; the radix longest of the series being 9 mm., and the salient, the shortest, 14 mm.; the degree of the radix was the lowest of any of the series, being 78°; while that of the salient was the highest, being 45°.—The types of nasal vestibule were as follows: 5 macrolophic,1 11 microlophic, and 9 analophic, thus differing conspicuously from the Seminole and the natives of the Santa Barbara Islands.—The average height of the alveolus was 16 mm.

The hyperbolic variation was greatly in excess of the other forms of the hard palate. There were 3 U-shaped palates, which is novel, and 5 parabolic.—The

1 The California skulls were on the border between line macrolophic and microlophic.
CRANIA FROM THE MOUNDS OF FLORIDA.

pedomorphic form of choanec is almost equal to the wide-based form, thus markedly differing from both Seminole and Santa Barbara varieties.—The foramen lacerum medium was closed in 7 and open in 18 examples.—The sphenoido-tympanic suture was not overlapped by the spinous process in 12 (quite one-half), both of the above furnished good characters when compared with those of the other series.—The malar bone lacked the suture-trace in 7 examples as against 2/4 of the other groups. The bone enters the sphen-maxillary fissure in all but 6, and the marginal process was large in 9.—The temporal ridge was interrupted in about half the specimens and the lambdoidal suture was harmonic near asterion in 17, a much larger proportion than in the Santa Barbara skulls, but about the same as in the Florida.—The average width of the sconce is the lowest of the series, being but 56; the maximum 150 and the minimum 94.—An unusually large number (12) of the lachrymal bones effect a junction between the hamular process and the maxilla. This is a character of reversion to many lower primatean genera. The seven examples retaining entire lachrymal bones showed an average measurement of 16 mm. long by 9 mm. wide.

The third molar of the lower jaw was in advance of the base of the coronoid process in four bones examined. The mental foramen was not in advance of the second premolar in a single instance.

Résumé.—Dolicocephalic, male 4, female 1.—Mesaticephalic, male 4, female 1.—Brachycephalic, male 5, female 4.—Orthognathous, male 3, female 9.—Mesognathous, male 7, female 3.—Leptorhine, male 6, female 3.—Mesorhine, male 6, female 6.—Platyrhine, male 2, female 3.—Mesosene, male 1, female 1.—Megaseene, male 13, female 11.—Microcephalic, male 7, female 9.—Mesoscopicphalic, male 1, female 1.

Measurements, Table No. 7.

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1 See Section III on Metopism.
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* External occipital line with external occipital condyle.
### CRANIA FROM THE MOUNDS OF FLORIDA.

#### Measurements, Table No. 10.

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#### Measurements, Table No. 11.

### CRANIA FROM THE MOUNDS OF FLORIDA.

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1 See Section III on Metopism.
CRANIA FROM THE MOUNDS OF FLORIDA.

(c) Description of Skulls Collected on the Santa Barbara Islands. The skulls collected from the Santa Barbara Islands off the southern part of the coast of California have been carefully studied by L. Carr (U. S. Geological Survey (Wheeler) 1879, 277), who analyzed 315 examples: 178 of these were male and 137 were female.

This group is well worthy of being separately considered. It is highly probable that the people were insulational for a time sufficient to have acquired some distinctive peculiarities, though their relationship to the mainland tribes is exact.

1,818 \( \delta \), aged 45 years,—stenocephalic.
Glabella and supra-orbital ridge prominent, 3 mm. The supra-orbital margin inclined 40°.—Nasal bone 24 mm.; frontal part almost nil; radix 4 mm., 90°; salient 17 mm., 30°.—Nasal vestibule analophic; nasal spine padomorphic, with sharp spinal crest. Alveolus small.—Choanae padomorphic.—Foramen lacerum medium open.—Petrososphenoidal suture not overlapped.—Sagitta at post-bregma carinated.—Malar bone with marginal process almost nil; not in spheno-maxillary fissure; suture-trace present.—Sconce 110 mm.—Skull rests on opisthion. It retains paroccipital processes 12 mm. on right, 6 mm. on left.—It bears a close resemblance to skulls from the South seas.\(^4\)

Lower jaw. Genial spine double, crest nil; lemurine process present; inner half condyloid process inclined.

1,823 \( \delta \), aged 40 years,—archencephalic; high and narrow.
Glabella and supra-orbital ridges, 4 mm.; superior orbital border scarcely inclined, 40 mm.—Nasal bone 23 mm. long; flat very low arch; frontal portion, 2 mm. long; maxillary 17 mm.; premaxillary 4 mm.—Nasal vestibule microlophic.
—Hard palate hyperbolic, alveolar height 12 mm.—Sphenoido-tympanic suture not overlapped.—Foramen lacerum medium almost closed; petrosa not inflated.—Skull rests on opisthion.—Sconce 122 mm.—Lambdoidal suture serrated throughout. Phenozomous.—Malar bone small, 20 mm. wide; marginal process small; not in spheno-maxillary fissure; suture-trace present. Lachrymal bones absent; osa plana small.—Consipienous ethmoidal bulla.

The resemblance already noted between some Santa Barbara skulls and the Polynesian type is conspicuous in this example. The nasal salient unusually low 20°.

1,822 \( \Omega \), aged 60 years,—cymbecephalic.
Glabella and supra-orbital ridge rudimental; outer part superior orbital margin scarcely inclined, 40°. Nasal bones flat; radix 6 mm., 90°.—Nasal vestibule microlophic; incisor eminence and alveolar line trenchant.—Hard palate parabolic; choana widely divergent; sphenoido-tympanic suture not overlapped.—Petrosa inflated.—Foramen lacerum medium scarcely open.—Temporal crest rudimental; parieto sphenoidal suture small 10 mm. Lambdoidal suture serrate at asterion;

\(^4\) All the specimens examined are in the museum of the Academy.
\(^5\) L. Carr (l. c.) notes the Santa Barbara skulls to be "roof-shaped along the sagittal suture."
large parietal foramen on right side. Interior of nasal chamber with large transverse uncinate process and ethmoidal bulla. Middle turbinal laminate.

1,826 ♂, aged 40 years.—Angularly oblong.

Glabella and supra-orbital ridges faintly expressed; superior orbital border scarcely inclined, 40°. Nasal bones coossified; broad low arch, frontal part small, 2 mm., rest mutilated. Nasal vestibule analophic; alveolus 13 mm. Hard palate parabolic; alveolar process 15 mm. Choanae remarkably broad at base 25 mm. Foramen lacerum medium closed. Sphenoido-tympanic suture not overlapped. Petrosa inflated; malar bone narrow, 20 mm.; small marginal process; bone enters fissure; suture-trace present. Hamular process of lachrymal bone joining maxilla. Mortise at post-squamosa.

Lower Jaw. Lemurine process faintly marked and scarcely deflected. Condyloid process worn on outer half, inflated, scarcely inclined on inner half. Mental foramen on line of second premolar. Spines double, crest nil. Upper molars 4–3–1; lower molars $\frac{2}{3} \frac{2}{3}$. Skull rests on opisthion; phanozygomatic. A light form but again recalling the South Sea type.

1,817 ♂, aged 40 years.—Platycephalic; angularly oblong.

Glabella over supra-orbital ridges faintly expressed. Superior orbital margin slightly inclined, 20°. Nasal bones long, 22 mm., low arch. Frontal portion long, 15 mm., remainder of bone 29 mm.; radix 9 mm., 90°; salient 12 mm., 40°. Nasal vestibule analophic; spine simple, acute with spinal ridge. Alveolus 20 mm. Hard palate parabolic, 14 mm. high; choanae subonal; petroso-sphenoidal fissure not overlapped. Foramen lacerum medium not opened on left, scarcely open on right. Lachrymal bone small with rudimental hamular process and crest. Malar bone with small marginal process, narrow, 19 mm.; suture-trace present. Phanozygomatic. Skull rests on opisthion.—Scone 124 mm.

Lower Jaw. Third molar scarcely in advance of coronoid. Condyloid moderately inclined, facets faintly expressed; spine double, rudimental, crest nil. Mental foramen on line with second premolar.—Teeth, upper molars 4–3–3; lower molars $\frac{2}{3} \frac{2}{3} \frac{2}{3}$.

1,825 ♂, aged 40 years.—Angularly oblong.

Glabella and supra-orbital ridge large, 3 mm.; superior orbital margin inclined. 40 mm.—Nasal bone 23 mm.; maxillary portion 18 mm.; premaxillary portion 4 mm.; radix 5 mm., 70°; salient 12 mm., 20°. All parts of nasal vestibule analophic; spine conspicuous and single, a ridge extends to it from the incisor eminence. Hard palate hyperbolic; alveolar process 20 mm. Choanae with parallel sides and base wider than apex. Sphenoido-vomerine union thickened. Sphenoido-tympanic suture not overlapped. Foramen lacerum medium small, almost closed on right side. Skull rests on opisthion; phanozygomatic.—Scone 114 mm.—An enormous transverse occipital torus. Lambdoidal suture harmonic near asterion;
mortise at post-squamosa; squamosa 40 mm. high; sagitta carinate.—Small lachrymal bone, hamular process uniting with maxilla; small posterior marginal process, os planum 8 mm. high.


1,815 ♂, aged 35 years.—cymbecephalic.

Glabella and supra-orbital ridges nil. Superior orbital margin slightly inclined, 40°. —Nasal bone broad low arch, depressed radix 5 mm., 90°; salient 13 mm., 50°. Nasal vestibule microlophic without classifiable characters; incisor eminence high, alveolar line faint, obscuring small fossa.—Hard palate scarcely parabolic, shallow, 11 mm.—Sphenoid-tympanic fissure not overlapped by the spinous process.—Petrosa not inflated.—Sides of choanae greatly inclined, 80°; wider at base than apex.—Lambdoidal suture serrate near asterion.—Malar bone with small marginal process; enters spheno-maxillary fissure; suture-trace present. Bone narrow forward.—The hamular process of the lachrymal bone joins the maxilla.—Skull rests on opisthion; phanozygomatic.—Sconce 110 mm.

1,819 ♂, aged 45 years.—archencephalic; oval, well filled.

Glabella with trace of metopism, supra-orbital ridge very large, 3 mm.—Nasal bones 25 mm.; frontal part 2 mm.; bridge low; radix 6 mm., 90°; salient 16 mm., 20°. —Nasal vestibule microlophic; incisor eminence and spinal crest rudimentary; alveolar line, line discernible.—Hard palate parabolic, alveolar process 15 mm.; choanae pedomorphic; pyramidal process produced; petroso-sphenoideal fissure greatly overlapped.—Petrosa on left side inflated.—Post-bregma carinate, bregma elevated.—Temporal impression markedly developed. Lambdoidal suture serrate near asterion.—Malar bone small, 20 mm. wide at narrowest part. Inner surface with suture-trace; marginal process conspicuous; bone does not enter into sphenomaxillary fissure. Skull rests on conceptacula; phanozygomatic.

Glabella and supra-orbital ridge conspicuous, especially at the beginning of the last named, but the actual projection of the first named small. The prominence on the malar bone extraordinarily developed. The nasal salient of remarkably low degree, 20°. The parieto-sphenoideal suture but 5 mm. long.

1,824 ♂, aged 45 years.—archencephalic.

Glabella and supra-orbital ridge moderate; superior orbital margin greatly inclined, 30°—Nasal bones asymmetrical, broad 9 mm., long 20 mm.; frontal portion 2 mm.; maxillary portion 15 mm.; premaxillary portion 6 mm.—Nasal vestibule anulopiphic; incisor eminence moderate; spine and spinal line well defined; alveolar line nil; alveolus moderate, 14 mm.—Hard palate hyperbolic, alveolar height 20
mm; choanae paedomorphic.—Sphenoido-tympanic suture scarcely overlapped.—Foramen lacerum medium scarcely open.—Temporal crest weak, parieto-sphenoidal suture obliterated.—Skull rests on conceptacula.—Sconce 104 mm.—Malar without marginal process; not in spheno-maxillary fissures; suture-trace present.—Lachrymal bone rudimental.—Middle turbinals laminate.—Rudimental paroccipital processes.

1.816 ♂, aged 25 years.—eurycephalic.

Glabella and supra-orbital ridge faint. Nasal bones broad depressed, mutilated; frontal portion nil.—Nasal vestibule analophic; alveolus high, 22 mm.—Hard palate hyperbolic; alveolar process 15 mm.; choanae with base wider than apex.—Sphenoido-tympanic suture not overlapped by the spinous process. Foramen lacerum medium closed laterally.—Temporal ridge not interrupted at stephanion; lambdoidal suture harmonic near asterion. Skull rests on conceptacula.

Lower jaw. Condyloid process much angulated, lateral facet much worn. Coronoid process not concealing third molar; mental foramen on line of the second premolar; genial spine single prominent; genial crest almost nil, set in a fossa. Upper molars 4-3-0; lower molars 0 ⅞.

1.820 ♂, aged 35 years.—cymbecephalic.

Glabella and supra-orbital ridge faint; superior orbital border slightly inclined, 40°.—Nasal bone 26 mm. long; frontal portion 2 mm.; maxillary portion 20 mm.; premaxillary portion 2 mm.; radix 7 mm., 80°; salient 16 mm., 50°, low arch, asymmetrical. Nasal vestibule analophic; alveolus 18 mm.—Hard palate hyperbolic; alveolar process 12 mm.—Sphenoido-tympanic suture not overlapped.—Petrosa moderately inflated.—Foramen lacerum medium scarcely defined.—Lachrymal bones rudimental. Hamular process not touching the maxilla.—Malar bone with small marginal process; bone enters spheno-maxillary fissure; suture-trace present.—Parieto-sphenoid junction small, 10°.—Small mortise.—Sconce 118 mm.—Skull rests on opisthion. Phaenozygomous. The nasal bone creeps in a little between the ascending process of the maxilla and the frontal bone. This is a character of Cercopti. Right side of occiput with large exostosis. Small transverse occipital torus present.

1.821 ♂, aged 40 years.—archencephalic.

Glabella and supra-orbital ridge moderate, 3 mm.; superior orbital margin much inclined, 50°.—Nasal bone high arched. Frontal portion 2 mm. long; maxillary portion 16 mm.; radix 3 mm., 90°; salient mutilated. Nasal vestibule microlophic, with ridge extending forward from incisor eminence.—Hard palate hyperbolic; alveolar process, 17 mm.—Foramen lacerum medium almost closed; petroso-sphenoidal fissure greatly overlapped. Malar small, 12 mm. wide with large tuberosity; marginal process enormous. The bone does not enter into the spheno-maxillary fissure; suture-trace present; external surface at beginning of bipartite suture evident. Skull rests on opisthion.
A Wormian bone lies in asterion on both sides; exostoses in both auditory meati; lambdoidal suture occupied by numerous coarse Wormians, like No. 1,789, Moore series. Trace of metopic suture just above nasion. Slight exostosis on either side of the occipital bone near foramen magnum.—Small paroccipital processes present.

In these twelve skulls from the Santa Barbara Islands eight were male and four female.—The glabella and supra-orbital ridge are of moderate development, the maximum being 4 mm., six being nil, and an average of six specimens being a little over 3 mm. The degree of inclination of the supra-orbital margin is about 40°.—The average of the sizes of the nasal bone, measured from without, are frontal portion 2 mm., maxillary part 16 mm., and the premaxillary part 4 mm. The length of the radix is 6 mm., being smaller than in any other series, while the salient is the same as in the Seminoles, but longer than in the western continental tribes.—The nasal vestibule showed no example which was macrolophic; five were microlophic, and seven were analoplic (some of the last named were transitional forms to the second), thus demonstrating a lower form of the parts as compared with the other groups. Three retained a small so-called prenasal fossa.—The alveolus was 17 mm. high, being thus higher than in the Seminoles.—The shape of the hard palate was noted in eleven examples, ten of these were hyperbolic and one parabolic. The same proportions obtain in the Seminoles.—The shapes of the choana are also the same: four which are pantamorphic and seven which are broader at the base than at the apex.—The foramen lacerum medium is remarkable for being closed in two, nearly closed in six and distinctly open in three only.—The spinous process of the sphenoid bone is also strikingly different from this process in the other groups, since it overlaps the sphenoido-typanic fissure in two instances only.—All the malar bones possess a suture-trace on the posterior surface. The bone enters into the sphenoid-maxillary fissure in five examples. The marginal process is large in two specimens only.—The temporal ridge is interrupted at the stephanion in two examples. The lambdoidal suture near the asterion is harmonic in three instances.—The sconce had a minimum width of 104 mm., a maximum width of 130 mm., and an average of 117 mm.—The lacrymal bone is small in all (14 mm. x 8 mm.), and absent in two; it joins the maxilla by the hamular process in three instances only.—In no example of the lower jaw did the third molar lie back of the anterior contour of the base of the coronoid process. The mental foramen was never in advance of the second premolar, thus presenting a contrast to the Seminoles. The condyloid process was faceted in all examples.

Résumé.—Dolichocephalic, male two, female one.—Mesaticephalic, male one, female six.—Brachycephalic, male one.—Orthognathous, male two.—Mesognathous, male five, female two.—Prognathous, male two, female one.—Leptorhine, male five, female one.—Mesorhine, male two, female three.—Platyrhine, male two.—Meso-same, male two.—Megaseone, male seven, female two.—Microcephalic, male three, female three.—Mescecephalic, male four, female one.—Megacephalic, male one.

1 L. Carr (l. c.) from a larger number found the "nasal opening" of medium size.
CRANIA FROM THE MOUNDS OF FLORIDA.

III.—Metopism.

The fact that specimen No. 1,781 presents a persistent interfrontal suture leads to a comparison with other specimens of skulls of North American Indians showing a like peculiarity. Authorities agree that this suture is extremely rare in the skulls of modern savages. Rolleston (British Barrows, 1877, 694) refers to the examples known to him at this time, one of an Andaman Islander (Wood Mason), one of an Abyssinian (Zuckerkandl), one from an ancient burial place in Eastern Tennessee (Busk). From among four hundred and sixteen North American crania examined by myself, but three examples (No. 929 Arickaree, No. 730 Seminole, No. 1,264 Lenape) retained the suture, and in all the specimens no artificial deformation existed.

In marked contrast with the above the suture is much more common in the criminal of modern Europe. Ferraz (Arch. d. Psich. e d'Anthrop. criminale, Torino, 1889) claims that in criminals the persistent interfrontal suture is found in 11 per cent of the males and in 9 per cent of the females; yet Ottolenghi and Roncoroni found in one hundred autopsies of criminals the open suture twice only. Lombroso and Ferrero (Das Weib, 286) found in sixty-six female criminals the open frontal suture in twelve instances. According to Corre the character appears in brachycephaly, and may be regarded as indicating inferiority of grade.

Measurements, Table No. 14.

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p Bi-patrotal.

1 L. Carr (U. S. Geological Survey, Wheeler, 1879, 283) found the suture in two per cent of Santa Barbara crania.

2 In view of the rarity of the interfrontal suture in N. A. Indians, it is interesting to note that an example is figured in one of the earliest contributions to craniology, namely Blumenbach's Decades, Pl. IX, where the specimen is named Indi-Amerique septentrionals.
### CRANIA FROM THE MOUNDS OF FLORIDA.

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The descriptions of North American metopic skulls are herewith given:

949 ♀, Arickaree. Aged 21 years.—stenocephalic. Figure 1.
Glabella and supra-orbital ridge not prominent; forehead rounded and full; outer part orbital arch oblique, 40°.—Nasal bones 25 mm. long, paedomorphic, depressed; frontal portion 4 mm. long.—Nasal vestibule macrolophic; incisor eminence none; spinal line trenchant, above level of floor of nose; alveolar line none; premaxillary crest complete, high spine, sharply projecting. Alveolus small.
—Hard palate parabolic, small, not flat. Alveolar process high. Spinous process long, overlapping sphenoido-tympanic suture.
—Petrosa moderately inflated; cerebellar fossa lies below the plane of the occipital condyles. Foramen lacerum medium open.
—Malar bone enters into the sphen-maxillary fissure; marginal process small; suture-trace evident. Mortise seen at post-squamosa. Lambdoidal suture serrated to asterion; small os inca. Temporal ridge scarcely interrupted at stephanion. The post-squamosal portion of the squamosa is open. From these appearances it is concluded that the individual had suffered from otitis media with purulent invasion of the mastoid region. Vertical suture in middle of lachrymal process. The long handle of the malleus fixed to posterior wall of the tympanum.

1,264 ♂, Lenape. Aged 30 years.—stenocephalic. Figure 2.
Glabella small; forehead rounded, full; outer part orbital arch scarcely inclined.
—Nasal bones depressed, paedomorphic. Nasal vestibule analophic; incisor eminence rudimental; ridge to spine discernible. Alveolar line scarcely visible, not marginal to anterior nasal aperture; incisor crest developed posteriorly only; nasal spine single, inter-premaxillary suture carinate; alveolus small.—Hard palate parabolic. Spinous and tympanic processes co-equal, the former not crossing the petroso-sphenoidal fissure; petrosa inflated.—Marginal process of malar bone and temporal crests rudimentary.—Occiput pentagonal.—Skull rests on opisthion. Wormian bones present in lambdoidal suture.—Ossa plana greatly deformed, uneven, with ethmoid cells opening into orbit; bulla ethmoidalis present right and left. Lachrymal bone absent congenitally on right side; lost on left.
730 5, Seminole. Aged 25 years,—stenoecephalic. Figure 3.

Glabella small; forehead slightly receding; outer part orbital arch abruptly inclined.—Nasal bones convex. Nasal vestibule microlophic; incisor eminence conspicuous; alveolar line defective; spine double.—Hard palate deep hyperbolic.—Spinous process large with a wide interval between it and the smaller tympanic process.—Petrosa inflated.—Foramen lacerum medium nearly closed; pterygoid fossa pseudo-morphic, as also is the sphenoido-vomerine junction. Foramen spinosum and foramen ovale almost confluent.—Squamoso-frontal suture present.—Marginal process of malar bone marked; the bone enters into the spheno-maxillary fissure symmetrically.—Skull rests on the condyles. Os incae and numerous Wormians present. Uncinate process in front of well defined bulla; lachrymal bones ossified with maxilla. The right side of nose distinctly the smaller.

In an Araucanian, No. 654, aged 25 years, a persistent interfrontal suture is present. The skull is platycephalic, nose depressed; nasal index 55 mm.; skull length 169 mm., height 123 mm., breadth 135 mm. Nasal vestibule analophic; prognathic, alveolar line trenchant; with shallow hyperbolic hard palate; small os planum and bulla ethmoidalis; Ca. 1,265. This skull differs from the North American specimens in being platycephalic and prognathic; but agrees with Seminole No. 730 and Moore series No. 1,781 in having a hyperbolic hard palate. On the whole it is nearer Leni Lenape, No. 1,264 and Arickaree, No. 949.

While the metopic suture is rarely open, a well marked convexity in the middle line of the frontal bone well up toward the bregma is not uncommon. An example
is seen in Assinaboine, No. 659. It starts at the bregma and is the result of hyperostosis of the interfrontal suture due to exceptional conditions at the anterior fontanelle, and is thus widely separated from typical metopism. In a second group of variations small, flat nodules are seen scattered along the line of the old interfrontal suture, or a ridge may occupy the median line of the forehead in the middle third, as in No. 1,030, Tchutchi. These may be of the same character as metopism so far as the primal character of the defect is concerned; but exact information is lacking on the subject. A second feature of interest relates to the proportion of cranial height to length. The low vertex is notable in all three of the metopic crania.

The frontal bone as it joins the nasal is often the seat of minute transverse, fissure-like lines which suggest that the interfrontal suture has closed under conditions different from those in any other part of the skull. A good example is seen in Tahitian, No. 1,021.

It is impossible to disassociate the ethmoid bone from an active participation in the etiology of metopism. The marked abnormality in the orbital aspects, the irregularity in the lachrymal bones, the wide intervals between the orbits are evidences pointing to this end. The inflated middle turbinals in the Lenni Lenape skull (female) is of no significance, since they are commonly present in the skulls of women.

In all the crania the occiput was of uniform curvature with the sagittal suture; except in No. 1,781, in which specimen the occiput slightly projected from the lambda, and in this respect showed itself to be kin with the other specimens. The Arickaree and Lenape skulls were alike; both of these skulls were from female subjects. The Seminole resembled the foregoing in the general shape of the head, but was more like Floridian, No. 1,781, in the height of the alveolus, the degree of depth of the hard palate, divergence of the dental arches and the bizygomatic diameter. In Arickaree and Lenape the average was 130 mm.; in Seminole and Floridian, No. 1,781, it was 142 mm. The interorbital space was in like manner 23 mm. to 26 mm.; the malar height 40 mm. to 49 mm. Other contrasted measurements suggested themselves, but they may be simply due to sexual peculiarities.

1 The so-called Pithecanthropus erectus Dubois, exhibits this elevation in a marked degree.

51 JOURN. A. N. S. PHILA., VOL. X.
### Measurements of Metopic Crania, Table No. 17.

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* Bi-parietal.

1 Moore Collection.

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* Moore Collection.
The Novel

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**IV. General Considerations: Remarks on the Manner herein Employed of Describing Skulls, together with an Explanation of Terms.**

In this section will be embraced:

1. Novel or unusual measurements. 9. The malar bone.
2. The prominence of the supra-orbital ridge and of chamaprosopy. 10. The lower jaw.
3. The orbit. 11. The norma verticalis.
4. The nasal bones. 12. The norma occipitalis.
5. The nasal chambers. 13. Ontogeny and pedomorphism.
7. The guttural region. 15. The functions determining the form of the skull.
8. The temporal fossa.

1. Inio-opisthion.\(^2\) I have conceived that to take the distance from the opisthion to the inion, or posterior point of the occiput, is useful since it is a more accurate measurement than the transverse occipital arc (which is omitted) and expresses the important fact of the amount of occipital projection quite as well. It is an approximation to the length of the base of the brain in the posterior cerebral fossa. It is of course variable, the maximum in Seminole skulls being 67 mm. and the minimum 44 mm.

\(^2\) Moore Collection.

\(^2\) The measurements of the occipital projection have been taken by craniologists irrespective of attempting to correlate the figures with the length of the posterior cerebral fossa. See Wyman, Cleland, Carr and Turner. The latter writer measures a "perpendicular radius" drawn upward from the auditory meatus and adopts this as a base line.
Crania from the Mounds of Florida.

Basio-opticn. This is the distance from the basion to the optic foramen. It is an approximation to the length of the base of the brain in the middle cerebral fossa; the maximum in Seminole skulls being 61 mm., and the minimum 49 mm.

Optico-nasion. This is the distance from the posterior border of the optic foramen to the nasion, and is an approximation to the base of the brain in the anterior cerebral fossa, and also to the antero-posterior diameter of the face-region at the level of the nasion. Taken with sliding rule it will be observed to be a fairly constant measurement, the maximum in Seminole skulls being 54 mm. and the minimum 49 mm.

Vomero-bregmatic. This is taken between the union of the vomer and basi-sphenoid bones and the bregma. It indicates the point of union of the anterior and posterior frontal segments. When contrasted with the basio-bregmatic it would also show the degree of inclination of the basilar process if it were not that it is a vertical measurement, while the one last named is oblique. Nevertheless the two are naturally to be contrasted, and are thus placed here in parallel columns since they are widely separated in the table.

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Least alisphenoid and bi-exoccipital diameters. These are contrasted in an attempt to place the narrowest part of the norma basilaris alongside of the widest. I exclude here the bi-mastoid diameter as being less exact. The least alisphenoid diameter is taken between the alisphenoids at the union of the ascending with the horizontal limb of the greater wing of the sphenoid bone; the bi-exoccipital between the sutures unifing the exoccipital with the ecto-petrous direct to the inner side of the base of the mastoid process. The differences between these measurements vary remarkably.

Squamosal height. The height of the squamosa is taken from the auricular to the top of the squamosa in order to contrast the Seminole crania with the Moore crania, in which group the squamosa was of low dimensions.

Bi-mastoid diameter. Taken between the tips of the mastoid processes. An unimportant measurement here introduced, not because it is essential, but because it has in a sense become conventionalized.

Palatal measurements. The manner of taking these measurements and the reasons thereon are stated in Section 6.

1 The basio-opticn is the same as the "foramino-optic line" of Cleland. The optico-nasion is the "orbital length" or "frontal depth" of the same writer (see J. Cleland, Phil. Trans., 1869, 117).
Choanal measurements. These are taken with the sliding rule. I have placed importance upon them from the fact that they are found to be exceedingly variable.

Malar widths. The upper malar width is the length of the malo-frontal union in the orbit, the lower is the distance from the free border of the orbit to the spheno-maxillary fissure. They are taken with the sliding rule. Malar widths indicate the great variation in the degree that the bone enters into the composition of the orbito-temporal septum (outer wall of orbit).

Width of external pterygoid plate. This is taken with sliding rule from the border of the plate to the bottom of the pterygoid fossa. The measurement is valuable in recording the extraordinary differences in the size of the plate.

Length of pyramidal process. This is taken from the union of the process with the internal pterygoid plate to the tip of the process. The contrasts in the length are striking (see p. 368.)

(2). The prominence of the supra-orbital ridge and of chamaeprosopy. In Blumenbach Decades (markedly in Pl. XXXVIII, America, Illinois, and in less degree Pl. IX, Indi-America), one notes the prominence of the glabella and the superciliary ridges.—Wilson claims to have been the first to observe this prominence of the superciliary ridges in the crania of North American Indians. It is not mentioned by Morton. From a list of seven skulls in Meig's catalogue exhibiting the peculiarity, one only is that of a North American Indian, namely, the skull (No. 1,512) from the Scioto Mound cited by Wilson (I. c.).—G. Busk refers to a skull of a Tennessee aborigine in which the “supra-orbital prominence” is “most marked.” The skull is note-worthy also for the retention of the interfrontal suture.—R. Virchow, out of eleven skulls from North America, describes the swelling in two only. The reference is scant and occurs in the text without comment.—Thus, while Wilson detects the prominent ridge as not infrequent in North American crania, Morton is silent on the subject, and Meigs alludes to it incidentally only and finds it at least as frequent in other races. Wilson's attitude is probably due to the discovery of the Neanderthal skull in 1857, in which the supra-orbital ridges are of enormous size, and led craniologists to identify the character in extant varieties of man. Schaafhausen, after describing the Neanderthal specimen, sought for this ridge in other crania. Wilson and Busk were probably led to make similar observations. Schaafhausen concludes, since the “prominence of the supra-orbital region occurs most frequently in the crania of barbarous and especially of northern races, to some of which a high antiquity must be assigned, it may be fairly supposed that a conforma-
tion of this kind represents the faint vestiges of a primitive type.” The occurrence of the prominent ridges in the crania of North American Indians is much more frequent than one would suppose from the above statements. It is indeed a common

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1 Prehistoric Man, 1862, II, 266.
2 Crania Americana.
3 The others are as follows: Celt, Norwegian, Finn, Calmuck, Esquimaux.
5 Crania Ethnica Americana, 1892.
6 Müller's Archiv, 1838, 453.
CRANIA FROM THE MOUNDS OF FLORIDA.

character. It is present in all the male skulls of the Moore series. Nos. 456, 1,556, 732 of the Seminole series exhibit it, and it is typically seen in No. 15, Huron, (figs. 10 and 11, p. 414). In the collection of North American crania in the College of Physicians and Surgeons, New York, it exists in the skull of a Pawnee, a Sioux, an Ontario Mound Indian, an Absaroka, a Californian "Digger" and an Alaskan. It is more prevalent in the Mound specimens than in those derived from other sources, and, in so far as this character is concerned, the Moore series crania resemble these Indians.

The symmetrical swellings over the brow in the Neanderthal skull are as marked at the outer part of the curve of the superior margin of the orbit as they are at the inner. In the skulls of North American Indians, on the other hand, the swelling is continuous with the prominent glabella and ends abruptly at the position of the supra-orbital notch. The appearance is distinctly seen in Pl. LIII of this essay, and Pl. LVIII, and less distinctly in Pl. XLIX. A peculiar frowning expression is given to the front of the skull in such specimens.

The prominent ridge, in examples already cited from the Moore series, is associated with depressed, rather broad nasal bones. In this respect they are strongly contrasted with the nasals in some other Indian skulls. I note in this connection No. 15, Huron, which closely resembles No. 1,781, Moore series (see figs. 10 and 11), the supra-orbital ridge, the depressed nose-bridge, the bimalar diameter and the least facial diameter being essentially the same. The Huron skull is narrower at the minimum frontal diameter, and the basi-nasal length is greater. So the usual harmony between the basi-nasal length and the other measurement here given is not noticeable. The nasal index is practically the same, being 44 for the Floridian and 45 for the Huron.
CRANIA FROM THE MOUNDS OF FLORIDA.

In marked contrast to the foregoing are the skulls which exhibit rounded foreheads and scarcely discernible frontal ridges. Together with this peculiarity the face is inclined to chamæproscopy. Thus in an Assinaboine (fig. 4) the alveolar height measures but 15 mm. The incisor eminence is small, but the ridge to the nasal spine is marked, as is also the alveolar line. The hard palate is parabolic and shallow. The foramen lacerum medium is almost closed, and the sphenoidotympanic fissure is not overlapped by the spinous process.

In No. 1,815, Santa Barbara (fig. 5), a striking example is seen of a cymbecephalic skull with convex forehead without prominent ridges, small narrow malar bone and rudimental lachrymal bones. The nasals are sharply arched, the margins of the anterior nasal aperture not expanded and the alveolus small.

Chamæproscopy is rare in North American Indians. For this reason three examples are shown for comparison with the prevalent type of leptoproscopy as illustrated in the Moore series. Remarkable contrasts are seen between the Moore series and all of the four crania.—No. 40, fig. 6, 418 Lenape, fig. 7, and 1,002 Otomie, figs. 8 and 9. Each of these specimens exhibits a depressed nasal bridge, ascending process of the maxilla nearly at right angles with the inner wall of the orbits, an expanded anterior nasal aperture, a rudimental alveolar line; the spine, incisor crest and eminence are small (analophic). The glabella and supra-orbital ridges vary, being almost absent in No. 40, but prominent in Nos. 418 and 1,002.
The alveolus is high in No. 40, but medium in No. 418 and No. 1,002. In the specimen last named, which is the most interesting skull of the series, the nasal bones do not reach the line of the anterior nasal spine. Nos. 40 and 1,002 are cymbecephalic, while No. 418 is stenocephalic.
The external nose in a skull of a Crow Indian, No. 1,228, Absaroka, fig. 12, is extraordinarily different from those of the Moore series. The arch of the nasal bones is high and compressed. The ascending process of the maxilla is parallel to the inner wall of the orbit. The distal part of the figure of the conjoined nasal bones is convex, in firm contact with the perpendicular plate of the ethmoid bone, which projects beyond the lumen of the anterior nasal aperture. The glabella and supra-orbital ridges are as in specimens Nos. 1,781, 1,782, 1,784, Moore series. The incisor eminence, the alveolar line, the incisor crest and anterior nasal spine are marked. The skull is platycephalic with moderately pseudomorphic occiput and enormous transverse torus. The contrast between No. 1,227 Blackfoot, Kootenay fig. 13, and any of the Moore series is seen in the rudimental glabellar, convexity at the nasal salient. The distal end projects beyond the line of the anterior nasal spine, though in less degree than in No. 1,228, Absaroka. The incisor eminence is marked, the alveolar line nil. The incisor crest and spine large. The skull is phoxocephalic.

(3). The orbit. The superior margin of the orbit is described as the orbital arch in text books. In truth it is rarely an arch. In this essay it will be assumed that an oblique line is present, which extends from the supra-orbital notch to the end of the external lateral process, and which constitutes the outer part of the orbital arch, and that the curved surface answering to the space from the same notch to the end of the internal angular process is the inner part of the orbital arch. The two parts are distinct in range of variation and in morphological significance. The inner part is found in all mammals, while the outer part is confined to the relatively few genera in which the orbit is limited,
in the main, by a process of the frontal bone (external lateral process), and which separates the orbit from the temporal fossa. The outer part of the orbital arch is much inclined downward and outward in leptoprosopic, and is nearly horizontal in chamaeprosopic crania. The shades of distinction in specimens are so numerous, however, that they should constitute part of the description in many skulls.

The theorem of a stout supra-orbital ridge being associated with a high degree of muscular power in the individual has been maintained by Schaafhausen. But I have inferred that no direct correlation can exist between factors so far removed from one another.

The inner orbital wall relates to the ethmoid bone, the lachrymal bone and thus directly to the nasal chamber; the outer wall to the temporal fossa, while the lower is described with the maxilla. The difficulties acknowledged in measuring the orbit arise from the slight morphological value of the region itself.

(4.) *The nasal bones* when seen in situ will be treated as though they were composed of three parts: the frontal, the maxillary and the premaxillary. As the names indicate, these are defined by the bones with which they are in association. The frontal part is measured from a point on the lateral margin answering to the tip of the ascending process of the maxilla to the proximal end of the nasal bone; the maxillary, from the tip of the ascending process of the maxilla to the beginning of the premaxillary portion; and the part last named, to the lateral margin of the nasal bone as it lies in contact with the ascending limb of the premaxilla (see next section). The suture at the lateral margin of the nasal bone is abruptly changed in character as it approaches the distal end. It is often marked by nodosities; and the ascending limb of the premaxilla is distinguished by the arrangement of vessel-grooves, which in all probability are in line of the primal maxillo-premaxillary suture.

The nasal bones can also be divided, for the purpose of obtaining degrees of deviation, from the vertical, into two parts, the *radix* and the *salient*. The radix is that portion not in contact with the nasal mucous membrane, but in articulation with the frontal and ethmoid bones. The salient is in contact with the nasal mucous membrane, and extends from the ethmoidal afix to the free margin. The distinction between the two parts can be easily determined by inspection of the nasal chamber, and by the change in the internasal suture line, on the exterior. The lengths of both radix and salient are recorded in the descriptions, together with deviations taken by a protractor in degrees from the vertical.

The ascending process of the maxilla, as a rule, is inclined; that is to say, with anterior surfaces which are diagonal between a plane answering nearly to the production of the inner wall of the orbit, and one which is at right angles to it. As variations we find the process quite in the same line with the inner wall of the orbit. The nasal bones are acutely arched, and the nose is leptorhine. When the process is at right angles to the inner wall of the orbit the nasal bones are not acutely arched but are flat, the nose is platyrhine. In the group last named the nose is changed in shape, as though (the parts being easily moulded) a rounded
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It is interesting to find the nasal chambers occasionally asymmetrical when the septum is straight. I have detected out of 1,904 crania, 51 examples of such asymmetry. In 29 specimens, the left side was the smaller, and the right in 22. Of race peculiarities it is noted that 27 out of 1,750 specimens were from savage or semi-civilized people not European, while 24 out of 150 specimens were of European origin. It is thus seen that asymmetry without septal deviation is more frequent in civilized than in aboriginal races.

It is important to note variations in the details of the ethmoid and lachrymal bones since these are numerous and appear to constitute a group independent of those which are met with elsewhere in the face.\(^1\)

Owing to the fact that the interior of the nose is often mutilated in crania selected for examination, the ethmoid and lachrymal bones are in practice of restricted value. But they should, when practicable, be included in the description of every skull. The ethmoid cells doubtless correlate with the disposition for the bones of the face, including the sphenoid bone and the zygomatic process of the temporal bone, to become inflated. The bulla ethmoidalis represents the amount of downward inflation of the anterior ethmoid cells. The position of the bulla is largely determined by the size of the lachrymal bones. When the bones are small the cells are apt to occupy a position nearer the front of the nasal chamber than when they are large. An interesting harmony exists between the size and position of the bulla, the lachrymal bones, and the width between the eyes. In specimen No. 556, Mexico, the parts appear to be of large size as the result of an injury. The lower part of the forehead (including the glabella and supra-orbital ridges), the nasal bones, and the ascending processes of the maxilla had been driven in by a blow. The parts were firmly healed and probably were independent of the cause of death, since the skull had been picked up on the battle-field of San Jacinto. The lachrymal bones were reduced to rudiments and the bulla large. The immense increase of the inter-orbital space had in this instance been followed by compensatory expansion of the anterior ethmoid cells. The association of the small lachrymal bones with the other factors is most likely coincidental. It is diffi-

\(^1\) The interorbital space may be said to agree in a measure with the development of the ethmoid bone. In Man the interorbital width being 30 mm., and the length of the skull 178 mm., gives an index of 52 mm. In \textit{Hyicus} the width being 53 mm., and the length of skull being 245 mm., gives an index of 22 mm.
cult to account for the absorption of the bones as a result of the accident. After noting the increased width between the orbits and the depression of the nasal bones, the nasal chambers should be inspected through the choanae. As a rule the middle turbinal will then be seen to be set well off on the outer side of the chamber and to retain a large bulla.

The region of the anterior nasal aperture demands a few words. I shall name it in this essay the nasal vestibule, since it enters into the composition of the floor. I propose calling the rounded elevation on the floor in advance of the incisor foramina the incisor eminence. The continuation of the lateral margin of the anterior nasal aperture to the anterior nasal spine becomes the basal marginal line, but since it always defines the alveolus superiorly, I have ventured to call it the alveolar line. Should a so-called prenasal fossa be present it lies between the incisor eminence and the alveolar line. Both the incisor eminence and alveolar line are, as a rule, complementary of one another. Extending from each to the incisor crest or anterior nasal spine delicate ridges are often found.

The measurements of the ascending and horizontal limbs at the nasal vestibule afford interesting characters. In Man and the apes the ascending limb is early united with the maxilla. Yet its position can be closely approximated by measuring the height of the side of the anterior nasal aperture. The horizontal limb is the inferior border of the aperture, and when the skull is seen in profile the forward extension of the crest of the premaxilla can be measured by the degree that it projects from this line. As is known, this region of the skull is exceedingly variable and accurate method is needed by which it can be studied.

Topinard recognizes three types of conformation of the anterior nasal aperture (here called the nasal vestibule): one in the form of the figure of the heart on the playing card, instanced in European races; one with blunt border, base spread out and with absence of nasal spine, instanced in African races; one with two digital depressions, instanced in the Chinese. Welcker proposes the term pteleiform (clni-leaf like) opening for extreme variations of No. 1 of Topinard. The word is peculiarly apt, for the asymmetry of the anterior nasal aperture as seen in many modern European skulls and those of ancient Etruria, is precisely like

1 That the incisive portion of the superior maxilla is homologous with the premaxilla of quadrupeds is a statement so well sustained that it often comes convenient to use the term in description. The incisor crest might become without violence the premaxillary crest, the margin of the vestibule that lies below the nasal bone is said to be composed of the premaxilla, and the premaxilla may be said to have an ascending or nasal limb, and a horizontal or incisor limb. These terms are available in descriptions of the human skull.

2 In Simia the floor of the vestibule is flat; in Gorilla it is greatly raised at the incisor eminence and inclines gradually toward the alveoli, which is without a limiting line; in Anthropopithecus the incisor eminence is rudimental, but the highest point of the floor is anteriorly near the small alveolar line and declines abruptly downward and backward to the incisive foramina; in Hylobates the floor is much the same as in the last-named genus, but the sides form oblique thickened borders, giving characters which are quite different in kind from those seen in other apes of the group. In no ape is the spine or incisor crest developed, but so far as the other features of the floor are concerned the variation of the vestibule can be considered to be atavistic.

3 L'Anthropologie, 1876, 227.
that of a leaf of *Ulmus montana*, even in the detail of inequality of the basal curves. G. Mingazzini\(^1\) terms the first type of Topinard the *forma anthropina*; the second, the *forma infantilis*; and the third, the *forma prenasalis*. A fourth type is suggested also by him, namely the *forma nasoalveolaris*, which answers to the characters noted in *Gorilla*, i.e., one in which the highest point of the floor of the nasal chamber in advance of the anterior palatal foramen is also the one which is most posterior, the alveolar line being absent. This author gives the name of *margo limitans* to the line called by myself the alveolar line. I have often noted that a *margo limitans* is composed of symmetrical ridges extending obliquely forward from the incisor eminence. As to the so-called fossa prenasalis, I believe that there is nothing to show that this fossa is ever in advance of the nasal chamber. The depression invariably lies between the incisor eminence and the alveolar line. The alveolar height is always low when the fossa is well defined. T. Dwight\(^2\) accepts the term *fossa prenasalis*, but observes in the description of an example in a Sandwich Island cranium that the "anterior lines are distinctly the continuations of the lateral borders of the nasal opening."

I venture to propose yet another classification of the varieties of the anterior nasal aperture. It is based upon the extent to which the incisor crest is developed. If the crest is conspicuously high the alveolar line is always trenchant; if the crest is low the alveolar line is never trenchant; indeed, is often absent. A third variety is met with (a retention of the infantile form) in which the crest is confined to the posterior part of the floor of the nares, when it is fixed to the vomer. The terms *macrolophic*, *microlophic* and *analophic* are available in naming these groups. While the *macrolophic* is synonymous with heartshape form of Topinard, the pteleiform of Weleker, or the *forma anthropina* of Mingazzini; and the *analophic* with the *forma infantilis* of the author last named, no word is at hand for the group of the microlophic unless we use the awkward term No. 2 of Topinard. No attempts at classification have yielded adjectives which are of a common origin and which can be uniformly employed. Besides it is highly probable that the variations in the shape of the floor of the nares are dependant upon the degree of development of the incisor crest, and it is accepted that the crest itself is of generic significance since none of the anthropoid apes possess a like structure. The variations in a generic character, it is justly assumed, may be of value in studying and naming anatomical varieties. The classification is based on ontogeny, but it must not be forgotten that while the analophic variety is also paedomorphic, it embraces the phylogenetic variety for the reason already given, viz.: that no anthropoid form possesses an incisor crest. This consideration does not in itself give us a strong foothold on atavism since the man-like apes are themselves highly specialized, and, in point of fact, the nasal vestibule in *Gorilla* alone resembles a variety met with in the group of the analophi.

The microlophic group is the most complex since it embraces those with a high

\(^1\) Arch. f. Anthrop., 1891, 176.
as well as those with a low incisor eminence. If the former condition persists the variety with the so-called prenasal fossa is defined: if the latter, oblique ridges extend forward from the low incisor eminence to the anterior nasal spine and in varying degrees characterize the floor of the vestibule. In an ethnic sense it is noted how predominantly the macrolophi appear in the higher, especially the European form, and the microlophi in the American Indian.

(6) The hard palate. All things remaining the same the U-shaped hard palate is the most efficient. The curving in of the posterior ends, or the diverging of the sides of the arch are without perceptible advantage. Broca in claiming that this divergent, or hyperbolic variation is highest, doubtless means that it is found in the highest people (i.e. the most intellectually advanced races), and not that it constitutes the best mechanical arrangement.

I am led to make two transverse diameters of the hard palate, one between the premolars, and one opposite the second molar. Duckworth takes the anterior width at a point between the canine and the first premolar. It is commonly so taken. I prefer estimating the anterior diameter at a point between the premolars. Where two premolars are alone present in a given dental series the second tooth tends to remain in close mechanical relation with the first molar; this throws the first premolar in almost equal apposition to the canine. The interval between the premolars appears to be a good neutral space, furnishing a favorable point for mensuration. The inclination downward and forward of the hard palate begins at a line which, drawn transversely, will intersect the dental arch between the premolars, and not between the first premolar and the canine. In the lower jaw the inclination of the two premolars is often opposed,—the first tooth being directed obliquely inward and forward and the second inward and backward.

1 The details of the nasal vestibule as seen in figures of Blumenbach’s Decades are worthy of being noted at this place. Incisor eminence with alveolar crest and bidental nasal spine, Pl. III, Asiatic. Large nasal spine profile, Pl. VIII, Aethiop; Pl. XII, Tatar. No nasal spine, high, convex alveolus, Pl. X, Carib. Carinated inter-premaxillary suture at alveolus, Pl. XVII, Aethiop; Pl. XXXIV, Ind; Pl. XXXVII, Greenland q; Pl. XLIII, Lapp q; Pl. LX, Bali boy; Pl. LXII, Kamtschada. High premaxillary crest, large spine, high maxillary spine, Pl. XLVI, Atar. Perpendicular plate produced so as to divide anterior nasal aperture into two parts, Pl. LVI, Mulatto. Alveolar line produced as in modern skulls, alveolar suture open, premaxillary crest high, Pl. LVII, Croat q. High alveolus, Pl. LVIII, Betocodi. Alveolar produced, Pl. LIX, Macassar boy.

Great differences are noted between the alveolar arches in respect of the depth of the transverse arch of the palate. As a rule the hyperbolic form is associated with high alveolar arches; and a disposition in the premaxillary portion of the palate to be thickened so that the depth of the alveolus back of the incisor and canine teeth is not much less than it is at the premolars and the molars. The palate being deep directly behind the incisors, compels these teeth to become vertical; on the other hand, the palate being shallow back of the incisors compels them to assume an oblique position (outward and downward). Thus phases of orthognathism and prognathism are established, and a reason sustained for measuring the height of the alveolar processes.

The palate exhibits in the middle line a tendency in the bones to be hyperostosed. This eminence has received the name of the *torus palatinus*. I have ventured to define two of these ridges which I name the *pre-torus* and the *post-torus*. The *pre-torus* is confined to the hard palate midway between the point of the premolars and the incisive foramen. The *post-torus* answers to the ridge as named by anatomists and is seen on the hard palate from a point midway between the premolars to the end or near the end of the horizontal palatine processes. In No. 1,261, New Hollander, the two ridges are fused, but this is infrequently the case. The *pre-torus* is more commonly absent than the *post-torus*, and both are more common in females than in males. The *torus palatinus* is often seen in Esquimaux crania, is frequent in Sandwich Islanders, while not rare in North American Indians.

(7). The guttural region. The main points of interest of the *norma basilaris* relate to the guttural region, namely, that at the pterygoid processes and extending thence backward to include the *pars petrosa*.

Four subjects are here presented for consideration: (a) the pterygoid and pyramidal processes; (b) the degree of inflation of the petrosa; (c) the foramen lacerum medium; (d) the line of the petro-sphenoidal fissure and squamoso-typanic suture.

(a). The pterygoid and pyramidal processes are of interest from the fact that the degree of depth of the pterygoid fossa, the length of the external pterygoid plate, the length of the pyramidal process of the palatal bone are exceedingly variable. The assumption is made that since these characters are of value in taxonomy that the variations seen to take place in man may be useful. Two main types can be distinguished, namely, one in which the fossa is shallow, the pterygoid plates not extending and the pyramidal process small and blunt. This is the phase seen in immature skulls and is doubtless, when met with in mature forms, an example of pedomorphism (see p. 368) for lengths of pyramidal processes. The other type of fossa, in opposition to the foregoing, is deep, with a wide external pterygoid plate and a long pyramidal process. In its marked form it leads to the junction of the external pterygoid plate and the spinous process, and to the creation of the *pterygo-spinosal foramen*. The spinous process, as a rule, uniting in a conspicuous

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1 The pterygo-spinosal is the same as sphenopterygoid foramen of writers. The term sphenopterygoid is without significance. A figure in illustration is given by W. Matthews, "The Human Bones of the Hemenway Collection in the U. S. A. Med. Mus., Memoirs Nat. Acad. of Sciences, 7th Memoir."
manner with the *tegmen tympania* gives the impression that the whole constitutes an important osseous septum which separates the temporal and zygomatic fossae from the pharynx and is morphologically of a significance similar to that by which the outer wall of the orbit becomes a septum separating the orbit from the temporal fossa.¹

(b). The degree of inflation of the *pars petrosa* on the posterior surfaces where they abut against the basilar process is always noted since it does not exist in the skulls of the anthropoid apes, and is often absent in the skull of the lower types of man. Whenever it occurs it may be said to be an abrupt departure from pedomorphic conditions. The inflated petrosa signifies that as the skull increases in transverse diameter (especially at its base) the petrosa tends to separate from the basi-occipital and the basi-sphenoid bones, the inflation in a degree representing the compensatory effort to occupy the space which would be thereby created. Inflations are apt to be found in skulls in which the foramina lacerica are wide. It must be remembered that the petrosa are never organically associated with either the occipital or sphenoid bones, and if it were not for the union with the squamosal and tympanic elements, would fall away from the skull in maceration as in the Cetacea and in many genera of Chiroptera.

(c). The foramen lacerum medium in *Simia* is closed between the petrosa and the sphenoid, at a point answering to the Eustachian groove (lateral portion), but open between the petrosa and the side of the basi-sphenoid (median portion). In *Anthropopithecus, Gorilla* and *Hylobates* the foramen is closed throughout. Hence the opening is clearly composed of a median and a lateral part. Its peculiarities should be noted in the description of every skull.

(d). The *sphenoido-tympanic fissure and suture*. The line indicated in the above title is nearly straight, with a disposition to be interrupted by the spinous process of the sphenoid bone, and for the oval and spinous foramina to approach or be merged in the fissure. When the process crosses the line it is described as overlapping. When the spinous process is large it is apt to be associated with the pterygo-sinous union. In all examples it evinces a disposition to extend outward and effect a junction with the tegmen tympani at or near the end of the sphenoido-squamosal suture.²

¹The significance of the external pterygoid plate is that of an osified intermuscular septum between the pterygoid muscles. It answers, in a way, to the power of these muscles since they can act with better advantage having origin from a bony septum than from a fibrous one. We expect also to find that a large external pterygoid process harmonizes with a high, wide ascending ramus to the lower jaw. In the description of the lower jaw and of the pterygoid processes these two factors should be associated. In like manner the pyramidal process of the palate bone extends a variable distance along the inferior border of the external pterygoid plate. The extent of this process harmonizes with the width of the plate.

²It is of interest to ascertain the changes which these characters undergo in the anthropoid apes. In *Simia* the spinous process is absent and the oval foramen is almost in the sphenoido-petrosal fissure; the sphenoido-tympanic suture is without visible tegmen in the adult; in the young, however, the tegmen is seen. The inner border of the gelenoid cavity is not produced below the level of the sphenoid bone. No trace of an opening answering to the foramen spinosum is present, the middle meningeal artery probably passing through the large oval foramen. In *Anthropopithecus* spinous the
The approaches 8
The temporal fossa is of importance in determining the shape of the skull. I venture to divide the crest answering to the limits of the temporal muscle impression into two parts,—the fronto-temporal and the parieto-temporal. The fronto-temporal part lies on the frontal bone, and extends from the end of the external angular process to the stephanion. The parieto-temporal part lies on the parietal bone and extends from the stephanion backward, curving down to or near the asterion. In muscular individuals, particularly in males, both parts are well defined. The fronto-parietal part is rugose and even spinose, when the other is faintly expressed. Sometimes a sharp spicule of bone is directed downward. The crest is often abruptly united with the parieto-temporal at the stephanion,—the beginning of the last-named curve being high on the side of the cranium as though separated from the fronto-temporal by a "fault," to use a term borrowed from geology.—The surface of the posterior part of the temporal fossa exhibits a peculiar texture. The bone is smooth and often porcellaneous. It is apt to be raised above the level of the lambdoidal suture, which shows for a short distance from the asterion a serrated appearance where the superior curved occipital line comes in contact with that region of the human skull which is comparable to the occipital crest of the lower mammals. The lambdoidal suture as it approaches the asterion becomes harmonic in many examples. The frequency with which this change is correlated with interruptions between the frontal and temporal portions of the temporal crest is noted, and constitutes an essential feature in the descriptions of skulls in this essay. The parieto-temporal crest as it approaches the lambdoidal suture is often defined by a Wormian bone, thus suggesting in an interesting manner that these structures are associated with the boundary lines of muscle-impressions. The Wormians appear to represent the consequences of compensation in rates of growth of bones. They are fines imposed by nature for neglect. I infer that these results of neglect may be exemplified in aborted or delayed rates of growth of the more important elements.

The squamosa and the so-called mastoid portion of the temporal bone (as seen in articulation with the sphenoid, parietal and occipital bones), have been the subject of special consideration. The pars squamosa is divided into the pre-squamosal and the post-squamosal portions. The pre-squamosal portion includes all of the temporal bone which is seen in the norma lateralis in advance of the posterior border of the auditory meatus. The post-squamosal portion is here reserved for that part of the process is present but in a rudimentary form and is exceeded in size by the tubercle answering to the inner border of the glenoïd cavity. The spinous process lies to the inner border of the tympanic bone. The tegmen tympani is distinctly seen in the adult. A small opening in the position of the foramen spinosum is evident, the foramen ovale being small and round. In Gorilla the parts are as in Anthropo-pithecos; the foramen spinosum, however, being larger. In Hylobates the parts are the same as in pedomorphic forms in Man. The inner border of the glenoïd cavity is without tubercle. The foramen spinosum is evident. Thus Hylobates more closely resembles Man at the petrosal part of the guttural region than does any other anthropoid ape. 1 The author is not unmindful of Albrecht's proposition to divide the squamosa on the norma basilaris into pre-tympanic and post-tympanic portions. The above division is thought to be preferable, since the parts are of the squamosa alone,—thus being independent of other cranial elements, besides which the parts directly over the tympanic bone remain by Albrecht's scheme unaccounted for.

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33 JOURN. A. N. S. PHILA., VOL. X.
squamosa which lies back of the auditory meatus. The temporal bone back of the post-squamosa is here denominated the *ecto-petrosal* portion.\(^1\)

The mastoid region as usually outlined thus disappears and in its place two subregions are named for the temporal bone back of the auditory meatus, namely, the post-squamosal and the ecto-petrosal portions. The remains of the suture between the two is often defined.—In the ecto-petrosal portion near the line of union with the parietal, the temporal bone is relatively thin and resembles that elsewhere seen in the cranial vault. The outer surface is distinguished by grooves for veins, the intervals between them being often speculate. These vein-tracks are deep, closely aggregated and since they present an appearance as though the surface was worm-eaten, I have used the word *serpiginous* in describing this portion of the skull. The entire region lies well on the *norma lateralis* in the dolicocephalic, but is carried round to the *norma occipitalis* in the brachycephalic skulls. The suture between the post-squamosal and the ecto-petrosal portions reaches the upper border of the bone.

In a general way it may be said that the line of junction of the temporal elements with the posterior-inferior angle of the parietal bone is made up as follows: the anterior one-fourth is post-squamosal and the posterior three-fourths are ecto-petrosal. The divisions of the *pars squamosa*, as a rule, unite abruptly, but they may pass into one another without "break" when the squamosa is said to be *inclined*.

Since the line of junction of the post-squamosal portion with the parietal bone is also the crest of the endo-petrosal portion as it abuts against the base of the cranial vault (a correlation which can be easily determined by the finger passed within the foramen magnum), the precise relations of the post-squamosal with the ecto-petrosal can be determined in the skull at any age. It is occasionally indicated by a bold process of the parietal which in this essay is called the *mortise*. I have ascertained that in a fragment of any skull in which the zygoma, the post-squamosal and the ecto-petrosal are destroyed, the horizontal plane of the skull can be established by taking the point above named as one factor and the line of the impression of the external pterygoid muscle on the angle of union between the ascending and horizontal limb of the alisphenoid (infra-temporal crest), as the other.\(^2\)

The variations in the squamosa, especially those seen in the transition from childhood to maturity, are sometimes marked. I have, therefore, measured the height, taking the distance from the post-zygomatic ridge at the mid-point over the external auditory meatus to the highest part of the parieto-squamosal suture.

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1. Huxley proposed a scheme of periotic bones for vertebrates in which he identified a pre-otic, an epi-otic and an opisthotic element. These identifications have not been sustained (see H. C. Chapman, Proc. Acad. Nat. Sci., Phila., 1894). The word periotic is definite enough and is synonymous with *pars petrosa*, since it is found that this element in the immature bone reaches the periphery in the lower part of the squamo-occipital interval. But in human anatomy the bony cochlea and semi-circular canals become invested with a specially compact bone of pyramidal form whose base is adjusted to the side of the skull in an abrupt and definite manner. The peripheral extension is here called the ecto-petrosal, since a name is needed in an attempt to displace, at least in morphological studies, the incongruous "mastoid."

It will be observed that the word “mastoid” is eliminated. In a morphological sense this is consistent. But in the anatomy needed in practical medicine the separation of the mastoid process, as above proposed, does not present advantages which are sufficient for the desertion of old landmarks. According to B. A. Randall it is true that the mastoid cells may be confined to what is here called the post-squamosal portion, while the ecto-petrosal remains diploetic, a condition which harmonizes morphologically with clinical considerations. But in many instances the cells of the mastoid which communicate with the tympanic chamber are not confined to the post-squamosal part, but range freely into the ecto-petrosal and, according to Hyrtl, may reach even to the pneumatic cells of the occipital bone.

The clinician, however, acknowledges that the word “mastoid” and its subdivisions are not in all respects satisfactory. The “mastoid region” and the “mastoid process” are vaguely defined: the mastoid region being an anatomical residuum accounted for after the conventional description of the squamosal and petrous portions of the bone is completed. The word “petro-mastoid” is sometimes reserved for that which in this text is called ecto-petrosal.—In Quinn's Anatomy it is stated that the ridge limiting the temporal fossa inferiorly back and above the external auditory meatus becomes the supra-mastoid ridge (linea temporalis, temporal ridge). This attempt to define the upward limit of the mastoid process is inadequate, since it leaves the region called in this memoir the serpiginous portion still undescribed. Macalister calls the entire mastoid region “the base of the petrous portion,” which again does not account for the serpiginous portion, for this is in the cranial parietes above the pars petrosa.

(9). **The malar bone.** The malar bone, serving as it does to separate the orbit from the temporal fossa, is one of the most important elements of the primate skull. Assuming that the main object in creating an orbito-temporal septum is to give increased resistance to the upper molars in the attrition of food, the bone should be considered as part of a group of appearances which embrace the upper and lower maxilla. The origin of the masseter muscle on the bone is the next most important factor leading to variation along its lower border. The marginal process varies exceedingly in form and size, and these peculiarities should be noted; it presents one of the best characters for sex, being large in males and small or absent in females.—The bi-partite malar is so infrequently present that each instance when noted should be carefully recorded. From the collection of the Academy it would appear that the examples of bi-partite malar can be grouped as follows: (a) An ossicle lying in the zygomatic arch at the malar-zygomatic suture. Fig. 15, a, b, c, d. In the four examples (Nos. 1, 556, 5, 1305 and 1,442), three were placed at the upper border of the arch and one at the lower. (b) An ossicle occupying the lower part of the malar bone its entire length. Of this peculiarity two examples are herewith given: Nos. 83 and 1,225, figs. 16 and 17; also fig. 10, Huron, p. 414.

2 10th Ed., 1890.
3 Human Anatomy, 1889, 222.
Rudiments of a suture-line, which, if complete, would divide the bone, are numerous. Kopernitzky, out of sixty-one Ainòs skulls, found the traces of the suture in fifty per cent. Tarenetzky\(^1\) states that in a series of seventy-seven Ainòs skulls collated from the papers of many writers, three examples (4 per cent) of bi-partite malars and thirty-nine (50 per cent) with persistent inner suture-trace were seen. Dönitz\(^2\) found in Japanese skulls a complete bi-partitism in 9 per cent and the suture-trace in 20 per cent. Virchow\(^3\) has examined the crania of many races with reference to the suture-traces in the malar bone. I have commented on the rarity of the bi-partite malar bone in the North American Indian.\(^4\)

In fig. 18 a fissure is seen extending from the middle of the malar-zygomatic suture forward toward the maxilla. This is figured as an illustration of a line which on the whole is not rare. A yet more common appearance and one which indicates the tendency for lower part of the malar bone to separate from the upper is seen by the inspection of the inner surface. Here a groove is ordinarily seen in the American Indian passing from behind forward.

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\(^1\) Kopernitzky, ibid., p. 40.


\(^3\) Tener Lecture, Smithsonian Inst., 1889.

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Fig. 15.—Examples of supplemental ossicles at the malar-zygomatic suture. \(a, c, 1,556; b, d, 1,305; e, 1,442.\)

Fig. 16.—No. 1,225, showing bi-partite malar bone.

Fig. 17.—No. 83, showing bi-partite malar bone.

Fig. 18.—No. 1,689, malar bone, showing a suture-trace extending forward from the malar-zygomatic suture. It is thought to represent the first stage of the process leading to the formation of the bi-partite malar.
from the zygoma to the maxilla exactly in the position of the suture in the true bi-partite malar. It varies exceedingly in length owing to the degree which the malar process of the maxilla and the zygomatic process of the temporal bones approach each other.

The least height of the malar bone lies distinctly back of the maxillo-maxillary suture. A tendency exists in the bone to be low at this place (as compared with the greatest height) in skulls which retain a lower jaw with broad ramus, a short body and whose alveolar and basal borders are nearly parallel.

(10). The lower jaw. There is no bone in the body whose shape is so variable in different periods of life, and which is so dependent upon the form, position and number of the teeth, as is the lower jaw. It is impossible to harmonize these variations with the important work assigned the bone. But the very intricacy of the subject makes it of interest, and will, I trust, warrant the somewhat extended comment I shall make.

The description of the bone will include in addition to the characters accepted as useful the following: (a) The molar ridge and alveolar hyperostoses on the lingual aspect of the ramus. (b) The parallelism between the alveolar and basal borders of the ramus. (c) The relation of the third molar to the base of the coronoid process. (d) The deflection of the angle of the jaw, whether inward or outward. (e) The shape of the condylar process. (f) The position of the mental foramen with reference to the teeth.

(a). The mylo-hyoid ridge is described by Quain as "beginning below the mental spines and passing backward and upward to the ramus." I note that a prominent ridge begins opposite the first molar and ends a little back of the third molar, and that the space between the mental spines and the first molar is marked by a low smooth rounded eminence entirely distinct from the ridge. The two characters are not connected in any important way and certainly are not created by the mylo-hyoid muscle. In this essay the first-named ridge will be called the molar ridge.—The free border of the alveolar process of the molars is often thickened. This border is continuous with a similar appearance opposite the premolars, but at this place it is not at the alveolar border but at a point below. It shall here receive the name of alveolar hyperostosis. I am in doubt of its value as an osteological character, since it may be pathological, or (if physiological) the result of eating coarse foods. In an essay on the Clinical Study of the Skull, I made the following statement: In the specimen of the lower jaw of an Esquimaux in the Academy of Natural Sciences an elongated rounded outgrowth of bone was noted lying on the lingual aspect of the ramus from the first molar to the canine tooth. In the skull of a young adult the outgrowth was mammilated, each nodule answering to the socket of a tooth. In the remaining bones, three in number, it was uniformly convex, and extended to a line which was nearly equal to that of the bottom of the sockets. The bone was firm in consistence and did not appear to be the result of inflammation. Out of thirty-four Esquimaux crania in the Army

1 Toner Lecture, Smithsonian Institution, 1889, 13.
Medical Museum at Washington the hyperostosis is absent in one example only. Since this observation was made I have noted the outgrowth in a number of lower jaws of North American Indians; for example, in skulls from the Ohio mounds, in the skull of a Pawnee, of a Seminole and of a Peruvian. In none of these specimens, however, is it so conspicuous as in the Esquimaux. It appeared in all of its varieties to be a nodular hyperostosis of the alveolar process, and to represent, in an exaggerated fashion, the minute bead-like masses which are often met with on the inner side of the sockets of the lower molars.\(^1\)

(\(b\)). The great contrast noted between the alveolar and basal lines of the ramus is one of the most conspicuous appearances in the majority of lower jaws examined; more particularly is this the case in the specimens obtained from dissecting rooms. The incisor region is apt to be elevated, the molar region depressed, while an emargination (pregenium) is noted on the basal margin in advance of the masseteric impression. In the skulls of uncivilized peoples the lower jaw has a marked tendency (modified by age and states of the teeth), to retain the alveolar and basal lines parallel one to the other.

(c). The third molar is sometimes concealed by the base of the coronoid process when seen in profile from without. This arrangement in a mechanical sense is weak; it modifies the alveolar process for the third molar to its disadvantage. The typical plan is accepted to be that in which the tooth is seen clearly in advance of the coronoid base.

(d'). The outward deflection of the angle is accepted as typical as opposed to the inward deflection. The one last named is assumed by Falconer to be indicative of low grade, since it is seen in marked degree in some of the most ancient bones, namely the lower jaw of Moulin Quignon. Yet it is well marked in No. 1,783 of the Moore series, where it is associated with no evidences of a primitive or degraded character. It is a sign of a weak masseteric, as compared to an internal pterygoid impression.—The question of outward or inward deflection should be answered in connection with the muscles inserted into the angle,—the masseter tending to emphasize the outward and the internal pterygoid the inward inclination. I have found the inward deflection marked in twenty specimens in the Morton cabinet.

(e). The variations in the form of the condyloid process have received but little attention. I have ventured in consequence to insert in abridgement a special study of the subject made by myself.\(^2\)

Out of four hundred examples in the Morton cabinet considered independently of race, one hundred specimens exhibit the peculiarity shown in fig. 19, namely, a marked angularity on the articular surface of the condyloid process.

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\(^1\) I have since met with this appearance in gentlemen who can trace his lineage through many generations of Anglo-Americans.

\(^2\) Dental Cosmos, 1867.
and thus defining two well marked planes. In thirty only of the entire four hundred was this angularity absent.—The point at which the inequality originated was nearer the external (commonly at the outer third) than the internal border. The inner facet was more convex than the other, generally less abrupt (sometimes really inclined upward), and was either rounded upon the inner border of the pterygoid fossa, or terminated more acutely in it; on the other hand, the outer facet was smoother and broader than the inner. The surface was more compact and often eburnated. In some specimens, namely, those with slight degree of angularity, it presented insignificant proportions, but in others (fig. 20) it was by far the most conspicuous feature in the condyle.

These points tend to show that the condyle, during the motion of the jaws, is subject to more attrition upon its outer than inner portion, a conclusion confirmed by the greatest development of this facet being seen in the jaws of fully matured individuals, and in its excessive obliquity in many jaws of the aged. It will have been perceived that the inclination of the condyle is by no means constant. Not only is variation observed in transverse direction, but the articular surface may be inclined either inward or outward, as the external plane is slightly or much worn. These characters give the articulating surface a pyriform appearance, the base of the figure being outward. This indeed may be taken to be a distinctive configuration of the adult bone, only eight specimens being seen in which the inner portion was thicker, or as thick as the outer. In the young bone, on the other hand, the proportions are reversed.

Commonly conjoined with the thinning of the condyle internally was a compression of the entire process antero-posteriorly. This was much more marked along the inner than the outer aspect, and was at times associated with a concavity on posterior surface of the condyle, which was probably in relation during life with the insertion of the capsular ligament. The concavity was markedly seen in twenty instances.

The depth of the impression for the insertion of the external pterygoid muscle was subject to variation. In some examples it was wide and deep, and from this extreme every shade of intermediate depression to the other where the concavity was barely evident. This form was united generally with a condyle developed in height rather than width and gave the parts a "globular" appearance. This, I infer, is the variety described by Falconer as present in the Abbeville jaw.
Upon the outer border of the neck, just beneath the articular surface giving attachment to the external lateral ligament, is seen a small prominence known as the *tubercle* (fig. 21).

It was not always necessary to compare the condyloid regions of two bones to detect the difference above mentioned. They often differed on opposite sides. Then the right condyle would be at times nearly level, wide, compressed, with large tubercle, while the left would be angular and thick, with little or no tubercle (fig. 24). From one hundred and seventy-one specimens examined upon this point, forty-two had the left condyle larger; fifty-four had the right the larger, and the remaining seventy-five were of about equal areas.

An interesting feature was seen in the manner in which the line of the sigmoid notch joined the condyle. It ran into the articular surface at one of four points, varying from the middle of the area to its outer edge. Thus, from one hundred and forty examples, in twenty-nine it joined it at its outer third, in thirty-two at its outer fourth, in thirty-two at its outer fifth, in forty-six at its outer edge. As a rule, the point of union was similar on the two sides, but in six marked instances it varied, one side having it at the outer third or fourth, the other at the edge. In one specimen only was the junction directly in the middle. In no instance did it appear to hold a relation to the site of angulation.

(f). The mental foramen in three instances was double on one side, two of these being on the left. In six specimens the foramen was the size of a pea, though not appearing to be the result of diseased action. The position of the foramen in three hundred and twenty-one specimens was found as follows: on level of the first premolar, six; between first and second premolar, sixty-four; on level of second premolar, eighty-six; between second premolar and first molar, one hundred and fifty-nine; on level of first molar, five; between first and second molar, one. In a few instances the foramen was placed differently on the two sides; thus, between first and second molar on the right, and on level of first molar on the left.

(11). *The norma verticalis*. This region includes the intertemporal region on the parietal bones; the forehead at the level of the frontal eminence and the occipital bone above theinion. All these surfaces are distinguished by a peculiar texture. The surface of the intertemporal region is the "sconce," or "crown" of common language. It is usually rough, pitted with orifices (*foramina Santorinina*) for minute veins or variably tuberculated. So many are the individual peculiarities of this region that it is well worthy of being noted in every description, and being measured in its diameter. In figure 25 the *norma occipitalis* of an Ancient Egyp-
tian (No. 1,290) is shown. Two deep median depressions are noted on the line of the sagitta, one at the post-obelon and the other at the intertubera; two are seen on either side of the sagitta, near the temporal ridges and two smaller ones on the frontal bone on either side of the metopic line near the eminences. These depressions being confined to the norma vertialis and found in a region in which individual characters are often found, no doubt remains that they are anatomical variations and not the results of disease.

(12). The norma occipitalis. The various normae of the skull derive their names from the positions assumed in their delineation. But in the norma frontalis and norma occipitalis names accepted in other senses are introduced. In the norma frontalis more than the front of the head is seen, for a foreshortened view of nearly all of the temporal fossa is possible. In the norma occipitalis the occipital bone does not yield even the most important area. Most of the surface of the occipital bone belongs to the norma basilaris. The narrowest part of the occiput is nearest the eye of the observer, and the anatomical limitations of the occiput are not those parts which are farthest from the eye, these being part of the skull as far forward as the parietal protuberance, the most convex parts of the squama, or even the line of the bregma.

In a word the norma occipitalis is not a view of parts seen nearly in the same plane as are those of the other normae, but is a view in perspective of the entire brain case as seen from behind. In brachycephalic skulls the parieto ecto-petrosal suture is seen in the norma occipitalis, but in dolichocephalic it lies on the norma lateralis. In a graphic sense the distinction between these two important types can be thus discerned without other definition or measurement. Wilson used the term “intermastoid arch” for the limitations of the field of the norma occipitalis and represented it as the line formed between the mastoid processes. When the term pentagonal is employed in describing the norma, it means that the entire contour is resolved into five facet-like lines; but two of these, namely, at the upper two-thirds, are not part of the occiput at all, but are derived from the parietal bones. The peculiarities of this norma occipitalis are so much more numerous and conspicuous than those of the norma frontalis that special attention will be given them.

1 For definitions for the terms "post-obelon" and "intertubera" see the author's Toner Lecture, Smithsonian Institution, 1889.

54 JOURN. A. N. S. PHILA., VOL. X.
Beside observing on what part of the occipital region the skull rests on a given plane, the curvatures of the several component parts are to be noted, especially the curve from the opisthion to the inion, the one from the inion to the lambda, and another from the lambda to the intertuberal. When these curves are inconspicuous, and a uniform curve, or one nearly so, extends from the opisthion to a point directly back of the bregma, we have an example of a high form of cranium. If, on the contrary, the curves as above defined are sharply indicated we have one of low grade.

(13). Ontogeny and paedomorphism. The ontogeny of the skull does not comprise a uniform series of stages. Many of the distinguishing signs are those which suggest the characters commonly seen in the skull of the infant or adolescent.¹

Since the classic studies of Gratiolet, many observers have made statements as to the occasional resemblance between the skull of the child and of some adults. Darwin ² gives in part the literature of the subject.

Aebly ³ claims that a skull is of high grade in proportion as it departs from the fetal characteristics.

G. Rolleston ⁴ draws the conclusion that in "ill-filled" skulls the frontal tubera may retain their infant-like prominence. He employs the term "retention of an infantile type," though oddly enough denominates it a "metaphysical expression."

W. H. Flower, ⁵ in speaking of the Andamanese, says: "there is much that is child-like in the physical characters, especially in those of the crania. The smoothness of the brow, the high orbital index and the low alveolar index are infantile characters."

Virchow ⁶ states that the skulls of females of the Goajiro tribe of northern Venezuela are persistent forms of the children's skulls of the same people. While in the skulls of Congo negroes it is the male type only which retains the child's characters.

I have ventured to denominate this process of retardation a retention of juvenile characters. I suggested ⁷ elsewhere the use of the word paedomorphism to express these peculiarities, whether they were confined to the skull or exhibited in any other part of the economy. So far as the human skull is concerned I can say that I have never examined a specimen which did not exhibit one or more paedomorphic characters.

The changes incident to infancy and youth are of importance in determining the shape of the skull. Among the more suggestive of these changes are those in the brain case, and notably in the region of the alisphenoid and squamosa. Among

¹ The study of the immature skull has been confined for the most part to attempts to define race characters. This in a sense is a small matter as compared to the detection of child-like characters in the skull of the adult; for many of them, as observed in this essay, do not appear to have ethnic values.
² Descent of Man, II, 302, Am. Ed.
⁴ British Barrows, etc., 1877, 663, 664.
⁶ Cran. Eth. Amer., 1892, 32.
child-like features which can be detected in the adult skull are the relatively large bi-tuberal diameter; the frontal bone as it enters into the composition of the temporal fossa remaining convex; the frontal eminence determining the curve of the forehead rather than the region of the interfrontal suture; the relatively large, flat nasal bones; the absence of the premaxillary crest and lack of union between the projection of each premaxilla (the union of these projections usually constituting in the adult the "anterior nasal spine"); the occipital bone between the opisthion and the union remaining flat, or nearly so, instead of becoming convex; the alisphenoido-frontal suture remaining patent; the great height of the orbital roof adjacent to the external lateral process; the persistence of the interfrontal suture; the choanae remaining oval and small; the pterygoid fosse being deep and narrow; the retention of a straight, laminose middle turbinal; the spinous process of the sphenoid bone not overlapping the sphenoido-typanic fissure or suture; the closure of the foramen lacerum medium; the shape of the malar bone; and the downward inclination of the outer portion of the orbital arch.

It would be an error to assume that all infantile characters are capable of persisting. The following changes are invariable: the development of the peripheral parts of the ecto-petrosal; the extension backward and downward of the post-squamous part of the temporal bone; the increase in the face height pari passu with development of the teeth; and the union between the maxilla and the pterygoid process for a distance nearly the entire length of the pterygoid. Other characters are peculiar to the immature skull, especially that of the new-born child. Among these may be mentioned the tubercle on the posterior surface of the frontal process of the malar bone in the position of the malar-alisphenoidal suture, and the horizontal stria on the anterior surface of the frontal bone above the orbit.

Excellent examples of paedomorphism in adult skulls are met with in the Eskimaux, in natives of the Sandwich Islands and in many North American Indians. A remarkable paedomorphic skull, unfortunately without locality, is seen in the Academy's collection. The parietals exhibit the proportions of the child at term. The sconce is remarkably changed in texture as also are the malar bones. But it is impossible to name all the paedomorphic characters. I believe they should form a part of the description of every specimen.

(14). The texture of the skull. The skulls of the Moore series were very brittle. In one specimen (No. 1,783) the outer layer of the flat bones was broken in places in the diploe. Fine sand had filled the brain cases. Even after careful cleaning the sand continued to come away in small quantities as the skull became thoroughly dried. Most of the fragments from superficial burials were fairly stuffed with the contorted roots of the palmetto, every foramen and fissure being used for transit of these vigorous outgrowths. Even in the specimens from the deeper burials, which have been here used, peculiarities of texture are seen (notably in Nos. 1,784, 1,781, 1,783) which are due to radicles lying close to the bones.

It is of some value in studying crania, such as those found in the Morton collection, to determine the differences in the texture of the bones, the result of the
varied experiences which the specimens have undergone. The protection of all surfaces by embalming is widely contrasted with those which had been exposed to the air. In the one case the bones are of normal texture though brittle, in the other this has been modified by the disintegrating effect of frost, heat, moisture, etc. Texture and color are often of value in identification. Skulls that are smoke-stained have been shelved or hung over open fires; those that are calcined have been acted upon by intense heat; those that are at one place earth-stained and at another bleached, marked with coniferous or lichens, show scant burial; those having the ethmoid cells mutilated by insects and filled with pupa cases have been laid on platforms or in trees, some show grooves from the teeth of rodents, the details often denoting the species that have committed the ravages. The white appearance of other specimens accompanied with a pitted effect on the surfaces demonstrates the action of a tropical sun and of high winds long driving sand against the bones.

(15). *The functions determining the form of the skull.* Among the mechanical factors which modify the shape of the skull are the following:

The growth of the brain.

The interstitial changes in the bones themselves leading to inflations, which may receive the name of the ethmo-maxillary, the fronto-maxillary, the mastoid, the petrosal and ex-occipital inflations, respectively.

The action of the muscles attached to the skull.

Of the first and second of these subjects the general fact is alone appreciated, but the differences within the normal range of variation are imperfectly, if at all known. What are the forces which determine the variations in the shape of the frontal and occipital bones? Why are some skulls widest at the bi-tuberal and others at the bi-squamosal diameter? Why do some skulls exhibit the union of the parietal with the alisphenoid bones, while others the union of the squamosal with the frontal? In like manner one may ask what are the causes of variation in the size of the sinuses? As a rule the sinuses are most developed in short faced and least developed in the long faced skulls, but the connection between these states is obscure. I refer in this connection to a communication by myself in the *Proceedings of the Academy of Natural Sciences of Philadelphia,* 1894, p. 181. Evidence was deduced from the Mammalia in support of the proposition that among the changes that take place in the skull incident to shortening of the face axis the formation of sinuses and pneumatic areas hold an important place.

It is far different, however, with the muscular forces which are exerted on the periphery of the skull. These doubtless correlate with the prominence of muscular ridges and the depth of fossa. While the general statement is true that shapes of bones are due in a measure to the muscles which are attached to them, it remains also true that, in craniology at least, we are needing precision of statement regarding the exact influence exerted by the muscles upon the shape of the several bones. Eight of the fourteen cranial bones (viz.:—the frontal, malar, inferior maxillary, palatal, parietal, temporal, sphenoid and occipital bones) yield origin or insertion to muscles, and, without exception, the shapes of all these bones are so modified.
It is, perhaps, owing to the exceedingly wide range of these modifications that anatomists have not availed themselves of characters thus afforded in the study of the skull as an aid in the identification of race types. The muscles which are most important are those that move the head on the vertebral column. The bones entering into the temporal, zygomatic and pterygoid fossae are modified by the muscles of mastication. The shape of the angle of the lower jaw appears to be due to the action of the masseter and internal pterygoid muscles, as is also the size of the ascending rami.

VI. A Study of the Teeth.

The manner in which teeth follow one another in a given series (here called their alignment), the directions of their "wear" and displacement (the results of mastication and age), are of interest. To a short account of these conditions a plan of studying cusps is appended. The titles of sections will appear as follows: (a) Alignment, "wear" and displacement of the teeth; (b) The cuspidation of the premolars and the molars together with a statement of the order of succession of the cusps.

(a). Alignment, "wear" and displacement of the teeth. Two tendencies of alignment are recognized in the teeth,—that of the molar and that of the incisor line. The molar line is that to which the molars conform. When projected forward the molar line always embraces the second premolar (which appears to be the rule in mammalian dentition), but the first premolar and the canine are often not in the molar line as projected, but in a line which answers to that of the incisors. The incisor line in its simplest expression is confined to the incisors. If the enamel is worn it is easy to align the transitional teeth, namely, the first premolar and the canine, to the molar or incisor line respectively. The effect of these differences in alignment upon the shape of the jaw has not been elaborated at this place, but it cannot be ignored.

By the torsion of teeth is meant the change in the inclination of the crown axis either forward or backward of the one which is normal. Examples of torsion are seen in the first and second upper molars, and in the lower premolars. In figure 30, for example, the square crown-faces of the first molar and the third molar, figure 33, yield a medio-lateral axis, which forms a right angle when intersected by the line of the alveolar process. In figure 32 the oval crown face of the first molar yields a medio-lateral axis which does not form a right angle with the line of the alveolar ridge.

The torsion of an upper molar may be expressed by the disposition of the protocone to touch the metacone to form the oblique ridge which is characteristic of the tooth. If exaggerated, the tooth forms an elongated ellipsoidal crown. Now the normal form is always in a series whose anterior and posterior walls touch each other, and the ellipsoidal is not apt to be in close contact with other teeth. I infer
that the disposition for a tooth to be twisted is an expression of its inability to resist a force coming to it from without, and that this force resides in the lower jaw and is a result of its motion in mastication.—In the lower jaw the premolars are apt to undergo torsion quite distinct from that seen in the first and second upper molars. The first premolar is inclined forward and the second premolar backward. This disposition, as already stated, places the first premolar in harmony with the canine and incisors, and the second premolar in harmony with the molars. The lower premolars may be said to occupy a position between two distinct sets of teeth which are functionally active, those at the anterior part of the dental arch and those at the sides far back. In the mammalian orders these teeth are exceedingly variable in number and form, but the rule above given is quite constantly adhered to, and even in the human jaw where there are but two teeth of the premolar series, it is found that they do not work together so much, as the first assists the canine and the second the first molar.

Mastication tends to displace the teeth from their alignments in a variety of ways, In the upper jaw the attrition pushes the incisors forward and the molars outward; and in the lower jaw all the teeth inward. The least amount of deviation is noted in the third molars of both upper and lower jaws.

A casual examination will show that the teeth of the upper jaw "wear," for the most part, on the palatal aspect. It is far different in the teeth of the lower jaw. Here the incisors, canine and the first premolar wear as a rule across the crown, the second premolar, first and second molar wear on the buccal part of the crown, while the third molar wears as do the incisors, canine and first premolar.—In middle life a disposition exists for the teeth to be pushed out of their sockets. This is notably the case in skulls Nos. 1,781 and 1,782. With this tendency an exaggeration of the molar-inclinations above named is noted, and the attrition-effects are especially marked,—namely, on the palatal surface of the maxillary and on the buccal aspect of the mandibular molars. In No. 1,781 the teeth are worn but are not displaced.

In No. 1,782, by the constant impact on the palatal side the tooth is pushed outward, the grinding surface being transferred from the face of the crown to the palatal side of the crown and the neck. The disposition to outward inclination of the molars is much greater in some individuals than in others. Broca uses the term hyperbolic to express the shape of the hard palate as determined by the degree of divergence of the sides of the dental arch (See Section 6). I believe that the divergence of the arches is equivalent to the outward inclination of the molars and, all things remaining the same, the greatest degree of divergence will be found to correspond to the disposition for the teeth to wear on the palatal half of the crown.

In No. 1,782, as already noted, the second molar on both sides is turned inward. The force of attrition on the palatal aspect of the cusps, while tending to force the tooth toward the buccal surface, has, by wearing away the crown, so far disturbed the equilibrium of the tooth in the jaw as to turn the crown in the direction of the grind-
CRANIA FROM THE MOUNDS OF FLORIDA.

The cusp, or butting surface and actually tilt the tooth from its socket. The teeth themselves are worn down horizontally in Esquimaux and Patagonians. According to Topinard, the incisor teeth in North American Indians are disposed to be vertical, but there are numerous exceptions that can be made to this statement.

In the "wear" of teeth, not only do the degrees of wear aid in the determination of age, and not only does the amount of the loss of enamel and dentine give clues (all things remaining equal) to the character of food consumed, but the details in the patterns defined on the grinding surfaces themselves afford excellent characters in determining what the original arrangement of the cusps had been.

The difference in the wear of teeth on the two sides of the jaw is conclusive that the habit often favors certain parts of the enamel covering and throws undue work upon other parts. In the elephant the molar on the left side may be alone worn down. Sometimes the left tooth appears to have been used in the main. In the living human subject I have often seen the teeth of the left side worn while those of the right remain as sharply cusped as when they were erupted. If I am right in assuming that a disposition exists for the lower jaw to push the maxillary front teeth forward and the side teeth outward, when the force is expended more on the front teeth than the side teeth, the upper jaw and palate become parabolic and the jaw prognathous; but if it is expended more on the side teeth than the front teeth the form of the palate becomes hyperbolic, and the jaw orthognathous.

(b) The cuspidation of the premolars and molars and the order of succession of cusps.

(1) The lower premolars. The skull No. 1,783 possesses a perfect set of teeth which were but little worn. I desire to call attention to these teeth, since it is likely that they represent the peculiarities of a people as ancient as any of which we have knowledge on the American continent.

The lower premolar exhibits a large outer and a smaller inner cusp. Indeed, the term cusp for the elevation on the inner aspect of the crown is scarcely correct since the enamel forms a mere lingule-like swelling about the base of the outer cusp. Compare 1,060, Caucasian, and 430, Malay, p. 438.

After making these inspections I became interested in noting the peculiarities of the lower premolars, and herewith invite attention to some of the variations of these teeth. The inner simple ring may become relatively large as compared with the outer cusp. Compare figs. 73 and 79 second premolar. Or the inner ring becomes marked by one or more rounded swellings (beginnings of which are seen in figs. 73 and 79) which appear in the depression between the outer and inner parts of the tooth. Compare fig. 126, and the second premolar in fig. 76. Or the inner margin of the tooth is cleft between these mammillations. Compare figs. 98 and 118.

A somewhat distinct class of variations is noted in the crown. The general character is that, indeed, of a true premolariform variety. The inner border is dis-

1 Owen, Odontography, pl. 4.
tinctly accented in the middle and a wide interval is defined between the cusps. Compare fig. 78 first tooth, 79 first tooth, 73 second tooth and 97. More distinct mammillations so arranged as to make a tricuspidate form are also noted. Compare fig. 98 second tooth and 93 second tooth.

The commissures are feebly developed in all forms of lower premolars. Raised anterior and posterior borders such as are met in many forms (compare figs. 98, 126) are not here alluded to. But in a smaller group of teeth these borders are worthy of receiving a distinct name, e.g., fig. 70 second premolar, and fig. 76 first premolar.

The enumeration of the parts of the crowns of the lower premolars as cusps and commissures appears to receive confirmation when these teeth are compared with those of the lower mammals, especially with the genera of the anthropoid apes.
and many genera of Chiroptera. In all the anthropoid apes the lower premolars exhibit two cusps and a large heel. In pteropine and glosocephaline groups of bats the same peculiarities are seen, with the exception that the heel is of enormous size. The commissural elements as a rule are marked, the post-commissure being larger than the pre-commissure. The main contrast between the premolars of anthropoid and those of Man consists in the fact that in the former the non-cuspidate portion is larger than the cuspidate and the post-commissure is pushed back far from the cusps, while in Man the non-cuspidate portion is nearly obliterated, the post-commissure being brought up close to the cusps.

It is a fact quite unexpected that the highest type of premolar—that is to say, one in which the lingual cusp and the commissures attain the greatest development—is found in the living subject and almost uniformly in low health conditions. The best examples are met with in tuberculosis and congenital syphilis.

(2). Cuspidation of lower molars. The plan of proceeding in the study of the cusps of the lower molars is distinct from that of the upper. The divisions between the cusps of the buccal and lingual sides of the crowns, and the commissures at the anterior and posterior borders are sharply defined.

I have found it convenient in taking notes to use numerals which indicates not only the numbers, but the position of the cusps. Thus, in the arrangement \( \frac{2}{3} \) it is implied that there are two cusps on either side of the tooth centre. The number above the interspace represents the buccal cusps and that below the lingual cusps. The small zero mark represents the position of a commissural or annectant cusp.

The number of examples of each kind of grouping is indicated in figures placed above the fractions. We then have for fifty right first lower molars the following:

\[
\begin{align*}
&9 \; 34 \; 4 \; 3 \\
&\frac{2}{3} \; \frac{2}{3} \; \frac{1}{3} \\
\end{align*}
\]

The frequency with which molars are absent make it difficult to formulate these cuspidations for equal numbers of teeth.

I have instituted an inquiry at the Eastern State Penitentiary upon the teeth of convicts,—the arrangement of the cusps and commissural cusps being as here-with given.

<table>
<thead>
<tr>
<th>First lower molar</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 Right</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>51 Left</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second lower molar</th>
</tr>
</thead>
<tbody>
<tr>
<td>59 Right</td>
</tr>
<tr>
<td>53 Left</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Third lower molar</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 Right</td>
</tr>
<tr>
<td>32 Left</td>
</tr>
</tbody>
</table>

55 JOURN. A. N. S. PHILA. VOL X.
It is seen from this table that in the lower molars the presence of four cusps characterizes the majority of teeth in the second tooth only. In the first molar the presence of a commissural cuspule toward the outer side (making three cusps on the outer side for two on the inner) is seen in over one-half. The number is practically the same on the two sides. The normal arrangement for the first molar characterizes less than one-sixth of the whole; while in the third molar the order is again different.

(3) *The cuspidation of the upper molars*. The cuspidation of the second upper molar may be taken as the most important variable for the reason that the first molar is never possessed of less than four cusps or more than five, and the third molar is so irregular that its characteristics are not likely to yield facts of importance.

The second molar is usually made up of four cusps, but it may have three cusps with a rudimental fourth, or have three cusps only. Observations on fifty inmates of the Penitentiary resulted in the following:—Four cusps, 30; three cusps and rudimental fourth, 7; three cusps, 13.

In the collection of the Academy of Natural Sciences of Philadelphia, one hundred skulls were examined (all modern Europeans being excluded) with the following result:—Four cusps, 26; three cusps and rudiments of a fourth, 29; three cusps, 45. It is thus seen that the rates of cuspidation differ in the series from criminal subjects and those from specimens found in a miscellaneous collection composed for the most part of uncivilized peoples.

Only one example of a second molar exhibited five cusps of which the supplemental cusp was in the form of a cingule to the paracone. The first molar in two instances only possessed less than four cusps, while in four instances it possessed the supplemental palatal cusps, thus making the entire number five.

The third molar is so variable that it cannot well be classified. In only three instances did it possess four cusps; in eight instances only did it retain three cusps, while in the remaining ten instances it was irregular; by which term is meant a departure from a polycuspidate form and exhibiting various crenulations and depressions which do not admit of arrangement. Some of these closely resemble the plan of a premolar; others are depressed in the centre and bordered by a folded hem, this I have called in my notes the crater-like tooth; some of the teeth have three mammillations arranged in order from without inward.

The third molar infrequently retains the cuspidation of the first and second. The protocone and paracone can be named as a rule; the cingule, from which the metacone and hypocone, arise often complete the tooth. As already shown occasionally the metacone will be developed at the expense of the hypocone; sometimes the contrary takes place, but in either event the division of the crown by the size of the several parts rather than by homology results in the protocone and paracone forming almost the entire crown.

(4). *The order of succession of cusps*. In 18751 I announced that a true development occurs from the canine and incisor series toward the molar by means

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1 Dental Cosmos.
of which the cingule of the canine becomes the cusp (i.e. the palatal cusp) of the premolar; that a new cingule be developed from the premolar it becomes in the molar the third cusp; and that should the molar possess more than four tubercles, three of these will be cusps, the remainder will be cingules. The simplest expression of a cone is exhibited in the incisors and canines, which may be said to be the lowest of the series, and that the highest expression anywhere seen is in the lower teeth.

In figure 27 the beginning of the bicuspidate form of tooth is seen in the manner by which the cingules are seen to vary.

In figure 28 the basal cingules while not so concrete are yet sufficiently well-developed to retain distinctive names and are of the nature of unusual variations in form in transition between the incisorial and the canini-form shapes of monocuspidate teeth and those of the bicuspidate type. The canine tooth exhibits on either side of the centre of the tooth a narrow depression or valley.

The folds of enamel at the side of the depressions just named are of importance in describing the variations of the bicuspid. In this paper these folds will receive the name of commissures. Figure 29 shows, in a conspicuous way, the distinctness of these folds.

In the molar series the succession of cusps from the monocuspidate to the polycuspidate is clearly shown. It is necessary here to distinguish between the forms of the upper and lower molars. The lower molars resemble the lower premolars in the disposition for the folds of enamel on the anterior and posterior parts of the tooth to thicken. The second molar shows this tendency to a less degree than either the first or the third, and the posterior fold to a greater degree than the anterior. The posterior fold is apt to bear a distinct cusp developed in the middle of the posterior commissure.
In the upper jaw the cusps are not so symmetrically arranged as in the lower, nor are the commissures so conspicuous.

In figure 32 the parts are typically disposed. The fifth cusp in the second molar is not an outgrowth of a commissure as in the lower jaw, but is a basal cingule of the hypocone. The axis of the upper molar is disposed to be oblique. The contact of the protocone and the mesocone forms an oblique line which has long been noted. The greater length of the crown surface in the direction of the paracone and the hypocone has escaped notice. It is marked in both of the teeth in figure 32.

The obliquity in the tooth shown in figure 33 is marked.

1. (No. 140). The elements of the hypocone are duplicated and appear as part of an enamel fold (which is not commissural) on the posterior surface of the crown. A similar arrangement is seen in figure 30, upper premolar.—2. (No. 828). Two elements of the value of cingules are here present. The first of these is the hypocone; the second lies directly to the palatal aspect of the protocone.—3. (No. 1,488). In the second molar the cingules are three in number and clasp the posterior and palatal aspects of the crown, throwing in the paracone from the periphery.—4. (No. 828). The second molar exhibits two cingules, one the hypocone in its usual position, the other placed directly back of the paracone.—5. (No. 29). The first molar showing an exceptional prominence of the enamel fold on the buccal aspect.—6. (No. 1,467). The presence of the enamel folds on either side of the protocone and paracone is evident. In the valleys thus formed are seen two well-defined eminences which do not receive names.—7. (No. 760). A conspicuous nodule, apparently anomalous, is seen on the buccal aspect of the first molar.—The anterior commissure of the deciduous molars marked in the lower jaw extends forward to a degree greater than is the case in the upper; two examples are illustrated in the above series. The anterior commissure of the first molar of No. 4 is produced and forms a cone-like figure whose base is directed backward. Such a configuration is seen in the last of the series of premolars in some mammals with long slender jaws. It denotes absence of pressure on the anterior part of the tooth and a resultant disposition in the tooth to advance in such direction.
CRANIA FROM THE MOUNDS OF FLORIDA. 443

The crown, as shown in figure 37, is that of a tooth whose elements are imperfectly defined by reason of the disposition of the grinding surface of each cusp to be split up into folds, and the middle of the tooth to be everywhere below the level of the borders. A tooth such as this is degenerating, and is on the way to lose all its cusps and become a crater-like figure, whose elements cannot be named and the walls of whose central depression are everywhere present.

Description of the teeth of the Moore Crania, No. 1,784. Upper jaw. Alignment disturbed by attrition, incisor forced slightly backward, worn transversely. Lateral incisor in true alignment, the right more worn than the left. Canine much worn, the right transversely, the left obliquely on buccal side. First premolar worn for most part on buccal side. On the right side the second premolar has been nearly lost; the crown has been worn obliquely from before backward through to the pulp chamber. The left tooth is worn evenly. The molars on the right are all in position. On the left they are absent. The first and second are much worn on the palatal side, the first into the pulp chamber, the crown being tilted inward. The third molar is worn evenly. Lower jaw. The incisor line confined to the incisors. The molar line includes the molars, premolars and canine. Incisors and canine transversely worn. First premolar right transversely worn; on left very obliquely worn, buccal. Second premolar evenly worn, more indeed than the first. First and second molars much worn, buccal, but not into pulp chamber. Third molars absent.

No. 1,781. Upper jaw. The incisor line including the first premolar; the curved molar line including the second premolar. The right incisors in different alignment from the left, probably from attrition or disease, those of the right are normal, but those of the left are thrown well forward and are without alveolar support, labial. The left lateral has been lost posthumously, the right is much protruded. All the teeth are evenly worn to moderate degree excepting the first molar, which is slightly inclined, palatal. The first premolar is more worn than the second.—Lower jaw. The incisor line includes the canine and first premolar. The molar line includes the second premolar. All the teeth are evenly worn to a less degree than the upper, and nowhere into the pulp chamber, nor is the alignment disturbed by attrition. With the exception of the first molar, which is worn obliquely, lingual; all are transversely true.

No. 1,782. Upper jaw. The incisor line confined to the incisors. The molar line includes the premolars and canine. The first molar is tilted palatal and the buccal cusps are thrown from their sockets and have entered into the “wear.” The second molar is evenly worn; the third molar is absent.—Lower jaw. The incisor line includes the canines, the molar line includes the premolars. The first premolar is more worn than the second. The first molar is much worn, buccal. The second molar less evenly worn; the third molar was small, but has been lost posthumously.

No. 1,783. Upper jaw. The incisor line includes the canine. The molar line includes the premolars and canine and is curved. The teeth had been perfect and little worn, but many of the premolars and first and second molars subject to pos-
CRANIA FROM THE MOUNDS OF FLORIDA.

thumous flaking of the enamel. There is slight palatal wear on the first molars. The formula for the molars is 4, 34, 3.—Lower jaw. All teeth in beautiful alignment and perfect with the exception of posthumous flaking. The molar line includes the premolar. The teeth show moderate wear except the third molar. The formula for the molar series is 223.

No. 1,789. The only teeth present are the right upper molars. They are little worn, but much broken, save the third molar, by posthumous flaking.

APPENDIX.

I.

The craniophore employed in these studies is simple in character (fig. 33.). It answers a useful purpose.

An iron stand with adjusting screws, for leveling the base, supports an iron upright, over which a brass canula with screw for fixation is carried. A U-shaped bar with two upright arms receives the skull, which is held in place by two brass rods, each of which bears on inner ends a conical piece of vulcanite to fit in the external auditory meatus.
CRANIA FROM THE MOUNDS OF FLORIDA.

The rods are adjustable and can be fixed at any point by screws. Clamped to the canula is a movable bracket for supporting the base of the skull. This instrument was manufactured by Richardson & Metzger, Philadelphia, and can be now procured of Ferdinand Metzger of the same city.

A small instrument which I have devised for measuring the alveolo-basilar length, the orbito-nasion length, the palatal length, choanal height, etc., is worthy of commendation. It is a simple rod marked in centimeters and millimeters and a sliding guide which is sufficiently long to serve as a support to the nasion in making the orbital measurements and to the alveolar point in making the alveolo-nasion and the palatal length. After many futile efforts to induce instrument makers to undertake its manufacture, the little model I have used was kindly made for me by Dr. Milton J. Greenman of the Wistar Institute of Anatomy and Biology.

In taking nasal, orbital, transverse palatal measurements, etc., I have employed a small instrument based on Flower’s craniometer. It has proved to be invaluable.

II.

The Classification of Crania proposed by James Aitken Meigs.—I have employed this classification, and it is proper that it should be here copied in full, since the original paper¹ has been overlooked by writers. Meigs does not state which of the names are original with himself, though most of them are so. He knew that Esquimaux crania had been described as “pyramidal” and that the word “prognathic or negroid” was in general use. The novelty of the term last quoted consisted in its application to the North American Indian.

The cymbecaphalic of Meigs is the same as the “kumbo-cephalic” of D. Wilson. “In the primitive or elongated dolichoccephalic type, for which the distinctive title of kumbo-cephalic is here suggested,—the parietal diameter is remarkably small, being frequently exceeded by the vertical diameters.”² The same author describes a skull³ which “nearly agrees with the lengthened oval form described by Prof. Nilson (sic) as the second race of the Scandinavian tumuli. They have mostly a singularly narrow and elongated occiput; and with their comparatively low and narrow forehead, might not inaply be described by the familiar term boat-shaped.” Fig. 7 of Wilson is almost identical with the crania named cymbecaphalic by Meigs. — “Cymbo-cephalic” is held by Rolleston⁴ to be equivalent to “scapho-cephalic,”⁵ and to the same as “birnformig,” “keulenfomig,” “elongate-oval,” and coffin-shaped—cuneate oval—of various writers.⁶

² Aitken, Arch. and Prehistoric Annals of Scotland, 1851, 177.
⁴ British Barrows, 615.
⁵ The term scaphocephalic is used vaguely by writers. It might be discarded with advantage.
⁶ Ibid, 651.
Stenocephalic is said to have been used by Broca, but the original reference I have not seen. The term is accepted by Aeby. — J. C Pritchard divides crania into three groups.—the mesobregmate, stenobregmate and platybregmate. The stenobregmate group is sufficiently near the stenocephalic of Meigs to be considered the same, as, indeed, the platybregmate is similar to the platocephalic of the same writer.

The "eurycephalic" of Meigs embraces skulls which, while chiefly dolichocephalic, are of a broad, oval form and is doubtless intended to include the eurycephales of Broca. Huxley used "eurycephali" to define brachycephalic skulls having a cephalic index below 85 and at or above 80. Topinard states that "eurycephalic" is the same as "crane large." C. Aeby uses the term "eurycephal zone," and thereby expresses the broadest zone of brachycephalic crania. Rolleston states that to "the brachycephalic British skull of the bronze-period the application of such epithets as 'well-filled' 'eurycephalic,' 'sub-cubical'" might be applied.—But Meigs does not anywhere imply that his eurycephali are confined to large skulls.

Classification of Aboriginal American Crania According to Their Ethnic Forms.

(a). Pyramidal or pyramidocephalic form.

General characters: Dolichocephalic; calvaria carinated and pyramidal; face lozenge-shaped and broadest below the orbits.

(b). Oval or oídoocephalic form.

General characters. Chiefly dolichocephalic; vertex and base of skull more or less oval in outline. This skull generally regular, sometimes rhomboidal or angular; sometimes long and narrow, sometimes rather short and broad. Occipital region more or less full and prominent; occasionally very much elongated. Occipital protuberance sometimes knob-like; sometimes acuminated. Posterior portion of the occipital bone shelving downward and backward like an inclined plane and portion of the plane sometimes formed by the upper half of the occipital bone. Forehead moderately well developed in breadth and height.

Subdivisions. I. Cymbcephalic, or boat-shaped form, in which the occiput is exceedingly protuberant. II. Narrow oval Form (Stenocephalic) III. Broad oval Form (Eurycephalic) IV. Barrel-shaped or cylindrical Form (Cylindricephalic) V. Angularly oblong Form. VI. Artificially elongated Form.

(c). Arched or hypsicephalic form.

General characters. General dolichocephalic; high or vertically elevated skulls.

1 Die Schädelformen des Menschen und Affen. Leipzig, 1867, 50.
2 Researches into the Physical History of Mankind, 2nd Ed. London, 1826, 173.
3 Bull. de la Soc. d'Anthropol. 1861, 645.
4 Prehistoric Remains of Caithness. Lond. and Edin. 1866, 85.
6 L. c. 58.
Forehead high, vertex or coronal region sometime curving from the glabella to the occipital protuberance so as to form a more or less regular arch, as in archencephalic; or sometimes running up to an elevated point at the junction of the coronal and sagittal sutures, as in phoxocephalic. I. Archencephalic. II. Phoxocephalic.

(d). Wedge-shaped or stenoecephalic form.
General characters. Chiefly mesocephalic or intermediate in length between the dolichocephalic and brachycephalic. Forehead more or less receding; crown triangular in shape, narrow at forehead and wide between the parietal protuberances. Back of the head more or less flat and pressed in toward the foramen magnum. Constitutes the transition to the square-headed brachycephalic.

(e). Flat or platycephalic form (subglobular).
General characters. Chiefly mesaticephalic like the preceding group, with flat vertex and rounded occiput. Transitionary to the round-headed or globular brachycephalic.

(f). Globular or sphericephalic form.
General characters. Brachycephalic; vertex, occipital region and base rounded and globular, occiput sometimes flat.

(g). Square, cuboidal or cubiccephalic form.
General characters. Brachycephalic; occiput vertically flattened, or nearly so.

(h). Prognathic or negroid form.

III.

A careful study was made of the nasal index in 415 crania of North American Indians in the collection of the Academy.

On the whole the platyrhine group constituted nearly one-fourth of the entire number, while the mesorhine and leptorhine groups constituted a little over three-fourths: platyrhine 98; mesorhine 170; leptorhine 157; total 425.

Broca divides the grades of nasal index as follows: between 53–88 platyrhine; between 48–52 mesorhine; between 42–47 leptorhine.—In our examination 16 examples were found where the nasal index was higher than 58 (ranging as high, indeed, as 70) and an equal number found lower than 42 (ranging as low 37). These have been included respectively in the groups of platyrhine and leptorhine. The above examinations were made before I concluded to measure the base of the nose from the alveolar line. The distance between the top of the incisor eminence (assuming that this may have been taken as the lower margin of the nasal aperture), and the alveolar line is often notable to the eye. It is evident that the proportions above given would be disturbed if the series were subjected to re-examination.—W. Matthews,1 gives the average nasal index of forty-four skulls from Salado, Arizona, as 51.66, though the range embraced measurements from 44.23 to 61.11.

1 Seventh Mem. Nat. Acad. of Science, Vol. VI, 1893, 196.

56 Journ. A. N. S. Phila., Vol. X.
and included examples extending from leptorhinian to extreme platyrhinian. In the crania from Cibola, in the same general locality with the foregoing, Matthews found the index to be practically the same.

The nasal index gives no indication of the shapes or sizes of the nasal bones, nor of the height of the nasal aperture. It is difficult to formulate impressions on these subjects since the nasal bones are so often found mutilated in museum crania. Still it must be acknowledged that the value of the nasal index is impaired on account of the fact that the types of the external nose recognized in anatomy are not therein expressed.

All measurements in tables and elsewhere are recorded in millimeters.

Erratum. Fig. 7, p. 413 is out of the horizontal plane and gives an erroneous impression of the height of the brain-case.

CERTAIN RIVER MOUNDS OF DUVAL COUNTY, FLORIDA.

By Clarence B. Moore.

The three succeeding papers give the results of our work in Florida, from January 16th to June 16th, 1895. These results, though mainly cumulative, having been arrived at with great care, are, we think, worthy of publication.

We wish to return thanks for valuable assistance to Professor Cope, to Professor Putnam, to Dr. E. Goldsmith, and to Prof. H. A. Pilsbry for identification of numerous shells.

Again we express our indebtedness to Dr. M. G. Miller for continuous assistance in the field and in the preparation of these papers.

August, 1895.

C. B. M.

Such mounds of Duval County as are considered in this paper, border that portion of the river between Jacksonville\(^1\) and the sea, a distance of about twenty miles by water. The large mounds of this territory have been noticed in Part II of our previous report,\(^2\) the smaller, often slight elevations, frequently covered with underbrush and unknown to the inhabitants of the neighborhood, escaped our notice during our previous work in this section, which was not so thorough as that on the upper portion of the river where the territory has been gone over literally dozens of times.

It is evident that this part of the river sustained a considerable population in former times, rendered possible, perhaps, by the great abundance of oysters in the waters near the river's mouth, where the low marshes are still studded with shell-heaps and a few years back contained deposits of great size.\(^3\)

It will be noticed that the great mounds of this portion of the river resemble Mt. Royal, near Lake George, as to contents, while on the other hand, the low, irregular ridges which seem characteristic of the extreme lower portion of the river, differ considerably in the nature of the objects inhumed, from the mounds of the St. Johns farther south. Mica, so abundant in these low mounds and ridges, was rarely met with and in but small quantities on the river south of Jacksonville.\(^4\) Again, deposits of numerous pebbles and pebble hammers together, almost

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1 The reader will bear in mind that the St. Johns, whose general course above is south to north, turns abruptly to the east at Jacksonville.
3 Stone Island, in the Sisters Creek, when first visited by us, had a deposit of oyster shells thirty feet in height. Since that time the mass has been reduced by shipments to the jetties.
4 Abundance of mica was present in one mound of the Ocklawaha.
unknown on the upper river, were found in great abundance in the low mounds near the sea. The same may be said of numbers of mussel shells buried in association.

One point characterizing this whole region, the low mounds in common with the great, was the comparative abundance of tobacco pipes. From all the sand mounds south of Jacksonville but seven tobacco pipes rewarded our labors, while over double this number were taken from a circumscribed district between Jacksonville and the sea.

The grooved axe, present in Georgia and farther north, was absent from the mounds of this section in common with those of other portions of Florida investigated by us.

Mounds Described in this Paper.

<table>
<thead>
<tr>
<th>Johnson Mound.</th>
<th>Broward Mound.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shields Mound.</td>
<td>Reddie Point (2).</td>
</tr>
<tr>
<td>Monroe Mound.</td>
<td>Denton Mound.</td>
</tr>
<tr>
<td>Grant Mound.</td>
<td>Chaseville (2).</td>
</tr>
<tr>
<td>Low Mounds South of Grant Mound (5).</td>
<td>Alicia (2).</td>
</tr>
<tr>
<td>Horseshoe Landing (3).</td>
<td>Floral Bluff.</td>
</tr>
</tbody>
</table>

**Johnson Mound.**

This symmetrical and previously uninvestigated mound lay in the pine woods about one-half mile in a northerly direction from the first landing on St. Charles Creek, a stream emptying into the St. Johns just east of the town of New Berlin.

The mound, which had a height of 7 feet 4 inches and a diameter at the base of 65 feet, was totally destroyed with the courteous consent of the owner, William A. Johnson, Esq., of Wilmington, N. C.

The mound was composed of a peculiarly dry sand of a light yellow shade, with occasional bits of charcoal scattered throughout and a limited number of fireplaces. Pockets of sand tinged cherry color by the artificial use of the red oxide of iron, increasing in number and in size toward the center, were encountered throughout the mound.

In all, human remains were met with at eleven points. In one case the burial was in anatomical order. In the remainder but limited portions of the skeleton were represented. The bones were past all possibility of preservation—a somewhat peculiar fact in view of the dry condition of the sand.

Sherds were very limited in number, the majority being undecorated, though three or four bore a complicated stamped pattern. No vessels or considerable portions of vessels were encountered.

Singly, loose in the sand, were: three arrowheads; one bit of mica; a small "celt" and several pebbles.

With human remains was a portion of a conch (*Fulgar*).
MAP OF THE St JOHNS RIVER FROM JACKSONVILLE TO THE SEA

* Indicates Sand Mound
Scale in Miles

1895.

Jacksonville
Three feet from the surface, with a few decaying fragments of human bones, were two flat pieces of fine-grained sandstone, one roughly given the shape of a hatchet, the other resembling a keystone—a form sometimes met with in Florida mounds. With these were: a pebble about two inches in diameter; a coarse sandstone hone; seventeen chips of chert; two columnellae of marine univalves with part of another; a portion of the body whorl of a conch; one incisor of a large rodent, and several masses of certain fresh-water mussels—three to four dozen in all—laid one within the other. These mussels, *Unio Shepardiannus*, Lea, are not reported farther south than Georgia nor are any fresh-water mussels present in the tide water of this portion of the St. Johns or of its tributary creeks. Moreover, the mussels of the St. Johns are distinctive. These shells were doubtless an importa-

![Fig. 1.—Muscle shell used as knife. Johnson Mound. (Full size.)](image)

...tion, and, as Fig. 1 shows, were peculiarly adapted for use as knives, for which we know mussel shells to have been employed by the later Indians.

Almost in the immediate center of the mound, separately, were: a tubular bead of sheet copper; a fragment of sheet copper about 1 inch by 1.5 inches; a minute bit of the same material, and a portion of a sheet copper ornament about 5 inches long with an average width of 2.5 inches. This fragment lay with human remains about 4.5 feet from the surface and was too badly decayed for determination as to its original shape.

Nothing in the Johnson mound gave any evidence of intercourse with the Whites.

**Shields Mound.**

The Shields mound, near Newcastle, in section 35, township 1, has been briefly noticed by us in our Report on the mounds of the St. Johns, where it is described...
as a mound near Mill Cove. As all our readers may not have access to the work in question, at the risk of repetition, we give certain details as to size and shape of the mound.

About 150 yards from the river's bank, which at this point forms a bluff commanding the stream for miles, is a great platform mound entirely unlike in form any aboriginal earthwork on the river. Its shape is not circular, as we have stated in our Report, but slightly oblong with rounded corners; its base diameter, about 214 feet; the diameter of its summit plateau, 115 feet by 133 feet. Situate upon rolling ground, its height depends upon the point from which the measurement is taken, a fair average being 18 feet. A graded way leads up to the summit plateau on the side toward the river, while certain curious ridges, one running directly from the mound, extend in a southerly direction for a considerable distance in the rear until lost in the surrounding level. Investigation indicated these ridges to have been made for some purpose other than sepulture. We are largely indebted to F. W. Bruce, Esq., engineer in the employ of the United States Government at the jetty at the mouth of the St. Johns, for the accompanying plan and elevation of the Shields mound and its adjuncts (Fig. 2). We have requested Dr. M. G. Miller, who assisted at the survey, to notice these curious ridges in detail.

"From the southern margin of the mound B a long ridge (see plan) runs in a southerly direction for a distance of about 500 feet. With a height of about one foot where it joins the mound, the ridge gradually rises until at C it attains an altitude of 8 feet 10 inches above the level to the east. Beyond C is a marked depression from which the ridge again rises, reaching its greatest altitude, 13 feet 8 inches, at D, from which, making an abrupt turn northward, it descends gradually to the point E. The southern slope at D is so abrupt as to be difficult of ascent.

"From C a narrow terrace leads down the eastern side of the main ridge and continues, with gradually decreasing altitude to F from where a low ridge, varying in height from ten inches to six inches, extends a distance of about 350 feet, to be lost in the surrounding territory.

"About eighty-five feet to the west of this is a similar low ridge, G, leading northward along the margin of a well-marked terrace, I.

"Limited by this terrace and the main ridge is a basin, L, which has two outlets, one at E leading to the space between the two low ridges, and the other at J, between the mound and the terrace H as it turns to the west.

"About 600 yards southwest of the mound lies a small lake, to which the space between the low ridges F and G may have served as a covered way. Unfortunately, the territory in which these ridges lie has been under cultivation and it is impossible to decide as to their original extent and character.

"At ab, cd, ef, gh, ij, are given the contours between corresponding points on the plan, while at XY is given the sectional elevation of the mound and main ridge."
EXCAVATIONS.

Seventeen days of seven hours each, during parts of April and May, 1895, with an average force of thirty-one men, exclusive of those engaged in directing the work, were devoted to the investigation of the Shields mound.

The entire mound was encircled somewhat above the margin of the base and work prosecuted for about two days, the discovery of a few interments, none over three feet from the surface, being the only result.

Next, the entire eastern slope, commencing a little in from the margin, was removed for a distance of twenty-seven feet, where the trench, at this point 175 feet in breadth, had approached to within eleven feet in a horizontal line of the edge of the summit plateau. From this point the trench, reduced to a breadth of 115 feet, was carried along the base, as before, a further distance of twenty-one feet, or ten feet beyond the margin of the plateau, as shown by accompanying diagram (Fig. 3).

In this considerable portion of the mound comparatively few interments were found—possibly two dozen—none at a greater depth than three feet, nor were there any accompanying relics, with the exception of a few shell beads.

Next, the entire plateau, with about five feet of adjacent slope was dug through to a depth of from six to eight feet from the surface.

COMPOSITION OF MOUND.

No uniform stratification is apparent in the Shields mound. The base is not absolutely determinable, though a streak of sand from two to six inches in thickness, discolored by charcoal, was taken as indicating it. the light yellow sand beneath it being free from admixture of any foreign substance. Above this was a stratum of dark yellow sand from three to five feet in thickness, containing considerable charcoal in scattered particles, and this stratum continued to the point where the investigation ceased. Above it the composition of the mound varied at every stage of the digging. Yellow sand, yellowish brown sand streaked with small layers of white sand, pockets of gray sand calcined by fire with abundant charcoal, small pockets of brick red sand and layers and pockets of oyster shells and midden refuse containing sherds and fragmentary bones of lower animals, made up an almost indescribable whole. In the central portion of the broad summit plateau,
extending to the eastern margin, was a very irregular layer, at places five feet in thickness, though this was exceptional. This layer, varying in shade from light chocolate to brick red, was due to intentional admixture of the red oxide of iron with the sand—a practice whose occurrence is frequently noted in our Report on the mounds of the St. Johns.

We append a description of a fairly representative section of the mound taken at the junction of the eastern slope with the summit plateau, going down:

2 feet, 8 inches—Sand of brick red and of chocolate color.
11 feet, 8 inches—Irregular and local strata; pocket of gray sand showing effects of fire, with much charcoal; occasional pockets of shell; pockets of yellow sand darkened by plentiful admixture of charcoal.
2 feet, 8 inches—To base. Pure yellow sand with occasional particles of charcoal.

**HUMAN REMAINS.**

In that portion of the mound beneath the plateau, interments were, as a rule, in the last stage of decay, frequently marked by a few crumbling fragments, isolated teeth, or even a line of small disintegrating particles of bone—hardly more than a yellowish stain. It was, therefore, impossible to give the exact number of interments met with, or, in many cases, to determine the form of burial. At not less than 150 points human remains were encountered, presenting both methods of sepulture—the bunched variety and the burial in anatomical order. In most cases, careful examination showed an unnatural juxtaposition indicating the interment of the remains when denuded of flesh.

With four exceptions, when the burials were encountered at a depth of six feet, all human remains lay within four feet of the surface.

In the western portion of the plateau, six feet from the surface, virtually in contact, were six crania associated with but one vertebra and two clavicles. This burial, however, was entirely exceptional.

In the central portion of the summit plateau, 3.5 feet from the surface, was a quantity of small fragments of human bones and of bones of lower animals, charred and calcined. With them were a number of human bones entirely unaffected by fire.

Two pathological specimens and a number of platycnemic tibiae were sent to the United States Army Medical Museum at Washington. One of these tibiae had
CERTAIN RIVER MOUNDS OF DUVAL COUNTY, FLORIDA. 457

an index of fifty: that is to say, its lateral diameter was but one-half of the diameter taken antero-posteriorly at the point of entrance of the nutrient artery. This is the lowest index ever met with by us in Florida or recorded by anyone as from that State. Most of our readers will recall, however, platycnemia is no longer regarded as a racial characteristic.

No crania were recovered save in fragments.

EARTHENWARE.

Occasional sherds were met with in all parts of the mound, especially with the midden refuse. In the material beneath the summit plateau, so far as explored by us, they were, however, infrequently encountered, though at times oblong pieces and triangular bits doubtless intentionally given the outline of the arrow point, were encountered in close association with human remains. Undecorated earthenware predominated. The square and the diamond-shaped stamps were represented

with the occasional occurrence of the complicated stamped decoration, though not of the patterns found so abundantly in several neighboring low mounds, but wanting in the great Grant mound less than one mile distant. Fig. 4 shows a complicated stamped decoration from the Shields mound.

Portions of two vessels in fragments, with cord-marked decoration, were colored inside and out with crimson pigment. Margins corresponding to missing parts gave evidence of ancient fracture, and it was clear that here, as in many other mounds demolished by us, broken, and consequently otherwise useless, vessels had been utilized for mortuary purposes.

During the investigation, nine entire vessels, none of so much as one quart capacity, were met with, including three unfortunately badly broken at the time of discovery. None were of special interest as to shape or decoration, and all were imperforate as to the base, if we except a toy vessel shown in Fig. 5.
Fig. 7.—Tobacco pipe of earthenware. Shields mound. (Full size.)

Fig. 8.—Polished hatchet of igneous rock. Shields mound. (Full size.)

Fig. 10.—Implement of sedimentary rock. Shields mound. (Full size.)
CERTAIN RIVER MOUNDS OF DUVAL COUNTY, FLORIDA. 459

A diminutive vessel, representing a sitting bird and to a certain extent recalling Tennessee forms of earthenware, was the only variation from common types (Fig. 6). Height, 2 inches; length, 3 inches; depth of bowl, .8 of one inch.

Two tobacco pipes of earthenware were found during the investigation. One, of ordinary type, somewhat broken, had an encircling line of indentations just beneath the outer margin of the bowl.

The other, an interesting specimen, was decorated as shown in Fig. 7. Maximum length, 1.7 inches; height, 1.5 inches.

STONE.

Polished Hatchets.—Twelve polished hatchets, or “celts,” were taken from the Shields mound. Their material has not been exactly determined. One, of fine-grained, compact rock of igneous origin, was within a small fraction of 13 inches in length, which is considerably more than that of any hatchet heretofore met with by us in Florida, and close to the limit of length attained by any other so far reported from any section (Fig. 8).

We are indebted to Mr. E. P. Upham of the National Museum, for the information that a polished “celt” from Alabama, 13.5 inches in length, is probably the longest in that institution.

One small “celt” of slate, 3 inches in length, has two deep transverse parallel grooves on one side and a single one on the other (Fig. 9). These grooves may have been made by the sharpening of implements. If not, and the grooves were made for the purpose of attachment to a handle, this is the nearest approach to the grooved axe ever, we believe, reported from Florida.

A chisel of sedimentary clay rock, 8.5 inches in length, was the only implement of the type discovered in the mound.

A handsome cutting implement of fine-grained sedimentary rock differed somewhat in form from any Florida implement we have seen (Fig. 10).

Arrow and Lance Points.—In the Grant mound, less than one mile away, arrow and lance points were of comparative rarity, as we shall presently see. In the Shields mound, on the contrary, they formed an important feature among the mortuary inhumations. In all, one hundred and fourteen were taken from the mound, the great majority of chert, a few of hornstone and of chalcedony. Numerous types and sizes are represented, none offering any unusual feature. On the tangs of some, considerable bitumen adheres showing the method of attachment to the shaft.

It is possible that some of the points classed by us as arrow heads may have served as knives, fastened into short handles for the purpose. Fig. 11 shows a number of selected lance and arrow points from the Shields mound.

Tubes of natural formation.—These objects, probably natural formations around some perishable material, such as wood, are occasionally found in the Florida mounds and were no doubt utilized as ornaments, though the larger may
Fig. 11.—Arrow and lance points. Shields mound. (Full size.)
have served in lieu of tobacco pipes. Twenty-six of these objects, from 1 inch to 4.5 inches in length, were taken from the mound, and in every case, where determination was possible, they were found with human remains. One of these curious objects is figured in Part I of our Report as coming from Mt. Royal.  

**Spade-shaped implements.**

— This curious type, discussed at some length in Part I, has been reported from Florida, we believe, by us alone, three specimens having been taken by us from Mt. Royal. Two of these implements, about fourteen inches and eight inches in length respectively, were taken from the Shields mound, associated with human remains. They are probably of *Saussurite*, though for obvious reasons we have not permitted mutilation for microscopic examination. In type they differ somewhat from the Mt. Royal specimens. The end of the shaft is neither tapered nor squared but left rough and unfinished. The wings are much broader, those of the larger specimens being about 3.75 inches across. Each has four nicks, or tally marks, on either wing. The larger is shown in Fig. 12.

**Ornaments.**—With a small earthenware vessel and human remains was a pebble of sedimentary origin, pierced through the center. A little to one side of the perforation another had been attempted and abandoned.

A fragment of clear quartz crystal, 1.4 inches in length, found loose in the sand, forms part of what must have been a beautiful pendant, flat on one side, convex on the other. It is grooved for suspension.

A “banner stone” in the form of a double-bladed axe, of the type figured by us in Part II

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CERTAIN RIVER MOUNDS OF DUVAL COUNTY, FLORIDA.

as coming from the smaller mound at Thornhill Lake, Volusia County, was found at a depth of one foot, where it lay with two arrowheads. The material is of dark chocolate claystone beautifully banded. Height, two inches; breadth, about 2.5 inches; maximum thickness, about .7 of one inch.

Another graceful ornament of a schistose rock of slaty texture, lay at a depth of three feet, with human remains. It is doubly perforated and has many notches at either end. Length, 4.5 inches; breadth, 1.7 inches; thickness, .4 of one inch (Fig. 13).

Four feet from the surface, with the small earthenware pipe already figured and two arrowheads, was a "banner stone," probably of soft claystone, shown in Fig. 14. Breadth, about 3.4 inches; height, 1.7 inches; maximum thickness, .9 of one inch.

A curious little boat-shaped pendant, presumably of soft claystone, of a form new to us, was found with human remains and numerous shell beads, three feet from the surface. A perforation at
either end serves for suspension. A deep groove not possible to show in the cut is on the base. Height, 1.3 inches; width, 2.7 inches; maximum thickness, 1.1 inches (Fig. 15).

A small sedimentary pebble evidently split during perforation, lay beneath a cranium, three feet below the surface. With the two parts were an arrowhead and a chip of chert.

_Tobacco pipe._—But one tobacco pipe of stone came from the Shields mound. The material was _Steatite_ and the type that of other stone pipes of the neighborhood. It was associated with human remains at a depth of three feet, and with it were an arrowhead and a few shell beads. Height, 3.7 inches; maximum length, 3.8 inches; orifice of bowl, 1.4 inches by 1.5 inches; orifice of stem, 1.2 inches by 1.3 inches (Fig. 16).

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Fig. 16.—Tobacco pipe of soapstone. Shields mound. (Full size.)

Fig. 17.—Weapon of chipped chert. Shields mound. (Full size.)
Miscellaneous.—Two and one-half feet from the surface, in a mass of crimson pigment, with human remains, was a double pointed implement—possibly a weapon—of chipped chert, about seven inches in length with a maximum thickness of .8 of one inch. The section is triangular. The cut fails clearly to represent the two sides of the triangle. This type, so far as our experience extends, has not heretofore been discovered in Florida mounds (Fig. 17).

Together, with human remains, 1.5 feet from the surface, were: a leaf-shaped implement of chipped chert, one end unfortunately missing, with a length of 5.5 inches, and a maximum thickness of about .4 of one inch; a portion of a dagger or lance head about 4.5 inches in length, probably of crystalline sandstone; a sandstone bone, and a part of the lower jaw of a bear.

One implement of chert was rudely chipped to serve as a hammer.

One bit of sandstone, about the size of half of a closed hand, had a considerable cavity worked for some unknown purpose.

Two cylindrical beads of undetermined rock were found together, while from another portion of the mound came a part of what had been a beautiful bead or small pendant of red jasper, oblong with rounded corners.

Three small cubes of galena came from various depths.

Throughout that portion of the mound beneath the summit plateau were broken arrowheads, chips and spalls of chert, bits of sandstone and quartz pebbles, found singly.

But one or two small sheets of mica were encountered.

Bone.

Bone pins in considerable number were present in the Shields mound, often six or more with one interment. Their condition, as a rule, was fragmentary, none being so well preserved or so artistically carved as those we have figured in another report as coming from the Tick Island mound, Volusia County, Florida. Some show certain attempts at decoration (Figs. 18 and 19), while others have rudely carved heads. In other cases a shank projecting from the upper end shows traces of bitumen, indicating the former presence of a head of some perishable material, probably wood.

In close proximity to human remains was a section of a leg of a turkey—doubtless a wild turkey, though determination is impossible—with the core of a spur. It is not

1 Tarso-Metatarsal.
unlikely that this portion of a turkey leg and spur may have been used as a decoration for the lobe of the ear. At the time of the occupation of the mouth of the St. Johns by the French Protestants, in the third quarter of the sixteenth century, it was customary for the aborigines to wear ornaments of considerable size buttoned into or thrust through the lobe of the ear. In Fig. 20 we reproduce a portrait of an Indian warrior decorated with the leg and claws of some large bird, from Plate XIV of the "Brevis Narratio." The artist, Jaques Le Moyne, was one of the few survivors of the ill-fated garrison of Fort Caroline, massacred in time of peace by the Spaniards, "not as Frenchmen, but as Lutherans." Fort Caroline cannot have been much over one league distant from the Shields mound.

COPPER.

Considering the interesting types in stone taken from the Shields mound, one would look for more varied forms in copper. In addition to a number of fragments of sheet copper five small sheets of familiar type were taken separately from various depths.

A portion of a large undecorated ornament of sheet copper, centrally perforated, 6.5 inches by 7 inches, lay near the surface. With it were fragments of vegetable fabric.

A curiously shaped object of wood with circular section, bent somewhat at one end, has a pin fitted into it evidently to connect with a missing portion containing a socket. The wood has been overlaid with copper which remains at places. This fragment is too imperfect for identification.

1 "Brevis Narratio," published by DeBry, Frankfort-on-the-Main, 1591.
A handsome double-pointed pin or piercing implement, a fraction over 12 inches in length, completes the meager list of copper from the Shields mound.

**SHELL.**

Large beads of shell were represented by few specimens, and the usual small discoidal beads were of by no means such frequent occurrence as in some other mounds. As usual, when found, they lay with human remains.

A few small shells (*Olivella*), longitudinally perforated, also were present with one burial.

One interesting feature of the Shields mound has not been noticed by us elsewhere. It was an aboriginal custom from Canada to Florida to inter with the dead, canine teeth of large carnivores, usually pierced for suspension. In the Shields mound were many such canines, the majority probably belonging to the bear, though a smaller one, submitted to Professor Cope, proved to be of the gray wolf. Sometimes with these teeth and sometimes alone, invariably with human remains, we believe, were a considerable number of pendants of shell, shaped and perforated in what seems to be a close imitation of the animal teeth also used as pendants. In Fig. 21 we show a canine of some large carnivore, the prototype of the form in shell given in Fig. 22.

One columella of a marine univalve and a portion of a body whorl, probably of *Fulgur*, worked to a certain extent, were found together.

A conch (*Fulgur carica*) from which a considerable portion of the body whorl had been cut, probably to furnish material for beads or for gouges, lay loose in the sand.

Near human remains, several feet from the surface, were three conchs (*Fulgur perversum*). Two have no unusual marks. The third, however, in addition to the regular hole so often found in the body whorl opposite the aperture, had three small perforations evenly made by some tool, at various points on the body whorl.

With one burial were twenty conch shells (*Fulgur*).

**MISCELLANEOUS.**

Associated with skeletal remains was a tooth, probably of a drum fish.
The enamel coverings of four teeth of the man-eating shark, were found during the investigation. Two of these lay together, three feet from the surface, associated with human remains.

Upon the surface of the mound were bits of concrete indicating its occupation as a place of abode at a period previous to that of the existence of the frame house of the present owner, Mr. Shields, destroyed by fire some years since. Nails, bits of glass and the like, were found at a certain depth in the mound in excavations made and filled by ourselves the year previous. In addition, in excavations of limited area, possibly post-holes, and in one case, perhaps the foundation of a chimney, filled with disturbed material and debris, were bits of rusty iron, buttons, a glass bottle, bits of china, a brass bolt, a half-penny of William IV of England, and other articles of White origin. These relics of a late occupation of the mound were sometimes not far removed from purely aboriginal objects and brought forcibly to our mind how readily a careless or inexperienced investigator, or one drawing conclusions from incomplete reports, might formulate erroneous deductions as to the period of the origin of the mound.

REMARKS.

Before proceeding to base conclusions upon the results of the somewhat incomplete investigation of the Shields mound, several facts must be borne in mind, which, though previously noted, for emphasis are referred to here.

The few burials discovered toward the margin of the mound were at no great depth, the maximum being about three feet. The great bulk of sand beneath the eastern slope, lying between the point at which some of these burials were discovered and the margin of the summit plateau, contained no interments whatever. In this mass of material, as we have stated, were strata of midden refuse with oyster shells, bones of lower animals, fire places and all the marks of prolonged occupation. It is probable that these strata extend through the mound. In fact, a large bed of oyster shells was discovered in a central position about seven feet from the surface of the summit plateau. In this bed was a circular hole 8 to 10 inches in diameter, and about 4.5 feet in depth, which may have contained a pole or post during a period when that level was used for domiciliary purposes.

No burials were found in that part of the mound dug down by us at a greater depth than six feet, and those at that depth were very exceptional. While we freely admit the slight dependence to be placed upon conclusions in respect to a mound which has not been totally demolished, we are inclined to believe that the great Shields platform mound was gradually built, and during this period used as a place of domicile; subsequently being utilized on the summit plateau for mortuary purposes.

That the burials in the summit plateau were not intrusive was clearly shown by the unbroken layer of colored sand above.
With undisturbed interments were no objects save those of purely aboriginal origin, though, as we have stated, and as might be expected in ground beneath a site used for residence in recent times and most probably during the English and Spanish occupation, at various points superficially were a number of objects found in use among the Whites. Under these circumstances there would seem to be no reason to assign to the burials beneath the summit plateau of the Shields mound a period other than one antedating the coming of Europeans.

**Gilbert Mound.**

The Gilbert mound stood in the pine woods, in full view of the road, about one-quarter of a mile southeast of the Shields mound. Its outline was that of an egg, its greatest height 4 feet 9 inches, being at the broadest portion from where it sloped gradually to the level of the surrounding territory. It was 86 feet in length, its maximum lateral diameter being 53 feet.

It was completely demolished, with the cordial consent of the owner, Mr. W. A. Gilbert, of Jacksonville, Florida.

The mound, unstratified, was composed of yellowish sand with occasional pockets of red sand in connection with some of the deposits of relics.

Human remains were encountered at various depths, superficially, in the body of the mound and below the level of the surrounding territory. In all, human remains were noted at twenty-seven points in the mound, though it is possible that a trench dug by a former investigator may have removed a certain number in addition. In no case did interments noted by us, which were of the bunched variety, include the entire skeleton. In a number of cases isolated crania were found and once, two skulls associated with no other bones. Again, the cranium was accompanied by the shaft of a long bone, while in one instance nothing was found but a portion of a tibia, curiously enough accompanied by art relics.

Virtually no sherds lay scattered loose throughout the sand, though numbers of fragments of vessels were found, usually with human remains. When put together, these fragments did not represent complete vessels. They belonged to vessels of ordinary type, of small or medium size and undecorated. In no case was stamped pottery met with, neither the stamped decoration of squares and diamonds so frequently found on the sherds of the two great neighboring mounds nor the complicated stamp of various intricate patterns so plentiful in the low mounds in the immediate vicinity.

Five and one-half feet below the surface, with an isolated cranium, was a globular bowl with inverted rim surrounded by an interesting raised decoration. The base is without perforation. Its height is 4.5 inches; its maximum diameter 6.4 inches; diameter of orifice, 2.8 inches (Plate LXXI, Fig. 1).

About two feet from the surface, associated with human remains, were two graceful vessels entirely intact. The larger (Plate LXXI, Fig. 2) of less than one
pint capacity, is of fairly good material carefully smoothed. Its height is 3.6 inches; its maximum diameter, 3.9 inches, while the aperture, from which the rim turns out slightly, has a diameter of 2.9 inches. There are two perforations for suspension.

The smaller vessel, with a height of 3.3 inches, a maximum diameter of 3.3 inches, and a diameter at opening of 2.6 inches, has a perforation at either side for suspension. The rim is slightly scalloped and to a small extent everted. The body of the bowl is decorated as shown in Plate LXXI, Fig. 3. The material is of good quality.

In the southern margin of the mound, three feet below the surface, considerably below the level of the surrounding territory, near human remains, was a vessel of about one pint capacity, from which portions of the rim, old breaks, were missing. Height, 3.9 inches; maximum diameter, 4.4 inches. The base is imperforate. Its incised decoration lacks uniformity. The most interesting portion is shown in Plate LXXII, Fig. 1.

In caved sand was a toy vessel about two inches in height with imperforate base and flaring rim which was unfortunately damaged by contact with a spade.

A number of additional vessels of ordinary type and size, without decoration, were recovered during the investigation. Some were intact, while others had been intentionally mutilated as to the base.

 Loose in the sand, near the base, was a mass of cherty material about 5 inches by 3.5 inches by 2.75 inches. Its shape was ovoid. It was doubtless fashioned to do duty as a hammer. A somewhat smaller mass of coralline limestone, not so regularly shaped, lay unassociated, about 3 feet from the surface.

Sheets of mica, of somewhat irregular shape, some so large as 7 inches square, came from various depths.

Some had perforations for suspension or for fastening to garments. These sheets of mica, as a rule, were associated with pebble hammers, chips of chert, bits of shell and of sandstone.

Two and one-half feet from the surface, probably on the base, as the mound sloped considerably at that point, with part of the shaft of one human long bone, were one rounded piece of sandstone, one bit of chert, two pebbles, one small fragment of earthenware, and many marine mussel shells (Modiola plicatula). These shells lay in bunches, one within the other, showing them to have been inhumed without the animal, and therefore not as food. About 18 inches below this curious medley was an undecorated bowl, imperforate as to base, of about one quart capacity.
A chisel or gouge, of shell, found alone, had two incised parallel grooves extending the length of one side (Fig. 23).

In the central portion of the mound, about 6 feet from the surface, with human remains, including a tibia of considerable pathological interest, were: five arrow heads of chert; two chisels neatly wrought from the lip of Strombus; one Fulgur; bits of sandstone; various fragmentary portions from columellae of marine univalves, showing grooves, probably the initial step in the manufacture of some ornament.

Near the base, with human remains, were a piercing implement of bone, the articular portion remaining; a bit of coquina; part of a cannon bone of a deer, a fragment of buck-horn, and a considerable number of marine mussel shells.

In various other parts of the mound, curious collections, somewhat similar to those described, were met with. With one lot was a small chisel of stone, polished at one end and roughened at the other.

Nothing in any way indicating intercourse with the Whites was discovered in the Gilbert mound.

Monroe Mound.

The Monroe mound lay about one quarter of a mile southeast of the Grant mound (see map), in a peach orchard, the property of Mr. George J. Monroe, of Joliet, Illinois. Its height had been reduced by cultivation. Its shape was somewhat irregular. Its length was about 63 feet; its breadth about 5 feet less. At the center of the broader portion, the maximum height of the mound was 3 feet 2 inches. A deep depression on the west showed whence the material of the mound had been derived.

There had been no previous investigation.

The mound was completely destroyed, being dug through at a depth of about 3 feet below the level of the surrounding territory.

It was evident that the mound had been constructed in the following manner. First, a fire was built on the surface, possibly to destroy the underbrush. Next, a pit of the area of the intended mound was dug to a depth of about 3 feet. In a central portion of this pit was made a deposit of human remains with certain artifacts to be described later. Then the pit was filled with the sand previously thrown out, through which was plentifully mingled charcoal from the surface fire. During the process of filling, various relics, but no human remains, were deposited, and covered by the sand. When the pit was filled to the general level, a great fire was made over its entire area as was evidenced by a well marked stratum of sand discolored by fire and containing particles of charcoal, extending entirely through the mound at the level of the surrounding territory. Upon this the mound proper was constructed and various bunched burials and art relics introduced.

In all, human remains were encountered eleven times, once at the base of the pit, the remainder in the body of the mound. The burials were of the bunched variety, but small portions remaining.

1 Sent to the United States Army Medical Museum, Washington, D. C.
CERTAIN RIVER MOUNDS OF DUVAL COUNTY, FLORIDA. 471

Sherds were fairly numerous, some of superior quality with lined decoration artistically executed. Others of less excellent material were undecorated or bore complicated stamped decoration of the type seen in neighboring low mounds (Plate LXXII, Fig. 2). The common square stamp and diamond shaped stamp were present but twice in the mound and then superficially.

At a depth of 1.5 feet, apparently unassociated, was an undecorated bowl of about three quarts capacity, with a perforation of base made subsequent to manufacture, which afterwards fell into pieces too small for restoration.

At the same depth, in a different portion of the mound, was a vessel of heavy ware of much better quality than usual. Its outline is elliptical. Small handles, one of which is partly missing, extend horizontally from either end. On the rim, which is .7 of one inch in breadth, and on the handles, is incised decoration. Height, 2 inches; present length, 5.7 inches; width, 4.5 inches. The base shows perforation after manufacture (Plate LXXIII, Fig. 1).

With a burial about 1 foot from the surface, though no doubt at a greater depth before long continued cultivation of the mound, were one polished hatchet and a fragment of a marine shell. With these were great numbers of fragments of various vessels, though in no case was the entire vessel represented.

About 1 foot down was a vessel with intricate stamped decoration, of about one quart capacity. Its base was intact. No human remains were noticed in its vicinity.

Four feet from the surface, unassociated, was a mass of graphite about 2 inches by 1.5 inches by 1 inch. One side was slightly pitted, the other deeply so.

Apparently unassociated with human remains, 4 feet from the surface, together, were: five arrow points of chert; one flake of the same material, used as a cutting instrument; one sheet of mica, and four worked masses of sandstone and of chert. One foot farther in, on the same plane, together, were: one pebble; one small mass of chert; one bit of coquina; two drinking cups wrought from Fulgur perternum, with perforated bases, one within the other, containing a number of marine mussel shells. With these lay an interesting little vessel, undecorated, with three compartments intact save a small portion missing from the base of one. The nature of this fracture would indicate the result of accident rather than an intentional perforation of the base. Length, 5.8 inches; maximum width, 3 inches; depth, 1 inch (Plate LXXIII, Fig. 2).

Almost in the center of the bottom of the pit of which we have already made mention, about 4 feet from the surface, were several decaying fragments of a cranium and a portion of the shaft of a long bone. With these was a boss of sheet copper with deep central indentation through the middle of which is a perforation for attachment. On the outside a knot of the original cord still remains. With this ornament was a lance head of copper, 7.6 inches in length, with a maximum breadth of 1.8 inches. This interesting piece, unlike anything else in copper we have seen in Florida, has almost a cutting edge at the sides with slightly increasing thickness to a maximum of .1 of one inch in the middle. A notch is at either

50 JOURN. A. N. S. PHILA., VOL. X.
CERTAIN RIVER MOUNDS OF DUVAL COUNTY, FLORIDA.

side of the base by which it was doubtless fastened to the shaft. One would hardly expect a weapon of copper of this thickness to be of much effect against any but unprotected bodies. Highly polished, it would have an attractive appearance and may have been used for ceremonial purposes (Fig. 24).

With one burial were two shell beads each about .75 of one inch in length.

Several vessels of medium size and uninteresting as to type, were taken from various depths, as were a number of pebbles, always several together.

REMARKS.

It may be well to note here that pebbles which seem of so little value to us, and whose presence in these low mounds must strike many of our readers as curious, were to be had in this section of Florida by importation alone, and were distinctly of value either for use as small hammers or as raw material for the manufacture of pendants and the like.

Nothing discovered in the Monroe mound points to an origin other than aboriginal.
Grant Mound.  

The Grant Mound, near New Castle, Duval County, Florida, in Section 35, Township 1, stood on the southern bank of the St. Johns River, on a bluff 25 feet in height. Its situation is noted on the Government chart relating to this portion of the river. It lay about one mile in a westerly direction from the Shields mound.

The height of the mound, taken from the present level of the bluff on the west, was 20 feet 8 inches. On the eastern side is an abrupt dip of the land and a measurement from this quarter would have given an exaggerated idea of its altitude. The base of the mound, as we shall see later, was marked by a layer of oyster shells. From this base line, taken on the western side where no natural depression exists, the height of the mound was 30 feet 9 inches and even this considerable altitude must be increased by at least one foot to allow for material removed by us at a previous investigation, as was shown by trees growing on the summit. It is evident, then, that the territory around the margin of the mound, which was composed, to a depth of several feet, of dark loamy sand and scattered oyster shells, either was a deposit belonging to a period subsequent to the erection of the mound and had consequently lessened its height by about four feet, or previously existing, had been dug into to a depth of four feet.

Fully one-third of the mound on the north, undermined by the river previous to our investigation, had fallen into the stream, and it is probable that had not the hand of man anticipated its destruction, a limited term of years would have seen the mound entirely absorbed by the river—to a certain extent a consolation for the loss of so notable a landmark.

In shape the mound was the usual truncated cone. Its base diameter was 216 feet and that of the summit plateau but 24 feet. The western slope was at an angle of 28°, the others somewhat less steep, though, taken as a whole, the mound was one of the most symmetrical we have met with.

Two low ridges, one somewhat better marked than the other, almost parallel, start a short distance from the southernmost portion of the mound, and, after a time, merge in the surrounding level. Investigation failed to reveal either interments or art relics in them, and it is presumable that these causeways were used as approaches, like others found in connection with Florida mounds.

The mound was totally demolished by an average force of forty-three men, exclusive of those supervising the work, digging seven hours per day during a period of five weeks of March and April, 1895.

1 A short account of a former investigation of this mound was given in our "Certain Sand Mounds of the St. Johns River, Florida," Part II, Jour. Acad. Nat. Sci., Vol. X.

2 See frontispiece.
COMPOSITION OF MOUND.

No uniformity of stratification was observed in the construction of the Grant mound. The bluff on which it was built had previously served as a place of abode for the aborigines whose kitchen refuse, in the shape of oyster shells, fragments of bone, and of earthenware, mingled with black loamy sand and charcoal, formed an irregular layer sometimes five feet in thickness.

This layer constituted the base of the mound.

Upon this base, through the outer portions of the mound, ran a layer of sand intentionally given a cherry color by the use of Hematite, from twelve to eighteen inches in thickness, which, gradually ascending, was lost, its place being taken, at certain points, by an irregular stratum of pure white sand with a maximum thickness of about two feet.

While the great bulk of the mound was composed of yellowish sand, there were very numerous pockets and local layers of considerable size of white sand, fine and again coarse and angular; of brown sand; of gray sand; of sand dyed a beautiful cherry, and of oyster shells mingled with black loam and midden refuse. A superficial layer of rich brown loam had a varying thickness of from two to three feet. The usual particles of charcoal were encountered throughout the mound.

At one point on the western side of the central portion of the mound was a striking combination of shades. Above the shell base was a layer of sand black in color through admixture of loam, six inches in thickness. This was surmounted by a band of white sand about ten inches through, above which was a stratum of sand of a chocolate tint, about three-quarters of a foot in breadth. Next came a layer one foot in thickness of sand of stone color, which was surmounted by seven inches of sand tinged a bright cherry. Above these layers were masses of yellowish sand with occasional strata of brown sand and of blackish sand containing oyster shells. This conformation, it must be borne in mind, was not representative of other portions of the mound.

Water-worn sherds, some from central portions of the mound, gave evidence that a portion of the material had been brought from the river front below.

Scattered oyster shells were frequently met with throughout the entire mound and to such an extent was their distribution that, by constant contact with the spade and thus exciting vain hopes of the discovery of more valuable articles, they considerably interfered with the interest of the search.

HUMAN REMAINS.

Skeletal remains in the Grant mound were singularly disproportionate in number to the vast bulk of material present, and emphasized more clearly than ever before in our experience how much needless labor was sometimes undertaken by the aborigines for their dead. Many men in our employ dug for days without encountering a vestige of human remains and in the entire eastern and southeast-
CERTAIN RIVER MOUNDS OF DUVAL COUNTY, FLORIDA. 475

eru portion of the mound virtually none was present while in no part (excluding
the side bordering the river, as to which we are not in a position to speak) had any
interments been made within nineteen feet from the margin of the base.

During our first investigation, which included a superficial portion of the
mound containing but few skeletal remains, no burials in anatomical order were
met with, such as were encountered being of the bunched variety exclusivity.

In point of fact, however, as was demonstrated by the demolition of the mound,
the burial in anatomical order largely predominated, though both forms were met
with. On the base, especially, few, if any, bunched burials were brought to our
notice.

More forcibly than ever before was brought to our attention the opposite state
of preservation of bones presumably of approximately the same age. At times, in
various portions of the mound, the skeleton was represented by remains with hardly
a greater consistence than putty, while again, often at no great distance from the
base, the bones were fairly well preserved. Such remains lay near oyster shells
from which, doubtless, the infiltration of lime was a potent factor in preservation.

In the Grant mound, as in all other mounds we have investigated, the great
majority of skeletal remains was unaccompanied by relics of any sort.

No crania were preserved, the facial bones being in all cases crushed or wanting
through decay and the vaults usually to a certain extent broken in.

Marked examples of platycnemia and of the pilastered femur were noted, and
these, with specimens bearing evidence of inflammation and others showing fracture.
were sent to the United States Army Medical Museum at Washington.

After a careful examination of the bones from the Grant mound we were
impressed, as has been the case during all our mound work in Florida, with the
exceedingly limited number of fractures present among them, probably much less
than would be encountered among modern skeletal remains. Presumably the level
country, the sandy soil, the absence of ice and of horses and of vehicles, of scaffold-
ing and of machinery, and of many other things incidental to civilization, militated
against accidents to the human structure.

LOCATION AND ASSOCIATION OF RELICS, ETC. 2

The proceeds of the demolition of the Grant mound were disappointing in so
much as, contrary to our expectation, few new types or specimens of remarkable
interest, were encountered. In fact, the eastern and southeastern portions of the
mound were virtually barren, as was that part 25 feet in all directions from the

1 The reader will recall that this flattening of the tibia is no longer regarded as a racial charac-
teristic but rather the result of muscular traction upon the bone, in running and climbing. Mémoire
sur la Platynétrie chez l'Homme et chez les Anthropoides. Dr. Manouvrier. Mémoires de la Société d'

2 The reader of our "Certain Sand Mounds of the St. Johns River," Part II, will recall that at
the previous investigation of the Grant mound we found one sheet-copper ornament, a number of beads
of the same material, two small vessels of earthenware and a number of "ceits" of polished stone.
margin of the base, save on the north where the encroachment of the river, to which we have referred, prevented determination. The objects discovered, comparatively few, when we consider the enormous mass of sand removed, were mainly confined to the north and northwest portions of the mound surrounding the summit plateau. Beneath the plateau itself the discovery of relics was comparatively infrequent. All the tobacco pipes found by us and five previously taken out by persons well known to us, were from the northern, or river, side of the mound.

So great was the height of the mound that frequent slides of masses of sand were unavoidable, and thus exact depths of objects found were often unobtainable, though at times close estimates were to be made since sections of the mound, sliding down a few feet as a whole, retained their integrity, holding undisturbed human remains and associated objects.

In describing various articles from the Grant mound we shall not give in all cases exact details as to objects found in association, but shall content ourselves with a few representative examples of “finds” of various relics encountered together and in the immediate neighborhood of skeletal remains, stating at the same time that, as we have said, most burials were without accompanying relics when found;

1 that shell beads, usually unassociated with other objects, were the most frequent tribute to the departed; that beads and sometimes ornaments, of sheet copper, were occasionally found with the beads of shell and that stone hatchets, singly, in pairs or very rarely three at one time, occasionally lay with the bones, sometimes associated with other objects.

About four feet from the surface, in the northern slope, a short distance apart, were two drinking cups wrought from Fulgur perversum. Into each a skull had been crushed to fragments by weight of sand. With one were a number of large shell beads and several ellipsoidal objects of shell. About one foot above was a large fossil shark’s tooth.

Beneath the cranium of a skeleton in anatomical order, 20.5 feet from the surface, in a mass of crimson pigment, were a tobacco pipe of sandstone and several shell beads.

Together, with human remains, in contact with, and partially enclosed in, a mass of red pigment, were many shell beads; several small sheets of mica, one cut square with central perforation, doubtless for attachment; small beads of sheet copper; numerous fragments of sheet copper; a large tobacco pipe of Steatite, and one human molar with incised line around the crown and a central perforation for suspension.

In the eastern side of the mound, with human remains, were: a shell drinking cup; many shell beads; small beads and very fragmentary ornaments of sheet copper; a mass of red pigment about the size of a cocoanut; a tobacco pipe of undecorated earthenware of the usual type found in the mound, and a disc of lime-

1 It is possible that objects of wood, fur, vegetable fabric and other perishable materials, when not in contact with copper, may have, in some cases, disappeared without leaving a trace.
CERTAIN RIVER MOUNDS OF DUVAL COUNTY, FLORIDA. 477

stone 1.5 inches in diameter and .2 of one inch in thickness, centrally perforated and overlaid with sheet copper on one side. These objects were about six feet from the surface.

PEARLS.

With shell beads, near human remains, were two symmetrical pearls perforated as is the case in the mounds. The larger pearl is .35 of one inch by .25 of one inch.

SHELL.

Beads.—Shell beads in great abundance, always with human remains, were present in the Grant mound. Though great numbers of the smaller forms were not recovered, nevertheless a box 14 inches by 10.25 inches by 5.75 inches, was entirely filled. The beads were of every shape, discoidal, spherical, barrel-shaped, tubular, of various sizes. One discoidal bead of shell, of about one inch diameter, had been overlaid with copper.

Two beads found 10 feet down in the northern slope, with other beads and associated with human remains, were of graceful and unusual pattern; the larger, with a length of 1.2 inches and a maximum diameter of .5 of one inch; the other somewhat smaller (Fig. 25).

In a few instances, numbers of small elongated marine shells (Olivella and Marginella) longitudinally perforated, lay in lieu of beads with human remains. These little shells were in use for a like purpose in post-Columbian times.

Drinking cups.—The reader will recall that the conch (Fulgur perversum) was utilized by the aborigines as a drinking cup by the removal of the columella and a portion of the body whorl.

Nine such drinking cups were met with during our last investigation, usually associated with other objects. Some of these were perforate as to the base; others were intact.

Pendants.—A number of pendent ornaments of shell, mostly resembling in type others described and figured by us elsewhere, were found throughout the mound. One, cylindrical in shape (Fig. 26) is of somewhat unusual design for Florida. Its length is 3.2 inches. The perforation begins at one side, meeting one from the top.

Another pendant, found with a long tubular bead of shell, is of a somewhat elongated pear shape with one side flattened.

A graceful ellipsoidal ornament of shell from the mound is shown in Fig. 27.

Miscellaneous.—Four columnellae of marine univalves were found during the excavation.

A cockle shell (Cardium) contained a certain amount of crimson pigment, but whether it had been used as a receptacle for paint, an aboriginal use for certain shells in California, or whether the pigment was accidentally obtained through proximity to one of these masses present throughout the mound, we are unable to say.

**EARTHENWARE.**

Thirty-five vessels of earthenware were taken from the Grant mound, none of so much as one quart capacity. Some had the base intact; others a hole knocked through after baking, though the great majority were of the "freak" style of mortuary pottery with perforation in the base made prior to baking. None bore any traces of soot or evidence of use over fire. These vessels, as a rule, did not seem to be associated with human remains, though, in the case of many which came from sand caved from above, absolute determination was impossible. The material of all was of the usual flimsy sort used for vessels made for mortuary purposes.

In Plate LXXIII, Fig. 3, is shown a bowl 1.8 inches in depth with a maximum diameter of 5.3 inches. In common with all other vessels in the Grant mound, it shows no sign of use over fire and is probably of the mortuary variety.

In Plate LXXIV, Fig. 1, we have a vessel doubtless of a similar type, though in both cases the base has been perforated after completion. Height, 2 inches; length, 6.9 inches; maximum breadth, 4.8 inches.

A specimen of the pure "freak" variety is shown in Plate LXXIV, Fig. 2. The perforation at its base was made previous to baking. The form is entirely new to us. Height, 4.2 inches; maximum diameter, at rim, 3 inches.

Plate LXXIV, Fig. 3, represents a portion of a vessel with perforations of side and base. The motive for constructing a vessel of this sort is not apparent. Very recently vessels each with numerous perforations at the base have been found...
are doubtless types of mortuary ware. The made prior to baking; the smaller, imperforate as to the base, has two small holes for suspension.

A bowl of about one quart capacity, with incised and stamped decoration beneath the margin, has but one of the two holes, one on either side, usually made for suspension. As the base has a large perforation made previous to baking, it is probable the potter was not over-careful as to the bestowal of details not likely to be called into requisition.

One small vessel with perforation of base made prior to completion, has a small hole on either side of this perforation and none in certain Kentucky mounds. These are supposed to have served as colanders or sieves, like those in use in southern Mexico for straining the cactus fruit. In the case of our vessel, however, such cannot have been the case, as a perforation at the base, made previous to baking, has a maximum diameter of almost 1 inch. It is perhaps an emphasized form of "freak" mortuary ware.

A vessel of a type entirely new to us was recovered in a somewhat fragmentary condition. The form calls to mind certain tobacco pipes, but in this specimen the perforation is wanting. Two small holes, one on either side of the rim, served for suspension (Plate LXXV, Fig. 1). Length of base, 5.3 inches; width of base, 2.2 inches; full height, 3.1 inches; maximum diameter of bowl, 2.7 inches; diameter of orifice, 1.7 inches.

Plate LXXV, Figs. 2 and 3, larger has a perforation at base...
beneath the rim. We have never before seen this proceeding and are at a loss to account for its motive.

Another bowl, with the usual small perforations beneath the margin on either side, has, about one inch below the rim in the other two sides, holes about three-quarters of an inch in diameter, carefully cut.

A number of other vessels from the Grant mound, though of considerable interest, will not be particularly described here, since, to a certain extent, they resemble vessels from other mounds referred to, and figured in, our previous reports.

Sherds were of infrequent occurrence in the Grant mound. Some bore the usual stamped squares and diamonds, but in one instance only was there brought to our notice the complicated stamp of such frequent occurrence in many low neighboring mounds.

But two tobacco pipes of earthenware were recovered. The larger, with length of stem 2.8 inches, height of bowl 3 inches, orifice of bowl 1.7 inches by 2.8 inches, had, when found, a small ornament of sheet copper fastened beneath the margin of the orifice, facing the smoker, by an encircling cord which crumbled into dust (Fig. 28).

A somewhat smaller tobacco pipe of ordinary type came from a depth of 6 feet, with human remains and many associated objects.

A large bead or pendant, of earthenware, was of equal proportions in height and in length, 2.3 inches (Fig. 29).

STONE.

Hatchets or "celts."—In all, 117 hatchets, or "celts," were taken by us from the Grant mound during the second investigation. Their material has not been separately determined, the majority, however, being from rocks of igneous origin, while an occasional sedimentary or metamorphic rock is represented. None of these rocks are found in Florida.

Twelve feet from the surface, just beneath a skeleton with which were beads of shell, was the most perfectly symmetrical and beautiful "celt" it has been our good fortune to find. The material, light green in color, is believed to be an altered Felsite. The semi-circular outline of the cutting edge has been conferred with wonderful precision. This implement is of the pure Santo Domingo type. The cuts by no means convey a fair idea of the appearance of the original. Length, about 5.5 inches; maximum breadth, about 2.6 inches; maximum thickness, about 1.5 inches (Figs. 30 and 31).

Arrow and lance heads.—The interment of arrow and lance points with the dead was largely a matter of fashion. In the Shields mound, less than one mile distant, they were very abundant, as was the case in Mt. Royal, which closely resembled the Grant mound in many particulars. In the Grant mound but fifteen were taken out by us. None was of unusual size or of especial interest.
Tobacco pipes.—Three pipes of soapstone, variously associated, came from the Grant mound. One of these was about the size and form of the one figured from the Shields mound. The others were somewhat smaller though of the same type. One had two lines rudely incised on one side and one on the other.

A tobacco pipe of sandstone came from a depth of 20.5 feet, beneath a cranium with a mass of red pigment and shell beads. Length of bowl and stem, 3.4 inches; diameter of bowl, about 1.7 inches (Fig. 32).

Another tobacco pipe of sandstone, with bowl nearly at right angles to the stem, lay in caved sand. Height of bowl, 2.5 inches; length of stem, including base of bowl, 2 inches; diameter of bowl, about 1.7 inches (Fig. 33).

Pendants.—A pendant, probably of fine-grained Diorite, 2.5 inches long with maximum diameter of 1.2 inches, lay in caved sand (Fig. 34).
CERTAIN RIVER MOUNDS OF DUVAL COUNTY, FLORIDA.

A pear-shaped pendant of quartz, grooved at the neck for suspension, about 2 inches in length, has a maximum diameter of about 1.6 inches.

_Tubes._—During the excavation several tubes of sandstone and of coquina, were met with. In addition, six curious natural formations, such as we have referred to in our account of the Shields mound, were recovered separately.

_Miscellaneous._—Several sandstone hones and a few loose pebbles and chips of chert were encountered separately. Mica was noted but twice, in each case thin sheets perforated for attachment. Fifteen masses of galena, some about one-half the size of the closed hand, came from various depths.

BONE.

A feature of the Grant mound was the great quantity of bone piercing implements and pins interred with human remains, sometimes a considerable number at one spot. Most, in a very fragmentary condition, were not preserved. None showed unusual or artistic forms. Fig. 35 represents a fragment with incised decoration. A considerable number, entire or but slightly fragmentary, are preserved in our collection with all the contents of the St. Johns and Ocklawaha River mounds at the Academy of Natural Sciences of Philadelphia.

COPPER.

The yield of copper from the Grant mound was somewhat disappointing, being, as a rule, a repetition on no very large scale of the usual types of ornaments of sheet copper and of other materials overlaid with sheet copper.
CERTAIN RIVER MOUNDS OF DUVAL COUNTY, FLORIDA. 483

In many places in the mound mere traces of the copper remained and at times a discoloration of bones or of beads was the only evidence of the former presence of the metal.

Upon a number of occasions a single bead of sheet copper, not over one-third of an inch in length, lay with many beads of shell, showing the scarcity of the material.

As in other mounds no two ornaments of sheet copper were alike, and the sheets were slightly irregular in length, in breadth, and in thickness.

What we have before noted, namely, the almost entire absence of copper implements of any sort in Florida,1 was emphasized in the Grant mound, where no object of that character was present save pins or piercing implements and even these may have done duty in the hair.

As in other mounds, the copper of the Grant mound was at times wrapped in bark or in vegetable fabric, a custom, as we have before stated, prevailing in other parts of the United States and in Canada, and, curiously enough, the occurrence of the same custom is noted in England, where, upon one occasion at least, prehistoric bronze was wrapped in linen.2

In addition to a considerable number of sheet copper ornaments, in a fragmentary condition, nine of the usual type consisting of repoussé bosses and beaded lines were recovered entire, or nearly so, from the Grant mound, two of which we show, full size, in Figs. 36 and 37.

One ellipsoidal bead of sheet copper, of the same shape though somewhat smaller than the one recovered during the previous investigation of the mound and figured3 in Part II, came, with human remains, from the western slope of the mound. In addition, four beads of the same material, though more elongated in shape, were met with, the largest being 2.75 inches in length with a maximum

1 From the interesting “Notes on Primitive Man in Ontario,” by David Boyle, we learn that the reverse of this is true in Ontario where such specimens of copper as are found are almost invariably tools or weapons.


Ornaments of sheet copper. Grant mound. (Full size.)
CERTAIN RIVER MOUNDS OF DUVAL COUNTY, FLORIDA. 485

diameter of .75 of one inch. Smaller beads of copper were found in considerable numbers.

A large bead of wood, 1.6 inches by 1.3 inches, spheroidal in shape, had been overlaid with sheet copper, portions of which still adhere.

Seven pins or piercing implements of copper, the longest 13 inches in length, were found variously associated at different depths. All seem to have been made by hammering sheet copper into the required shape.

A disc of limestone, 2 inches in diameter, with a central perforation, overlaid with sheet copper on one side, and a somewhat smaller disc of shell or of limestone of the same type, came from different portions of the mound. With the smaller was an earthenware pipe.

Two discs, probably of limestone, overlaid with sheet copper, with shanks extending from the lower central portions, were found together near human remains and were doubtless used as ear plugs. A somewhat similar ornament is figured by us\(^1\) in Part I as coming from Mt. Royal.

About 13.5 feet from the surface, near together, associated with human remains and a mass of red pigment, were two cones of wood, 3.2 inches and 1.7 inches in height, respectively, each with base diameter of 1 inch. These cones had been overlaid with thin sheet copper which had preserved the wood. Portions of the coating were still adherent. From the base of the larger cone projected a pin .9 of one inch in length, exactly fitting into a socket having a depth of .6 of one inch in the base of the smaller cone. This pin was not an integral portion of the cone from which it projected, but had been let into a small socket and secured with bitumen.

These interesting specimens, unique so far as we know, were carefully allowed to dry and then treated with shellac.

It is not unlikely that these objects form two parts of an ear ornament, one worn on either side of the lobe, the pin passing through the perforated portion (Fig. 38). The difference between the length of the pin and the depth of the socket would be about made up by the thickness of the lobe of the ear.

During the investigation an ornament, or, more probably, two somewhat similar ornaments, of sheet copper, were laid bare at a depth from the surface of about

\(^1\) *Op. cit.*
20 feet. Before this copper could be removed a section of the mound fell from above burying the objects beneath tons of sand and breaking them, to a certain extent, as we learned hours later when they were recovered. It was apparent at the same time, however, by the carbonated edges of certain fractures that the ornaments had undergone some breakage previous to the caving of the sand.

The larger ornament consists of a shield, or escutcheon, shaped concavo-convex sheet of copper, with a maximum length of 2.6 inches and a maximum width of 2.2 inches. This shield has repoussé decoration, probably intended to represent the human face, the raised portion of the decoration being on the concave side of the shield. Near the margin, about .7 of one inch from the upper edge, is a small perforation on either side as shown in Fig. 39. From the convex side of the shield, where the design is depressed, the remaining portion of a band of copper, about 1.3 inches broad, projects (see section, Fig. 40). It is slightly bent, but has the appearance of having at one time been at right angles to the shield and having been bent by weight of sand. Near the shield lay a band of copper, 3.5 inches in length, and of the same breadth as the portion fastened to the shield. The ragged edge at either end, however, is carbonated, showing an early fracture. One portion of this band, which

![Fig. 39.—Ornament of sheet copper. Grant mound. (Full size.)](image1)

![Fig. 40.—Transverse section of same. (Full size.)](image2)

is heavily carbonated, being cleared by acid, shows a straight line of rivets, running transversely, where it had probably been joined to the tongue projecting from the shield.

The shield-like portion of the second ornament is somewhat smaller, having a maximum length of 2.3 inches, and a maximum width of 1.9 inches. It is thinner than the larger shield, from which it differs in that it has repoussé decoration on the convex side alone, the concave side being undecorated and the excised portion from the upper part in the concave side does not end squarely, but has its base in the form of an upright wedge. Vegetable fabric, not shown in the cut (Fig. 41), adheres to the convex side which shows considerably less convexity than the larger shield. From the convex side, as in the case of the other specimen, a band of sheet copper, irregularly bent over, probably by weight of sand, projects as represented in section (Fig. 42a). Near the shield lay a band of copper about 2.5 inches in
length, of the same breadth as that portion projecting from the shield. The line of fracture shows a recent break as does that of the band on the ornament. As the two portions do not join, it is probable an intervening portion is missing. This band of copper differs from that probably belonging to the larger shield, which is made of but one thickness of copper, in that it is constructed of one sheet bent upon itself to give double thickness, the edges meeting at the margin.

Dr. M. G. Miller, who has made a careful examination of the method of construction of these ornaments, writes as follows:

"The surfaces of both shields were obscured by a thick coating of carbonate, the removal of which required the use of acid.

"The smaller ornament consists of two plates. That on the concave side, smooth, undecorated and showing no fissure in the median line, was made from a solid sheet. The plate of the convex surface is composed of two sheets each cut according to the pattern shown in Fig. 42c and united in the following manner:

First, the tongue, D, was bent to a right angle with the remaining portion. Then the sheet of the other side being prepared in a corresponding fashion, the two were brought together in such a way that the tongues were in apposition and the margins overlapped at E and F, Fig. 42b. Rivets along these margins, as indicated at E, F, in Fig. 42b united the sheets, while the edges of one tongue were bent around those of the other as shown by the dotted lines. The plate thus formed was decorated as represented in the cut, and attached to its companion by applying it against the convex surface and turning its edges around the margin of that plate and pressing them tightly against the other side (Fig. 42a and dotted lines on 42b). More rivets than those represented in the cut may have been used in the formation and union of the plates, but fear of serious injury to the
CERTAIN RIVER MOUNDS OF DUVAL COUNTY, FLORIDA.

specimen restricted the search. At G and H are indicated places where the convex plate has fallen away exposing the plate beyond.

"The larger ornament was examined on both surfaces as carefully as its condition would allow, but no rivets were discovered. It was, however, apparently constructed after the fashion of the convex sheet of the smaller ornament, as shown by the overlapping at the point, by the fissure along the median line of the concave surface and by the apposed tongues projecting from the convex surface."

REMARKS.

It is probable that the demolition of the Grant mound was a work as extensive and as carefully conducted as anything of the kind ever undertaken in this country. During the entire investigation not one object in any way connecting the mound with a period subsequent to White contact, was discovered. Under the circumstances, we think the mound and its contents may safely be assigned to a period prior to the arrival of Europeans.

LOW MOUNDS SOUTH OF GRANT MOUND.

About 500 yards in a southerly direction from the Grant mound, in dense underbrush, was a series of low elevations of irregular shape, which had been considered of natural formation, by persons who knew of their existence.

![Plan of low mounds south of Grant mound.](image)

It was difficult to determine whether these earthworks consisted of one curved ridge with occasional depressions, or a number of low intersecting mounds. For purposes of description we shall treat them as a series of mounds as figured in accompanying plan (Fig. 43). The mounds were totally demolished by permission of James B. Grant, Esq., the owner.

*Mound A.* Height, 4 feet; diameter of base, 36 feet. But two burials were discovered in this mound, both of the bunched variety, one representing portions
CERTAIN RIVER MOUNDS OF DUVAL COUNTY, FLORIDA. 489

of two skeletons. In addition, two bones were found separately. All skeletal remains, and, with trifling exceptions, all artifacts were deposited near the margin.

In the southern margin, about 1 foot below the surface, was a small vase, imperforate as to the base, with interesting decoration as shown in Plate LXXV, Fig. 4. A portion of the rim is wanting. This vase was apparently unassociated with human remains.

Two feet down in the S. S. W. margin, unassociated with human remains, were two bowls, each of about three quarts capacity. The material is inferior. Traces of red pigment are visible exteriorly.

With a bunched burial in the southern margin, 3.5 feet from the surface, were: one pebble-hammer; one rounded mass of stone about 2.75 inches in diameter, flattened on one side and slightly pitted at places; one columella of a large marine univalve, considerably affected by decay.

A polished stone "celt" lay 3.5 feet from the surface, about 1 foot above a bunched burial.

With no human remains in association, or, at least, with none remaining, 4 feet from the surface, were: one small "celt"; one slab of bituminous slate, 5 inches by 6.25 inches by .75 of one inch, rudely cut in the form of a keystone; three sheets of mica.

One and one-half feet down was a bowl with inverted brim, of about one quart capacity, bearing traces of red pigment. Immediately beneath were: three incomplete arrow-heads; a portion of another; ten fragments of chert and of sandstone, showing workmanship to a certain extent. No human remains were encountered near these relics.

Several other vessels of ordinary type, crushed by weight of sand, were met with in the mound and numerous sherds of good material, with the complicated stamp of Georgia and of Carolina, lay loose in the sand. This intricate stamped decoration is not met with on the St. Johns River farther south than Dunn’s Creek, ten miles above Palatka.

Mound B. Height, 2 feet; diameter of base, 28 feet. With the exception of one fire place, no evidence of human origin was encountered.

Mound C. Height, 3 feet; diameter of base, 30 feet. One small sherd alone was recovered from this mound.

Mound D. Height, 3 feet 4 inches; major and minor axes respectively 36 feet and 17 feet.

Together, toward the center, with a few fragments of human remains, in sand dyed with red Hematite, 4 feet from the surface, were: eleven conchs (Fulgar carica); numerous shells of salt-water mussels; many sections of columellae of marine univalves; several small bits of stone.

In the margin, about 3 feet down, was a pocket of cherry colored sand leading to a mass of crimson pigment, followed, on the same plane, by a seam of cherry sand, about 1 foot in length, connecting with another mass of pigment.
No human remains were discovered in association, nor were there apparently any further traces of skeletal remains in any other portion of the mound.

*Mound E.* Five feet eight inches in height; major and minor axes 91 feet and 78 feet respectively.

This mound was dug through with great care at a level considerably below that of the surrounding territory.

At but four points in the mound were skeletal remains encountered. All interments were of the bunched variety, in no case representing the full complement of bones.

The mound was literally filled with earthenware—whole vessels, fragmentary ones, and sherds. Many sherds bore complicated stamps, one of which we show in Fig. 44. Another had a pinched decoration (Fig. 45).

With an isolated cranium, 2 feet 8 inches from the surface, lay a piercing implement of bone, badly decayed, with a number of large fresh-water mussel shells
(Unio jayanus, Lea), pierced through the impression of the anterior adductor muscle, to enable them to be worn strung as a necklace. These large shells with the nacreous portion in evidence, must have made an effective showing. In addition, were portions of columnellae of marine univalves and a vessel of earthenware. This vessel, 12.2 inches in height, has a maximum diameter of 8 inches. It is centrally constricted and decorated and has decoration below the margin. It is imperforate as to the base and absolutely intact, and is by far the finest specimen of earthenware recovered by us from any Florida mound. Considerable soot remaining upon it shows it to have been in actual use (Plate LXXVI).

With a small earthenware pot was a graceful ovoid vessel of good material, handsomely decorated beneath the rim (Plate LXXVII). Its height is 7.2 inches; its maximum diameter, 5 inches. Considerable soot still remains upon it, showing culinary use for so ornamental a vessel. A portion of the rim and body is wanting through a fracture previous to inhumation as the missing portions were not present with the remainder of the vessel. Below the line of the fracture is a perforation with a semi-perforation a short distance away. It is evident that the intention was, by boring holes in the broken portion, to attach it to the remainder, a purpose for some reason abandoned.

A small bowl with two compartments, somewhat crushed, of a type already noticed by us, lay about 1 foot down with many fragments of various vessels. It has been entirely restored. Length, 5.1 inches; width, 3 inches; height, 1.3 inches.

In the northern slope, 5 feet down, were two vessels together, unaccompanied by skeletal remains. One, a bowl of ordinary type but of good material, holding about three quarts, has traces of red pigment inside and out. The rim projects. It is imperforate as to base and otherwise intact with the exception of several cracks produced by pressure.

The other, gourd-shape, of yellow ware, absolutely intact save a slight chipping at the mouth, lay on its side. It is unornamented save for traces of red pigment. Height, 9.6 inches; maximum diameter, 7.7 inches; diameter of aperture, 2 inches (Plate LXXVIII). About 1 foot above these vessels was a layer of charcoal nearly 4 feet in length.

About 1 foot below the surface, with fragments of various vessels, was a vessel with two compartments, and a handle somewhat resembling a third, though much shallower. Small holes had been broken through the bottom of each compartment. In Plate LXXIX, Fig. 1, the vessel is shown, the handle to the front. Length across compartments, 6 inches; across handle and partition, 5.1 inches; height, 1.5 inches.

About 2.5 feet below the surface, with a mass of crimson pigment about the size of a cocoanut, and apparently not in proximity to human remains, were: sheets of mica; two pebble hammers; two chips of chert; a bit of clayey substance about the size of a chestnut; the head of a shell pin with shank missing through
decay; a mass of bituminous clay about 2.5 inches by 3 inches, evenly pitted on one side to the size of about the first joint of a human thumb.

In a central portion of the mound, 3 feet down, together, each resting on its base which showed intentional perforation after manufacture, with no traces of human remains apparent, were five vessels of ordinary type, each of about two quarts capacity. The material was very inferior, several dropping to pieces after discovery. The only decoration was traces of red pigment exteriorly.

Surmounted by crimson sand, 3 feet 9 inches down, together, were: one large tobacco pipe of earthenware of ordinary pattern; one thick sheet of mica 3 inches by 4 inches; and a bit of a marine shell. Here again no skeletal remains were encountered.

In the E. N. E margin of the mound, 2 feet down, were two vessels together, one in somewhat fragmentary condition, in addition to the loss of a portion of its base. This vessel, of medium size, offered no novelty as to type. Its decoration is parallel lines running diagonally. The second vessel, of ware fully equal to any found by us in the Florida mounds, has a capacity of about five quarts. Bowl-shaped in form, its rim, 1.5 inches in breadth, is inverted horizontally. It is interiorly decorated with crimson pigment. Portions of the vessel broken, but not detached, by pressure of sand, were readily fastened into place. Within it were seven pebbles and two chips of chert. Near by, on the outside, were two pebble hammers and one small bit of chert. No human remains were evident in association.

In the margin of the mound, unassociated with human remains, together, were two small undecorated vessels, rude and of ordinary type. Their bases are intact.

About 4 feet down was an isolated cranium, badly decayed, lying in cherry sand. One foot distant, in the same plane, lay a pebble hammer of considerable size, showing use, and pitted on one side.

Together, in the southern margin, were many fragments of a small bowl and a globular bowl of about one quart capacity, the bottom of which had been knocked out, and, with the exception of a small portion, placed within the vessel.

Two and one-half feet from the surface, in the southern margin, apparently apart from human remains, together, were: three small undecorated vessels of ordinary type and poor material, imperforate as to bases; two curious toy vessels, unbroken, with side perforations for suspension, one showing decoration (Fig. 46). In addition was a cylindrical vessel with slightly round imperforate base, the rim somewhat flaring. The decoration is of the complicated stamp variety. This vessel was slightly broken by contact with the spade. With all these were a number of pebbles, chips of chert, and pieces.
CERTAIN RIVER MOUNDS OF DUVAL COUNTY, FLORIDA.

of marine shell which probably at one time had some definite shape. Again, human remains were wanting.

In the northwest slope, together, unassociated with human remains, were two rough undecorated bowls, one perforate as to base, the other showing perforation intentionally conferred. With these were: one "celt" of polished stone; one small boss of sheet copper; bits of sandstone and a number of pieces of chert resembling small rude arrowheads.

Four feet from the surface, without association, in red sand, was a pendant of polished banded slate, 5.5 inches by 2.5 inches, with maximum thickness of about 1 inch (Fig. 47).

Two feet down, apart from human remains, were a polished hatchet of stone and a fragmentary ornament of sheet copper with central double perforation.

A small vessel of ordinary type lay 3.5 feet from the surface. With it was an undecorated cylindrical vessel with rounded imperforate base and slightly flaring rim. Height, 7.25 inches; maximum diameter, 4 inches; aperture, 3.75 inches. With these, placed one within the other, were several cockle shells (Cardium).

Occupying a central position in the mound, 5 feet from the surface, in pale cherry sand, was a curious medley of objects with fragmentary remains of an adolescent at one extremity and probably the entire skeleton of a young child at the other. Included in the deposit were: bits of charcoal; a large clay tobacco pipe of the usual type; a curious object of polished sedimentary rock (Fig. 48); a slab of syenitic rock, entirely smooth and slightly concave on one side, probably a sharpening stone; several phalanges of the deer; part of the core of a buck horn; two "celts"; hammer stones; pebble hammers; pebbles; a small fragment of bitumen; many worked portions of columellae of marine univalves; numerous chips of chert, some very diminutive; one arrowhead; bits of coquina; sheets of mica; a small bit of clayey substance; one small undecorated earthenware bowl; one cutting implement of chipped chert; many large and small beads of shell; a circular ornament of sheet copper.
Throughout the mound were various other bowls of ordinary type, some imperforate; pebbles; bits of marine shells and the like, variously associated and often in pockets of cherry or reddish sand.

At various points were considerable deposits of bits of earthenware representing parts of different bowls, but in no case sufficient for restoration.

REMARKS.

These low mounds offer, so far as the earthenware is concerned, a striking contrast to their near neighbor, the great Grant mound. In that mound the earthenware, almost entirely of the “freak” mortuary variety, showed no marks of domestic use, while the vessels in the low mounds were in many cases evidently originally intended for culinary purposes and bore on their bases and sides the soot received during domestic use. Earthenware of complicated stamped decoration, virtually absent from the Grant mound, abounded in these low neighboring mounds.

As we have stated, human remains were encountered at but four points in the largest mound. That so great a heap of sand should have been thrown up for so few interments seems unlikely, in view of the number of art relics found in every portion. In mounds where relics are inhumed in a general way, they are found in a central position and somewhat superficially. We deem it not unlikely that all traces of other interments in this mound have entirely disappeared.

Nothing was discovered in these low mounds in any way connecting them with a period other than pre-Columbian.

LOW MOUNDS NEAR HORSE-SHOE LANDING.

These low mounds and ridges lie about 500 yards in a southerly direction from the landing. They were thickly covered with “scrub” and had sustained no previous examination. Our investigation was conducted with the kind permission of J. B. Parsons, Esq., the owner.

Mound A, the easternmost, was somewhat irregular in shape, and had an average diameter of base of 50 feet. Its maximum height was 3 feet 7 inches. It was completely demolished.

Human remains were encountered but four times, in each case but a small portion of the skeleton being represented.
CERTAIN RIVER MOUNDS OF DUVAL COUNTY, FLORIDA. 495

Sherds were infrequently met with. Several bore the complicated stamp of the type encountered in neighboring low mounds. Three undecorated vessels of medium size and of poor material came from various depths. One of these, on four sides, about equidistant, showed careful chipping away of material without perforation. The base had been treated in a similar manner over an extent about 2.5 inches in diameter. We have before met with chipping of this nature at one or possibly two points on the surface of certain vessels, but never before have we noticed it executed with such evident intent.

Three feet down was a small hatchet of stone and two arrowheads in a pocket of sand blackened by fire. No skeletal remains were in association.

Together, unassociated with human remains, 3 feet down, were eleven fragments of stone including four partially completed arrowheads, the end of a polished chisel, and six bits of chert. In addition, variously associated, were small "celts," mussel shells, smoothing stones, pebbles and arrowheads. Several of these arrowheads were coated as to the tangs, with bitumen which bore the impress of some long-fibred wood, probably reed or cane.

Certain other smaller mounds in the immediate neighborhood were partially investigated with negative results.

About one-quarter of a mile in a southerly direction from the low mounds, was a mound on the property of an old colored man named Brutus. Its shape was somewhat unusual (Fig. 49).

A careful investigation, not, however, carried to complete demolition, indicated its erection for other than sepulchral purposes.

BROWARD MOUND.

This symmetrical mound, in the pine woods, about one-quarter of a mile northwest from Cedar Creek Landing, had a height of 8 feet, a breadth of 60 feet across the base.

It was totally demolished with the courteous permission of its owner, Napoleon Broward, Esq., of Jacksonville.

Above the level of the surrounding territory was an irregular layer, from 6 inches to 14 inches in thickness, of pure white sand often containing beds and
pieces of charcoal. The remainder of the mound was of yellowish sand with local streaks and pockets of white sand throughout and several small seams of cherry-colored sand in the northeastern portion.

Human remains were not present in the marginal portion of the mound, but were encountered toward the center at twelve different places. The usual bunched burial of fragmentary portions of the skeleton prevailed. Four times, isolated crania were encountered. Again, shafts of a femur and tibia lay with a pelvis and a single vertebra. In one case two long bones represented an entire burial, and again a single humerus was found unassociated. The bones, in the last stage of decay, were encountered at different depths, from the base to within a short distance of the surface.

Sherds were infrequently met with.

Two and one-half feet from the surface, near no human remains, was an interesting cylindrical cup 4.4 inches in height, with a diameter of 2.8 inches. It is absolutely intact. The base is flat, permitting the maintenance of an upright position. There are two holes for suspension at opposite sides of the rim. It has interesting incised and punctate decoration (Plate LXXIX, Fig. 2).

Chippings, flakes, and cores of chert, so abundant in some mounds, were wanting in this one.

In all, five polished stone hatchets were met with, four separately in caved sand, one about 2 feet from the surface. None seemed to be in the neighborhood of human remains.

A serrated arrowhead of chert lay, unassociated, 1 foot from the surface.

A pebble about 2 inches long, showing use at either end, completed the list of art relics taken from the mound.

REMARKS.

The Broward mound is typical of a certain class of sand mounds met with on the St. Johns in that the considerable amount of material was wholly disproportionate to the small number of interments.

In another respect also it was typical of certain mounds of the river. All relics were comparatively centrally located, and, so nearly as could be determined, at no great distance from the surface and unassociated with skeletal remains, showing the inhumation of art relics to have been made in common toward the completion of the mound. There were, however, it must be remembered, many mounds on the St. Johns, not embraced in this class, where artifacts were discovered from the margin throughout and associated with human remains. Of this class of mounds were that at Tick Island, Thursby mound, the mound at Blue Creek and others.

Nothing in the Broward mound gave evidence of White contact.
CERTAIN RIVER MOUNDS OF DUVAL COUNTY, FLORIDA.

Low Mounds near Reddie Point.

About one-quarter of a mile in from the landing at Reddie Point were two low mounds on the property of Dr. Anita Tyng.

The larger mound had a base diameter of 80 feet. The territory is reported to have been in use for years as a cotton field, and the mound had been virtually leveled. At three points near the margin were deep depressions from which the material had been taken. The mound was dug through at a depth varying from 4 feet to 6 feet below the surface. It was composed of yellowish sand, unstratified, with the usual charcoal and fire places.

Human remains, infrequently met with and fragmentary, were found so far down as 4 feet.

Earthenware was represented by several vessels of ordinary type and size, undecorated and of poor quality. All showed portions missing from the base through intentional fracture. Other pots had important portions missing, and evidently had been utilized for mortuary purposes.

Sherds were mainly undecorated, some, however, bearing an intricate stamped design (Plate LXXIX, Fig. 3).

Two "celts" and two arrowheads were found separately, and numbers of pebbles and pebble hammers variously associated. Mica was in comparative abundance. One sheet had been rudely given the outline of a lance point (Fig. 50).

Four feet from the surface, with human remains and shell beads, some over one inch in length, was a neatly made ornament elliptical in shape, with central
perforation. The material is of sedimentary origin, composed mainly of iron pyrites. Length, 1.3 inches; breadth, 1.2 inches (Fig. 51).

Apparently unassociated was a mass of somewhat deteriorated Hematite, about the size of a clenched hand.

A small fragment of sheet copper lay with human remains.

Near an isolated lower jaw were three small ornaments of sheet copper, of about the same size, oblong with rounded corners (Fig. 52) and a portion of another. At the end on one side of each of the three unbroken ones was a flat circular deposit of bitumen, used for purposes of attachment.

About 25 yards east of this mound was another with a height of about 1.5 feet and a diameter of base of 60 feet.

It was completely dug through.

No copper was present in this mound. In other respects it resembled many mounds of the neighborhood as to deposits of mica, pebble hammers, arrowheads and the like.

MOUND AT DANIEL'S LANDING.

This mound, about one-quarter of a mile in a northerly direction from the landing, had long been under cultivation, and had previously been dug into to a considerable extent.

Its height was 2.5 feet; its diameter of base, 60 feet. It was virtually demolished.

The usual fragments of shell, mica, etc., were present with fragmentary human remains.

LOW MOUNDS AT ALICIA.

On the property of John G. Driggs, Esq., of Jacksonville, to whom our thanks are tendered for permission to investigate, at Alicia, about 400 yards in from the landing, were four low mounds.

Mound A. Height, 3.5 feet; diameter of base, 45 feet. This mound was about two-thirds demolished by us, human remains in small fragments being encountered at three points. Near the center was a mass of sandstone pitted on either side, weighing about ten pounds. Nothing else of interest was encountered.
Joining mounds A and B was a causeway about 28 feet long, 1 foot 4 inches in height, with an average width of 12 feet at the base.

Mound B: A considerable portion of this mound had been carted away for use in the neighboring orange grove. The discovery of many art relics is said to have been made at the time. The height of the remainder of the mound was about 18 inches. Judging from trees still remaining, the original maximum altitude was from 3 feet to 4 feet. The diameter of the base was 86 feet.

The mound was carefully dug through by twenty men during two and one-half days.

The sand was of a brownish color, apparently from the effect of fire and a considerable intermingling of particles of charcoal. This combination extended about 2 feet below the level of the surrounding territory. Relics were found from the margin in, both above and below a dark line showing a large percentage of charcoal, which ran through the mound at the level of the surrounding territory and seemingly marked where a fire had been built after the filling of an excavation.

Human remains were represented by small fragments in the last stage of decay.

As much of the contents of this mound suggest those of many low neighboring mounds, we shall not give in detail the various associations of pebbles, pebble-hammers, mica, chips of chert, bones of sandstone, marine shells and fragments of shell contained therein.

Three "ceils" were met with, several arrowheads, small pendants of shell, and at one point a large mass of crimson pigment.

Near the base, that is to say about 2 feet below the general level, or 3.5 feet down, together, were: two pebbles; a toy pot; a shark's tooth, and 142 minute chippings of chert.

Earthenware constituted the feature of the mound, and was encountered in great abundance, though, with two or three exceptions, so poor was the material that vessels were recovered in a very fragmentary condition. Certain large vessels and numerous smaller ones, inhumed with portions missing and badly crushed by weight of sand, were abandoned.

Sherds were abundant and, in common with fragmentary vessels, presented various intricate stamped designs shown in Plate LXXX, and Plate LXXXI, Figs. 1 and 2.

Lined and punctate decoration also was represented on fragmentary vessels and sherds, while in one case the use of a small tubular stamp was apparent, showing a circular prominence surrounded by a depression.

Of the larger vessels, some of so much as about four gallons capacity, none was capable of restoration. Four vessels were recovered intact, and nine in a more or less imperfect condition. Four vessels were imperforate as to the base; the remainder, and apparently all others interred in the mound, had suffered intentional mutilation of the base after completion.

Two small bowls lay together, one containing the other. A vessel of good material, thick and heavy, somewhat globular, with sloping rim, is decorated with
red pigment inside and out. A portion of the base is missing. Maximum diameter, 5.8 inches; depth, 3.4 inches; diameter of orifice, 3.6 inches (Plate LXXXI, Fig. 3).

An interesting vase was recovered virtually intact. Its height is 9 inches; maximum diameter of body, 4 inches; diameter of aperture, 4.2 inches. The imperforate base is flat with a diameter of about 1.75 inches. Interesting incised and punctate decoration surrounds the rim to a depth of about 2.5 inches. On one side are two perforations about 1.5 inches apart, nearly three inches below the rim. Their use is not apparent (Plate LXXXII).

One tobacco pipe of earthenware came from the mound. The type is the same as that found in the neighboring mounds with the exception that, on the part facing the smoker, two raised parallel lines, one at either side, run the entire length of the pipe.

The two remaining mounds at Alicia, each about the size of mound A, were not investigated. One had been utilized as a place of burial within recent years.

**Denton Mound.**

About one-half mile east of Chaseville, in thick undergrowth, was a ridge or possibly three intersecting mounds of irregular shape, the largest to the east, two smaller by side to the west. The length of the ridge was 77 feet. The eastern end was 40 feet across; the western, 30 feet. The maximum height, which was near the eastern extremity, was 2.5 feet. These low mounds were not before supposed to be aboriginal remains, and had undergone no previous investigation.

They were completely dug through with the consent of the owner, James L. Denton, Esq., of Jamaica, N. Y.

The usual yellow sand and charcoal were present.

Human remains were few and very fragmentary.

Sherds were infrequently met with. One small bowl, undecorated, was broken by contact with a spade. An undecorated globular vessel, perforated through the base after completion, has a height of about 2.5 inches, and a diameter of 3.75 inches approximately.

Three feet from the surface was a vessel of great interest, in numerous fragments, crushed contemporary with or previous to inhumation and with certain missing portions chipped off by use of a pointed tool. This vessel, of excellent material and graceful design, with incised decoration of straight diagonal and of curved lines, has on one side, the repoussé head of a duck, neatly made. The upper portion of a similar head is on the opposite side. As we have said, this form of ornamentation, so novel for Florida, is, in this case, repoussé, and was not modelled previously and fastened on by pressure, as is the case of the human head from the mound near Old Okalumpka, described in this volume. These two examples of such use of effigies of heads are the only ones to come under our notice in Florida. The height of this interesting vessel is 7.75 inches; its maximum

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1 Since writing the above these mounds were investigated with negative results.
CERTAIN RIVER MOUNDS OF DUVAL COUNTY, FLORIDA.

diameter, 10.5 inches; diameter of aperture, 4.5 inches. It is shown, pieced together, in Plate LXXXIII, while in Plate LXXXIV, Fig. 1, we give a front view of the head.

We have above alluded to the chipping off of portions of vessels with pointed implements. In Part II of our report on the St. Johns mounds we spoke of many sherds not broken but detached by piercing implements, and stated that this curious custom seemed to be confined to a limited area bordering the lower portion of the St. Johns River. Since the publication of that report we have noted the occurrence of these peculiar sherds and of vessels intentionally deprived of certain parts by the aid of pointed implements, at points throughout a wide area, including a mound on the Econlockhatchee Creek, Orange County, about thirty-five miles by water south of Sanford, and certain mounds of Crescent Lake, Putnam County.

A sheet of mica and a handsome arrow point of jasper were the only other art relics discovered in the mound.

About 10 feet south of the western extremity of the Denton mound was a mound about 1 foot in height and 20 feet across the base. In the center, about 2.5 feet down, was a small layer of charred human bones. Two or three sherds completed the contents of the mound.

A MOUND AT
CHASEVILLE.

On the property of Mr. I. Harrington, who readily granted permission to explore, was the site of a mound which had been entirely leveled and carted to an adjacent field. The diameter was about 30 feet. It probably once had a height of about 2 feet.

It was completely dug through at a depth of 2.5 feet below the surface. The usual mica, chips of chert, fragments of marine shells, variously associated, were present, and in addition, a noble barbed lance-head of reddish chert, 5 inches in length, lying with a shell chisel at a depth of 2 feet (Fig. 53). No human remains were met with.
CERTAIN RIVER MOUNDS OF DUVAL COUNTY, FLORIDA.

A few yards from the mound just described, on the property of Mrs. Mary Bennevis, was a mound 1 foot in height, with a diameter of base of about 20 feet. About 1.5 feet from the surface was a central deposit of human bones representing parts of various skeletons. No others were met with. Loose in the sand and singly were: one undecorated bowl in fragments; one cube of lead sulphide; one arrowhead; one bit of pottery intentionally given the outline of the arrow point and various sherds.

Low Mounds at Floral Bluff.

By the roadside, about 300 yards inland from the landing at Floral Bluff, on the property of Mr. G. H. Shepard, to whom we wish to express our thanks, was an asymmetrical mound, or, more properly, a V-shaped ridge, having its maximum height of 4.5 feet in the western arm, about 50 feet from the apex which points almost due south. The western arm has a length of 170 feet; the eastern, about 30 feet less. The maximum width of the western arm was 46 feet; that of the eastern, 37 feet.

The most prominent portions of the ridge were dug through at considerable depth.

Human remains—mere fractional portions of the skeleton—were encountered seven times, all within an area of a few square yards, beneath the highest portion of the ridge.

With human remains, about 3 feet down, was a large tobacco pipe of earthenware, one portion filled with bitumen and with a considerable quantity near by. This pipe, somewhat broken, had all portions present. About 1 foot above was a smaller tobacco pipe of earthenware in many fragments and incapable of restoration.

About 3.5 feet from the surface, near human remains, was a vessel of bean-shaped outline of about one quart capacity. Its base is intact. Traces of red pigment are inside and out (Plate LXXXIV, Fig. 2). With it were many pebbles and chips of chert.

At various depths were nests of fragments of parts of different vessels, and one deposit of many minute chippings of chert.
TWO SAND MOUNDS ON MURPHY ISLAND, FLORIDA.

BY CLARENCE B. MOORE.

Murphy Island, on the eastern bank of the St. Johns River, by water ten miles south of Palatka, Putnam County, is separated from the mainland by a small stream known as Murphy Creek.

Two sand mounds and a considerable shell deposit on Murphy Island were briefly noticed by us in Part I, "Certain Sand Mounds of the St. Johns River, Florida."

Unfortunately, during our investigation of the mounds of the St. Johns, we were unable to come to terms with the owner of the property, but have, however, availed ourselves of an arrangement subsequently made.

Neither of the sand mounds on Murphy Island is believed to have sustained any previous investigation, with the exception of a small hole in one, made by a party of excursionists from Palatka during part of one day in the early "seventies."

The northernmost mound, visible from the steamboat landing, was one of the most symmetrical earthworks we have encountered in Florida. Its shape was almost a perfect truncated cone; the slope of the sides being at an angle of thirty degrees. The diameter of base was 80 feet; that of the summit plateau, 21 feet; the height, 11 feet 9 inches.

Large sweet-orange trees and towering palmettoes grew on the top and sides. The mound was totally demolished by us during four and one-half days of June, 1895.

The body of the mound was composed of the whitish sand of the surrounding territory, with the marginal portions, 4 feet or 5 feet in, dyed a light pink through intentional admixture of the red oxide of iron. Pockets of pink sand and of light chocolate colored sand, some of considerable size, were encountered throughout the mound. The material of the mound was notably cohesive as through a certain admixture of clay. Although a considerable deposit of Paludinae and Ampullariae with fire places, fragmentary bones of lower animals and all the usual midden refuse, exists within a short distance of the site of the mound, no shells were encountered at any depth beneath the immediate surface where cultivation would not explain their presence. We were informed that superficial shells had been hauled from the adjacent shell heap to serve as a fertilizer.

1 Journ. Acad. Nat. Sci., Vol. X.

63 Journ. A. N. S. Phila., Vol. X.
HUMAN REMAINS.

Burials were of the bunched variety, which, our readers will recall, consists of piles of bones previously denuded of flesh by exposure to the elements. In this case separate interments were often represented by isolated crania or by various long bones of one skeleton or of several individuals.

Certain burials found near the surface with iron implements and glass beads had also the appearance of belonging to the bunched variety of interment, though of these we may not speak positively as they had possibly been subjected to disturbance by subsequent cultivation of the mound and the setting out and removal of orange trees.

In that portion of the mound included in the slope and not covered by the summit plateau, human remains were noted at forty-eight different points, many of these deposits, however, including the remains of a number of individuals.

In that portion of the mound beneath the summit plateau, that is to say, a mass of material about 12 feet high and 21 feet in diameter, interments were so numerous at places and so frequently in contact—single crania, bunches of long bones, and great layers of human remains, in places over one foot in thickness—that all efforts to record the number of individuals represented, were abandoned. Moreover, in many places—and this applies also to other portions of the mound—mere discoloration of the sand or at most yellowish powder, marked the former presence of bones.

No human remains were encountered at a depth greater than 12 feet, though certain objects of aboriginal design were fully one foot lower.

No skeletal remains were preserved.

EARTHENWARE.

The earthenware of this mound was of markedly inferior quality and design.

In the northern portion of the mound, including about one-third of the circumference, beginning near the margin and extending in for about 15 feet, between 2 and 3 feet from the base, was a curious layer of bits of earthenware and considerable fragments of vessels. These sherds were not laid in close proximity but at irregular distances, here and there, as though strewn upon that portion of the mound during its erection. No human remains were encountered with these sherds.

None but comparatively small vessels were recovered intact, though, from a considerable depth, near the center of the mound, four vessels of several quarts capacity each, but fragmentary and incomplete, were found in association. Several large fragments and one complete vessel had basal supports which we have noted as present in but three or four other mounds of the St. Johns. The use of feet on early aboriginal earthenware is unusual in any section of the United States, and
we are informed that the clay pots found in Ontario are round bottomed and without supports.¹

It has been suggested that feet on aboriginal vessels of earthenware might possibly be attributed to an imitation of metallic forms obtained from the Whites. So far as our experience goes we are strongly inclined to doubt this, since we have always obtained earthenware with basal supports from depths to guarantee original deposits in mounds where evidence of European influence, if present at all, was superficial. Moreover, the European kettle with feet, if we mistake not, had three supports, while the pottery of the Florida mounds, when supplied with feet, has four.

While the bases of a majority of the vessels of the mound showed perforation after manufacture, some were entire, and a few samples of the “freak” variety of ready made mortuary pottery, with perforation of base previous to baking, also were present. This perforation of the base of earthenware by the aborigines of the Peninsula was done, it is believed, to free the soul of the vessel to accompany the spirit of the dead to the land beyond.

As a rule, though with occasional exceptions, vessels seemed to be unassociated with human remains, though taking into consideration the advanced state of decay of some of the bones, exact determination was impossible. It is not unlikely, however, that most of the earthenware was put into the mound in a general way, and not to accompany individual interments.

In all, twenty-five vessels of earthenware were found in the Murphy Island mound in a condition to justify removal. These, in common with vessels in fragments and isolated sherds, were almost invariably at considerable depth—some so low as 13 feet from the surface. None bore stamped, punctate, or incised superficial ornamentation. One small vessel of the “freak” mortuary variety, 2.5 inches in height with a diameter of 2.7 inches across its laterally extending rim, and 1.65 inches through the body, was covered with crimson pigment inside and out. The base showed perforation prior to baking.

One vessel, 4.4 inches in height with a diameter of 3.5 inches, had a rude fluting around the body surmounted by the remains of an encircling projecting band 1.5 inches below the aperture. The entire bottom had been knocked out. This vessel lay 12 feet down with another broken vessel.

About 7 feet down were three bowls, the largest with a diameter of 14 inches, containing the other two, one within the other. Near by lay a fourth. These vessels, incomplete at the discovery, later fell into pieces, rendering restoration impossible—no great loss, so poor was their quality and so ordinary their type. We have already made reference to them.

Ten feet from the surface was an imperforate pot resembling a crucible in shape. Height, 3 inches; diameter at mouth, 2.2 inches; diameter at base, 1 inch.

TWO SAND MOUNDS ON MURPHY ISLAND, FLORIDA.

With it was a toy vessel also intact as to the base, having a height of 1.5 inches; a diameter at aperture of 1.4 inches, and .9 of one inch across the base (Fig. 54).

A spool-shaped object of earthenware, with edges slightly broken, has a height of 3 inches; a diameter at each expanded end of 2 inches; a diameter through the body of 1.5 inches. These spool-shaped objects of earthenware probably belong to the "freak" variety. We have figured one* from the mound at Davenport on the Ocklawaha, and found a somewhat similar specimen in the mound in the pine woods near Duval's, Lake County.

![Fig. 54.—Toy vessel of earthenware. Northernmost mound, Murphy Island. (Full size.)](image)

The remaining vessels from the mound at Murphy Island offered no feature worthy of remark.

But two tobacco pipes of earthenware were recovered from the mound. One of the usual type found on the lower river, was in fragments, with several considerable portions missing; the other (length, 3.5 inches; orifice of bowl, 1.6 inches by 1.2 inches; orifice of stem, .7 of an inch by 1 inch) is of especial interest, having a rude projecting animal head below the distal margin of the bowl as shown in Fig. 55.

A curious pendant of earthenware, rude and of poor material, came from 11 feet from the surface. Length, 1.8 inches; maximum diameter, .7 of one inch (Fig. 56).

An earthenware pendant or bead, with transverse perforation, found loose in the sand, is shown in Fig. 57. Length, 1.5 inches; diameter, .6 of one inch.

* Op. cit., Part II, Plate XXVIII, Fig. 1.
TWO SAND MOUNDS ON MURPHY ISLAND, FLORIDA.

Near human remains, was a ring of earthenware, 1.6 inches in diameter, .7 of one inch across the opening, and .3 of one inch in thickness. It was found 7 feet from the surface (Fig. 58).

COPPER.

The reader of our report on the mounds of the St. Johns may recall that between Jacksonville and Lake Washington—the end of navigation—aboriginal copper was met with in but four mounds. It was, therefore, especially gratifying to find a variety of objects of this metal in the principal mound on Murphy Island.

Well in toward the center, in the northern portion of the mound, at no great distance apart, but each with a separate interment, 12 feet from the surface, were: (1) fragmentary remains of an ornament of wood overlaid with very thin sheet copper. One side is flat, the other repoussé. The breadth is about 2.2 inches; its original length is undeterminable. With it was a large sheet of mica. (2) An ornament of sheet copper, bent over and repoussé as shown in Fig. 59. A part of one side is missing...
Fig. 60.—Crescent of copper. Northernmost mound, Murphy Island. (Full size.)
through corrosion. At one end of the broken side are two perforations. Length, about 7 inches; width, about 2 inches. (3) An ornament of thin sheet copper apparently at one time coating a tube of some long-fibered substance like cane. It was recovered in several fragments, but probably when entire had a length of about 8 inches, with a slightly irregular diameter averaging 1.5 inches. (4) A fine specimen of sheet copper, entirely unbroken, and not materially affected by corrosion, representing the crescent moon. Distance between horns, 10.3 inches; maximum width, 1.7 inches; thickness, .04 of one inch. About one-half inch from the central part of the convex margin of the body, 1.7 inches apart, are two perforations by the aid of which this ornament, in early times doubtless highly polished, could be fastened to the chest or suspended from the neck, the horns pointing down (Fig. 60).

Toward the center, in the eastern portion of the mound, 12 feet from the surface, with human remains, together, associated with a pendant of shell, were: (1) apparently a number of separate discs, each about 1.8 inches in diameter, of sheet copper firmly cemented together through corrosion and too greatly carbonated to permit any successful attempt at separation. (2) A disc of sheet copper, centrally concavo-convex, about 2 inches in diameter. (3) A much corroded object of sheet copper, apparently of the sort known as spool-shaped, supposed by some to have served as an ear-plug, by others, as a button or stud for garments. Similar objects have frequently been figured as coming from Ohio mounds and elsewhere. Diameter of upper and lower portions, about 1.8 inches. (4) An ornament of sheet copper consisting of a disc centrally perforated and symmetrically bent and repoussé, as shown in Fig. 61, with section. Maximum diameter, about 2.1 inches.

Loose in caved sand was a small disc 1 inch in diameter. Within its slight concavity lay remains of wood.

**SHELL.**

Twenty-two specimens of shell drinking cups wrought from *Fulgar perversum* by the removal of the columella and a part of the body whorl, were taken from the mound. Some were intact; others showed an intentional perforation of the bottom. So far as we could determine, these drinking cups, though coming from different points, were all from within a few feet of the surface.

The quantities of small beads so often found with interments were not met with in this mound. At two points, beads from .5 of one inch to one inch in
diameter—thirty in all—were encountered with human remains, while perhaps one dozen others were gathered from various portions of the mound.

Two feet from the surface, with human remains, were two shell discs with diameter of about 3 inches and 2.5 inches respectively, probably cut from the body whorl of *Fulgur*. The smaller had near the margin a double perforation for suspension. In neither was any decoration apparent.

A somewhat smaller disc was found loose in the sand.

Two shell pins, the larger 5 inches in length, lay together, near human remains, 2.5 feet from the surface. Two others, somewhat smaller, also with skeletal remains, were about 2 feet down. A fifth pin was recovered loose in the sand. These pins were all of types previously figured by Mr. Holmes in his exhaustive "Art in Shell," by others, and by ourselves in our account of the mound at East Palatka, Putnam County.

An interesting ornament, as shown in Fig. 62, was probably cut from the lip of the great marine *Strombus*. Its length is a little less than 2 inches; its breadth, about 1.3 inches. It had evidently formed a central ornament in a string of little shells (*Olivella*) longitudinally perforated, as one of these still lay in its perforation.

With a layer of human bones, 8 feet down, were four chisels of shell, probably cut from the lip of *Strombus*, approximately from 2 inches to 4 inches in length. With them were two stone "celts" and a columnella of some large marine univalve. These columnellae, as we have pointed out elsewhere, were probably removed from the shell for shipment, to be manufactured into beads and ornaments.

Several other chisels of shell were found variously associated.

**STONE.**

During the demolition of the mound, sixty-six hatchets, or "celts," of smooth or polished stone, from about 2 inches to 12 inches in length, were taken from the mound. These hatchets—mainly of igneous rock—presenting no points of difference from other mound specimens, were not separately determined as to material.

A cutting implement of chipped chert, about 3 inches by 6 inches, flat on one side, lay 3 feet from the surface with human remains and several pebbles.

A pitted hammerstone, about 2.6 inches by 4 inches, was apparently unassociated.

Mica was found in but three places.

Twenty-six arrow and lance points of chert and of chert breccia were found separately, at various depths and a number of others associated with various objects. None presented anything unusual as to type.
TWO SAND MOUNDS ON MURPHY ISLAND, FLORIDA.

Ten feet down, in a pocket of red Hematite, near human remains, together, were: twelve arrow and lance points; a sharpening stone of claystone, almost rectangular, about 6.3 inches by 3 inches, with an average thickness of about .3 of one inch; one "celt"; a heart-shaped bit of rock, apparently claystone, 3.8 inches by about 2.5 inches, used for sharpening pointed tools, grinding beads, or both, as shown by grooves on either side across its widest part; a small bit of sandstone; one flake of chert, and twenty-two chips of the same material. We have frequently remarked the inhumation of great numbers of fragments, chips, and flakes of chert, especially in the smaller river mounds between Jacksonville and the sea, while from Mt. Royal, near Lake George, Putnam County, we took 951 associated masses of chert, averaging about the size of a hen's egg. Lieutenant-General Pitt Rivers, in his monumental work, speaks of great numbers of flakes, chips, and cores of flint (which is almost the same as our chert) found by him in the barrows.

Four quartz pebbles; one core of chert; three fragments of fossil bone, shaped to a certain extent, the largest rectangular, about 1.6 inches by 2.5 inches, with an average thickness of .5 of one inch, were found in association. Fossil bones are not infrequently met with in Florida in the clay and in the bottom of streams.

Two and one-half feet from the surface, in immediate association, were: a pebble hammer of quartz, 5 inches long; fifteen smaller pebbles and pebble hammers; three small bits of sandstone; one fragment of an apparently clayey substance; four arrow heads of chert; a small natural formation, tubular in shape; ten bits of fossil bone, some worked to a certain extent; one unidentified object of the same material, about 3 inches long, 1.5 inches high, with an average thickness of 1.6 inches; a portion of a tooth of a fossil shark; an astragalus of a fossil llama, and a small fragment of striated rock.

Three feet from the surface was another curious medley consisting of: one bit of fossil bone; two rude arrow heads of chert; one pebble hammer; four small pebbles; one chip of chert; four bits of sandstone; two pieces of coquina, and one small fragment of Steatite.

All together, 4 feet down, were: sixteen bits of fossil bone from .5 of one inch to 3 inches in length, some by their even edges showing a certain amount of work; ten pebble hammers; thirty small pebbles, one pebble partially ground for suspension, an incipient pendant; seven fragments, of sandstone and of other rocks; two chert arrow heads; one tubular bead of soapstone, about .75 of one inch in length.

In addition to these curious deposits there lay separately throughout the mound, pebble hammers, sharpening stones, and certain natural formations in the form of tubes, largely used by the aborigines, similar to one figured by us in Part I of our Report on the St. Johns mounds as coming from Mt. Royal, and found in such numbers in the Shields mound, Duval County.


2 Identified by Professor Cope. Three species of fossil llama from Florida have been described by Leidy.

61 JOUR. A. N. S. PHILA., VOL. X.
Loose in the sand was a cuboidal mass of carbonate of lime, with rounded corners, about the size of an English walnut, while apparently unassociated was a mass of undetermined rock about the same size, spheroidal, depressed at the poles. A flat pebble of clayey material, about 2 inches by 4 inches, with a maximum thickness of .8 of one inch, has four perforations apparently of natural formation around twigs. These perforations, doubtless, the aborigines had been quick to utilize.

Two small pendants, one of crystalline granular rock, possibly of igneous origin, the smaller of *Agalmatolite*, lay with human remains, 8 feet from the surface, with a small shell chisel. Their shape is triangular and each has a countersunk perforation for suspension. In addition, the larger, 1.1 inches in length with a maximum width of .6 of one inch and a thickness of .2 of one inch, has a curved groove extending across one side (Figs. 63 and 64).

Nine feet down, with human remains, was a handsome banner stone of a crystalline rock in which the silica projects while the felspathic material is much decomposed—possibly a *Granulate*. It is laterally and longitudinally perforated. Two shoulders with median grooves encircle it. A small portion is broken from one side. Length, 3.4 inches; minimum diameter of shaft, .6 of one inch; maximum diameter of shaft, .8 of one inch; diameter of smaller shoulder, 1 inch; of larger, 1.1 inches (Fig. 65).

A graceful pendant of a crystalline granular rock, probably syenitic, came from a depth of 5 feet with a "celt." Human remains were in association. At either end is a rim, while from one end is a small projection as shown in Fig. 66. Length 2.6 inches; diameter of body, 1.3 inches; diameter of larger rim, 1 inch; of smaller rim, .7 of one inch.

A fusiform pendant, probably of steatitic material, grooved at one end for suspension, strongly resembles in shape pendants of shell found by us in the mound on Tick Island and figured in Part II of our Report. Length, 3.7 inches; maximum diameter, 1 inch (Fig. 67).
TWO SAND MOUNDS ON MURPHY ISLAND, FLORIDA.

A curiously shaped pendant of steatitic rock, having a length of .9 of one inch and a maximum diameter of 1.2 inches, lay with a burial 6 feet from the surface (Fig. 68).

Two pendants of quartz were found separately in the mound. One, a rough fragment about 1 inch in length, is rudely grooved at one end. The other, a crystal, 1.9 inches in length with a maximum diameter of .5 of one inch, is neatly grooved and shows considerable wear (Fig. 69).

We have, in a former Report, quoted Laudonnière's statement as to presents of fine crystal made by southern Indians.

At various depths, though at no great distance from the surface, singly, were seven beads of soapstone, some cylindrical, others oblong, varying in length between 1.1 inches and 2.2 inches.

INTRUSIVE DEPOSITS.

Two and one-half feet from the surface, with a burial and a chisel of stone, was a comb apparently made of leather, with scroll decoration on either side.

With a burial three feet down were an iron or steel axe with long narrow blade, and an unidentified tool of the same material. With these implements, of
necessity obtained from the Whites, were a number of long blue cylindrical beads of glass and spherical polychrome beads of the same material.

Together, accompanying a burial, 1.5 feet from the surface, were a long knife, two chisels, a triangular chisel or tomahawk, and an unidentified tool, all of iron or of steel.

An implement resembling a modern grubbing hoe, and a narrow bladed axe, both of steel or of iron, lay together with fragmentary human remains about 2 feet from the surface. Near by was a hatchet of polished stone. It is not unlikely that these implements of metal were placed in the neighborhood of a pre-existing deposit of stone, nor is it unlikely that all belonged to the same period, since implements derived from White contact did not at once supplant all products of aboriginal art.

**AN OBJECT OF UNDETERMINED DERIVATION.**

Twelve feet from the surface, toward the central portion of the mound, in association with human remains was taken out. in our immediate presence, an object resembling the lower portion of a small nail (Fig. 70). Its length is .8 of one inch. It is affected by the magnet, and is therefore iron or steel or iron ore.

It may be well to explain to the general reader that the aborigines were unable to reduce iron from its ores, and that this metal in a native state, if it exists at all on this earth, is of extreme rarity, and that the only iron in aboriginal use in pre-Columbian times was that obtained from meteorites, as is shown by the high percentage of nickel present when analytically tested. There is no reason why the aborigines of Florida should not have been possessed of some small piercing implements of meteoric iron. Unfortunately, the original material of this specimen cannot be determined by analysis, as it weighs but 215 milligrams and is corroded through and through.

It seems unlikely that aborigines in a way to obtain iron and other products of White contact such as lead, pewter, brass, bronze, glass, china, glazed earthenware, etc., should have scrupulously kept them from the body of the mound wherein lay the great majority of the burials, after placing upon the base a portion of a single nail.

It may be well, moreover, to state in this connection that not one spadeful of sand was thrown back from this mound save in our presence, and that, in addition, three persons trained to careful mound work for years, were present at all times to aid us. Furthermore, after the discovery of superficial iron, if possible, greater vigilance than ordinary was exercised by all, no part of the mound being left without constant inspection. In addition, the work at this mound was done at the close of the season by picked men mostly for many months in our employ. It is, therefore, unlikely that any deposit in the mound escaped us.
TWO SAND MOUNDS ON MURPHY ISLAND, FLORIDA.

REMARKS.

The contents of the northernmost mound on Murphy Island are of considerably above the average interest. The numerous fragments of fossil bone are new to us, while the collections of pebble hammers, chips of stone, and the like, buried together, have not been met with before above Jacksonville, though in low mounds between that point and the sea, they are common enough. The period when the mound was built depends upon the nature of the small piece of iron discovered at the base, and of this we have already spoken.

SOUTHERNMOST MOUND, MURPHY ISLAND.

About two hundred yards in a southerly direction from the mound we have just described is another in full view of the river, did not a thick growth of sour orange trees intervene. The height of the mound is 10 feet; its diameter of base, 70 feet. A number of large forest trees grew upon it. Irregular ridges, evidently artificial, not directly connected with the mound, ran in an easterly direction from it.

Owing to the presence of many orange trees around a portion of the margin, the entire mound was not demolished.

A trench 103 feet wide at the beginning, including the south, southeast and southwest parts of the circumference, was carried in until over one-half the mound had been removed.

The mound proved structurally of great interest. From the start, with its base at about the level of the surrounding territory, was a black layer of midden refuse surmounted by a stratum of sand artificially colored by the use of the red oxide of iron, sometimes pink, and again a bright cherry. Above this was mottled sand containing various local streaks and layers. As the work progressed a second layer of midden refuse was observed.

At the center of the mound, the strata, though somewhat irregular in thickness, were about as follows:

Superficial 4 feet.—Mottled sand, pink, white, and gray at places.
1.5 feet.—Black loam, solidly packed, containing midden refuse, sherds, bones of lower animals, charcoal, and very occasional shells.
6 inches.—Cherry colored sand with pockets, extending into the layer below.
2 feet 10 inches.—Mottled sand.
1.5 feet.—Black loam—midden refuse.
7 inches.—Sand brownish in color, resembling a stain.

Beneath this was pure white sand showing occasional signs of mottling and containing scattered particles of charcoal and at least one worked fragment of chert. There was no definite base line, and how much of this white sand may have been filled into a previous excavation there was no method to determine.
During the entire investigation but seven burials were encountered, all of the bunched variety and none deeper than 5 feet from the surface. In association were several small bits of pottery, a chipping of chert, and, together, two pins of bone.

Occasional sherds were in the midden refuse, and two small imperforate bowls were found separately in the same material. A few arrow heads lay loose in the sand and in the loam.

This curious mound, evidently a place of abode during two extended periods, had been subsequently used, to a small extent in the upper portion, for sepulchral purposes.

In default of total demolition we do not feel justified in drawing conclusions as to this mound.
CERTAIN SAND MOUNDS OF THE OCKLAWAHA RIVER, FLORIDA.¹

BY CLARENCE B. MOORE.

The Ocklawaha River, whose narrow, winding and rapid current enters the St. Johns from the western side of that river, about twenty-five miles above Palatka, has its source in Lake Apopka (see map) though the head of navigation is at the channel between Lakes Eustis and Dora.² From Lake Apopka, running in a northerly direction, it traverses Lake Dora, Lake Eustis and Lake Griffin and continuing first through marsh and then through swamp land and joining Orange Creek, an unnavigable stream, it turns abruptly to the east, pursuing this course until its union with the St. Johns.

Passing through a portion of Lake County, traversing the county of Marion and skirting on the south about one-half of Putnam County, the Ocklawaha, irrespective of curves, has a length of about seventy-five miles. So tortuous, however, is the stream that these figures convey not the faintest idea of the distance to be travelled by water in a journey from the outlet of the river to its source.³

In comparison with the St. Johns, the Ocklawaha had little to offer the aborigines as a place of abode. From the mouth to the union with the stream from Silver Springs (where the acquaintance of the tourist with the river usually comes to an end) the Ocklawaha runs between cypress swamps with very occasional bits of solid land; while above, the course of the stream is through saw-grass marshes offering an equal paucity of landing places.

It is therefore evident that the archaeologist exploring this stream, fully cognizant of the fact that the aborigines were no mean judges of living sites, must set out with a less sanguine spirit than would be justified on the St. Johns, especially as it is doubtful whether the lower Ocklawaha, obstructed, at every turn as it must have been, by huge trunks of fallen cypresses, offered in early times a channel of communication. In point of fact, the paucity of shell-heaps and their restricted

¹ The mound on Bear Island and that at Davenport, within a few miles of the mouth of the Ocklawaha River, have been described in Part II of our "Certain Sand Mounds of the St. Johns River, Florida," Jour. Acad. Nat. Sci., Phila., Vol. X.
² The channel between Lakes Eustis and Dora has, at places, scarcely two feet of water. In addition, two immovable bridges bar the way.
³ A table of distances used on the line of steamers plying on the river, gives as 101 miles the distance by water between the point of union with the St. Johns and the entrance into Silver Springs Run, somewhat less than one-half the length of the Ocklawaha, and this, be it remembered, is a less tortuous portion of the stream than that farther south. Between Alligator Landing and Moss Bluff on the upper river, the distance by land is given as three miles by those in a position to know, and as five times that number when the journey is made by water.
CERTAIN SAND MOUNDS OF THE OCKLAWAHA RIVER, FLORIDA. 519

size, insignificant if compared with the great shell deposits of the St. Johns, testify to a scanty population.

From the mouth to the end of navigation the territory bordering the Ocklawaha was found to contain no mound over eight feet in height and very few approaching even that altitude. It has been, therefore, in the power of the ignorant treasure seeker, or of the "relic hunter," even with his limited time and means, seriously to impair the archaeological value of many of these mounds by the removal of central portions—an impossibility in the case of the greater earthworks of the St. Johns.

As the reader will see, the mounds of the river proper were virtually barren, while no rich harvest was yielded by those of the "lake" country beyond.

This investigation was conducted with steam motive power and an abundant force of men during portions of January and March and all of February, 1895.

We append a list of mounds investigated on the Ocklawaha River, to be followed by a detailed account of those offering any interest either structurally or as to human remains or relics of aboriginal art.

<table>
<thead>
<tr>
<th>Mounds near Ditch Creek, Putnam County.</th>
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<tbody>
<tr>
<td>Ditch Creek (2).</td>
</tr>
<tr>
<td>Indian Bluff.</td>
</tr>
<tr>
<td>Palmetto Landing (7).</td>
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<tr>
<td>Delk’s Landing.</td>
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<tr>
<td>Silver Springs.</td>
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<tr>
<td>Electra Landing.</td>
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<tr>
<td>Lake Weir Landing.</td>
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<tr>
<td>Moss Bluff (3).</td>
</tr>
<tr>
<td>Stark’s Landing (2).</td>
</tr>
<tr>
<td>Hopson Mound.</td>
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<tr>
<td>Near Higley.</td>
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<td>Near Umatilla.</td>
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<td>Near Fort Mason.</td>
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<td>Lake Griffin (3).</td>
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<td>Lake Eustis.</td>
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<td>Near Tavares.</td>
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<td>Barclay’s.</td>
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<tr>
<td>Near Yallah.</td>
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<td>Richmond Mound.</td>
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<tr>
<td>Near Helena.</td>
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<td>Okahumpka.</td>
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Ditch Creek enters the Ocklawaha from the left, going down, about eighteen miles by water from the river’s mouth. About one mile up the creek is a landing, and from this landing, about four hundred yards W. N. W., was a mound 1.5 feet in height and 45 feet in diameter of base. It had apparently lost somewhat in height by the trampling of cattle.

It was totally demolished.

It consisted of gray, loamy sand with the usual admixture of charcoal. At one point were two bits of human femur; at another, charred fragments of human bones. Numerous chips, flakes, and two cores of chert were found and one bit of plain undecorated earthenware.

The mounds of Lake Harris, though not properly belonging to the Ocklawaha River, are included in this paper. The territory bordering this lake had one mound of an altitude greater than the limit given above.

65 JOURN. A. N. S. PHILA., VOL. X.
520 CERTAIN SAND MOUNDS OF THE OCKLAWAHA RIVER, FLORIDA.

About one mile north of the landing at Ditch Creek was a mound 4 feet 9 inches in height and 60 feet through the base. It was much spread out, probably by trampling of cattle and bore marks of previous superficial investigation.

It was completely dug through with the kind permission of J. J. Cummings, Esq., of Beaufort, S. C.

Bunched burials were comparatively numerous, and all or nearly all within 1 or 2 feet of the surface, though, of course, at greater depth when the height of the mound was unimpaired. With one burial were charred turtle bones, while with several were associated calcined fragments of human remains.

About 2 feet down, not far from the center of the mound, was a considerable mass of calcined fragments of human bones mixed with those of lower animals in similar condition. These apparently were not in proximity to any interment.

Throughout the mound were sherds of fairly good quality for Florida, some decorated with red pigment, others with incised lines, etc.

With the exception of the sherds and of a rude and somewhat fragmentary cutting implement chipped from chert, no relics were met with.

MOUNDS NEAR PALMETTO LANDING, MARION COUNTY.

Palmetto Landing on the Ocklawaha River is said to be about seventy-seven miles by water from the river's mouth. About one mile in an easterly direction from the landing were five mounds at no great distance apart, while about one-half mile and one mile respectively farther in the same direction were two others.

Nearest the landing were two symmetrical mounds with base margins almost in contact at one point. The northernmost had a height of about 5 feet with a base diameter of about 52 feet; the southernmost, a height of 6 feet 3 inches and a diameter of base of 57 feet.

These mounds were completely demolished.

They consisted of coarse yellow sand, unstratified and almost, if not entirely, devoid of the usual intermingled charcoal.

No human remains nor indications of burial nor, with one exception, sherds of any description were encountered.

A number of cores and chippings, of chert with two rude chipped cutting implements of the same material, lay loose in the sand. No other relics of any sort were found.

Fifty-five paces in an easterly direction from the northernmost of the twin mounds was another, with a height of 4 feet 4 inches and 48 feet across the base. The entire central portion of this mound was dug out with no return.

Eighty-five paces northeast of the preceding mound was another, 4 feet 3 inches high with a diameter of base of 55 feet. Absolutely nothing was obtained from this mound.

About 20 paces farther was a fifth mound 3.5 feet high. The base had a diameter of 53 feet. Again careful investigation was absolutely unrewarded.
CERTAIN SAND MOUNDS OF THE OCKLAWAHA RIVER, FLORIDA. 521

On the property of Mr. R. D. MacDonald, about one-half mile farther to the east, was an unsymmetrical mound of yellow sand, 7.5 feet high and 71 feet through the base. This mound was not demolished. A certain amount of investigation yielded nothing.

Still farther on, about one-half mile in the same direction, was a beautiful little mound 4 feet in height with a diameter of base of 68 feet. It was built on the edge of a small lake which bordered a portion of its margin, while the remainder was surrounded by a trench about 24 feet wide and 1 foot in depth, which, in the wet season, made an island of the mound.

It was totally demolished, the task being a very difficult one owing to the presence of great quantities of scrub palmetto roots.

The mound was unstratified. Its material was coarse white sand. The usual charcoal was not noticed. A few sherds, undecorated save one which showed marks of red pigment, were scattered through the sand as were a few flakes of chert and a fragmentary lance head.

Almost centrally situated in the mound, at three separate points, each about 18 inches from the surface, were fragmentary human remains, while a small excavation made by a previous visitor showed fragments of human bones in the sand.

This mound illustrates the amount of work at times undertaken by the aborigines to make a limited number of interments.

We can form no conclusion as to the five mounds nearest the landing. They may have been erected for domiciliary purposes, but it is worthy of remark that no village site refuse was found upon them. But, for that matter, we have never in Florida found any marks of habitation upon any mound which, through absence of human remains and products of aboriginal industry, we have been inclined to assign to the domiciliary class.

MOUND NEAR SILVER SPRINGS, MARION COUNTY.

This mound, about one mile in an easterly direction from Silver Springs, had a height of 4 feet 2 inches, with a base diameter of 50 feet. A trench surrounding it, from which its material had been taken, gave an appearance of considerably greater altitude to the mound.

The mound had undergone much previous exploration. A trench had been dug on one side from the margin to the center, and the upper central portion had been excavated to a depth of about 2 feet.

The mound was totally demolished, being dug through, as is our habit, at a level considerably below that of the surrounding territory. Its material was yellow sand without stratification, but with the usual intermingling of particles of charcoal. In various parts of the mound, especially on the base, were small pockets of sand showing marks of fire.

Burials were of the bunched variety, but human remains, when found, were
in the last stage of decay. At one point on the base was a layer of intermingled bones representing a number of individuals. No human remains were saved.

**EARTHENWARE.**

Great numbers of sherds, usually undecorated, some, however, bearing traces of red pigment, and, in two instances at least, ornamented with graceful curves and lines, were met with. A number of fragmentary vessels were found which had evidently been interred in an incomplete condition, as careful search failed to reveal the missing portions. This utilizing of otherwise useless earthenware was very prevalent among the makers of the mounds in Florida. Fragments of various vessels showed perforation of the base subsequent to manufacture.

One small vessel, somewhat broken (Plate LXXXV, Fig. 1), with everted brim and stamped decoration on the body, had four feet for support, a somewhat uncommon occurrence in Florida, though we have met with it on the St. Johns in

![Diagram of incised delineation. Mound near Silver Springs. (Full size.)](image)

the mound at Racey Point, and have seen basal supports on fragments from the mound at Tick Island and on vessels from Murphy Island.

In a portion of the mound at some distance from previous excavations, so far as the most careful investigation could determine, at 3 feet from the surface, in sand where the closest scrutiny could discover no previous disturbance, was found, in our immediate presence, a portion of a small bowl of earthenware. The remainder was not discovered, and was probably not present in the mound. The hollow portion of this fragment contained a solid mass of roots probably belonging to scrub palmettoes on the surface of the mound. Upon examination by us it became
CERTAIN SAND MOUNDS OF THE OCKLAWAHA RIVER, FLORIDA. 523

apparent that incised figures were on the fragment, one probably representing a deer, and that others had been on the missing portion, since incomplete figures were at the broken margins at either side. A close inspection showed that a certain amount of soot, gained doubtless during the entirety of the vessel while in use for culinary purposes, still remained upon the fragment, and that the incised figures were cut through this soot, or after the abandonment of the vessel for domestic use. It is, therefore, evident either that the decoration is aboriginal, but made subsequent to the vessel's final contact with the flames, or that our judgment as to undisturbed sand, in the absence of stratification, is at fault, and that the fragment was a recent addition to the mound, left by some previous investigator. It is shown diagrammatically in Fig. 71.

We have submitted this fragment to Professor Putnam and append the opinion of this high authority.

"Thanks for allowing me to see the fragment of pottery from the Florida mound. It is a very interesting piece of incised work, and again shows the rude character of the art of the people who buried their dead in the sand mounds of Florida.

"That the cutting is not recent I think is shown by the edges of the lines, and also by the fact that in the lines forming the front leg and foot there are little particles of mica that seem to be cemented to the bottom of the incised lines. Now this, it seems to me, could not have happened if the cutting were of recent date and the bowl put into the mound only a short time ago.

"There is every indication, to my mind, that the carving was made by the people who buried their dead in that mound, and no indication of fraudulent work. The whole thing is in keeping with what you have found before.

"We took a piece of similar pottery from Florida and cut lines upon it of the same character, and we found that in making a very slight line we cut into the black interior of the pottery, and the edges were sharp. Whereas, the edges of
your specimen are smoothed over, as if considerable handling had taken place since they were cut. If you will try this on a piece of the same kind of pottery you will at once see the difference between the lines on the bowl and the lines that you cut.”

The incised delineation of an animate object on earthenware has never before been encountered by us in a sand mound, and but once previously in a shell-heap.

In the island shell-heap constituting Mulberry mound, Orange County, Florida, from a depth of 10 feet, were thrown out, in our presence, two fragments of the same earthenware vessel, which, upon being fitted together, showed incised delineation representing a human head and portion of the body, the remainder of the body having been on parts of the vessel not left in that portion of the shell-heap.

Incised delineation of the human form on early earthenware, it may be interesting to know, is believed to be represented by this specimen alone within the limits of the United States and probably beyond. We have given in “The American Naturalist” 1 a full account of our work at Mulberry mound, and have borrowed from it, for comparison, a representation of the incised figure (Fig. 72). Certain parts of the delineation, represented in the cut as less distinct than others, are not of unequal depth, but still contain a certain amount of soot, a relic of pre-historic fires. This point, of considerable interest, shows the decoration to have been made during the entirety of the pot, and not to have been scratched on a detached sherd subsequent to breakage.

STONE.

Flakes and chippings of chert were present in the mound in unusual numbers. Four arrowheads and one drill, also of chert, were met with separately.

A small polished cutting implement of compact igneous rock was in caved sand.

On the base, near the margin of the mound, was a small object of sandstone, probably an ornament, a little short of 2 inches in length. Its shape is ellipsoidal, flattened on one side. A median groove is confined to the curved portion.

In immediate association, 4.5 feet from the surface, lay eleven masses of chert showing cleavage, varying in length from 3 to 9 inches, evidently material for implements. Some were several pounds in weight.

SHELL.

At depths showing them to be of original deposit were two chisels probably from the lip of Strombus and a gouge from the body whorl of Fulgur. One chisel lay with human remains. The other was with a copper bead.

COPPER.

Three cylindrical beads of copper were found during the excavation, all apparently of original deposit. These differed from beads of the same material found by

1 August, 1893.
us on the St. Johns, on which river all beads are of thin sheet copper or of wood, limestone, or shell, overlaid with a thin coating of metal. The copper beads from this mound are more massive, and, while the method of manufacture by hammering to overlap the edges was the same, the thickness of copper employed was greater.

**MISCELLANEOUS.**

The tooth of a fossil shark lay 3 feet from the surface. A notch on either side had served as a medium of attachment by cord or sinew.

**REMARKS.**

In no portion of the mound was anything found in any way indicating contact with the Whites.

**Gamble Mound, Marion County.**

This mound, about one-quarter mile from Stark’s Landing, on property of Mr. R. Gamble, of Tallahassee, to whom we wish to express our indebtedness, was demolished by us during three days in February, 1895. We take occasion here to return thanks also to Mr. T. J. McKinnon, superintendent of the grove.

The mound, long under cultivation, had been reduced to a height of 5 feet 8 inches. The diameter of the base, increased by material from summit and sides, was 76 feet.

The mound was composed of yellow sand, unstratified, with the usual particles of charcoal intermingled. In the sand were present throughout the mound, pockets of fire-whitened sand and deposits of charcoal. One at least of these deposits of charcoal had been made subsequent to the extinction of the fire, as sand unaffected by the flames was mingled with the charcoal.

Throughout the mound, at about the level of the surrounding territory, was a layer of an approximate thickness of 3 inches, composed of fire-whitened sand, mingled with small particles of charcoal. At places in this layer, pockets of sand, nearly one foot in thickness, showing marks of fire, and containing considerable charcoal were met with.

No occurrence of human remains was noted until well on toward the central portion of the mound, when fragmentary bones, indicating the bunched burial, were found, though by no means in numbers proportionate to the size of the mound.

Sherds, plain and stamped in squares, were met with at every depth; also several portions of vessels with base supports. In the eastern margin of the mound, on the base, 2 feet from the surface, was an undecorated bowl 4.5 inches in diameter at aperture and about three inches high. The base has two perforations made subsequent to manufacture, one through the agency of a pointed tool.

Six and one-half feet from the surface was an ellipsoidal object of shell without perforation. These objects are not uncommon in the mounds.
CERTAIN SAND MOUNDS OF THE OCKLAWAHA RIVER, FLORIDA.

STONE.

Five and one-half feet from the surface was a pendent ornament wrought from a nodule of chert, globular in shape, with grooved projection for suspension. Traces of bitumen surround the groove. The ornament lay in a pocket of fire-whitened sand, though no traces of heat are upon it, and the presence of bitumen shows the deposit to have been made after the extinction of the fire. Length, about 2.5 inches; maximum diameter, 1.7 inches (Fig. 73).

A graceful pendant of slate, of a type not met with by us elsewhere, was recovered from previously disturbed sand. Former explorers state that from the small excavation made by them, an exactly similar ornament was recovered. The shape of the pendant is cylindrical, swelling out somewhat at and below the center and then tapering to a point. A groove surrounds the upper portion. Length, 3.7 inches; maximum diameter, .5 of one inch (Fig. 74).

A pendant, probably of silicified fossil bone, in shape somewhat suggesting our "Indian clubs" used for exercise, though thicker at the handle, has a length of 2.6 inches, a maximum diameter of .75 of one inch. Considerable bitumen surrounds the groove and upper portion of the ornament (Fig. 75).
CERTAIN SAND MOUNDS OF THE OCKLAWAHA RIVER, FLORIDA. 527

From a depth of 5 feet came a pendant of a sedimentary rock approaching *Agalmatolite*, somewhat similar in shape to the preceding. The lower portion is missing. Its length is 3.5 inches; its maximum diameter, .8 of one inch (Fig. 76).

A pendent ornament of sedimentary rock, elliptical in outline, flattened on one side, with a small portion missing above the groove, has a length of 2.3 inches with a maximum diameter of .6 of one inch (Fig. 77).

A pear-shaped pendant of some igneous rock, with a length of 1.9 inches and a maximum thickness of 1 inch, came from a depth of 3.5 feet. This specimen also has bitumen adhering to the upper portion. A part of one side is missing (Fig. 78).

On the base, in a pocket of fire-whitened sand, was an ovoid pendant of limestone, unfortunately somewhat injured by contact with a spade. Length, 2 inches; maximum width, 1.4 inches.

So far as careful search would indicate, none of these pendants were associated with human remains, though it is of course possible that all traces of the former presence of bones may have disappeared. It is worthy of note that the inhumation of pendants seemed to prevail in this mound, and that these pendants were uniformly grooved for suspension, bitumen, upon certain occasions at least, having been used to aid in attaching the cord or sinew. We shall see later how, in the mound at Tavares, the pendants, as a rule, had perforation, in which case the use of bitumen would be needless, and it was apparently not employed.

66 JOURN. A. N. S. PHILA., VOL. X.
A sheet of mica, 2 inches by 3 inches, came from a depth showing original deposit. Sheets of mica, so abundant in the low mounds between Jacksonville and the sea but seldom found in the larger ones, are of very rare occurrence and found only in small quantities in the mounds of the St. Johns River above Jacksonville.

Two and one-half feet from the surface was a portion of a superb lance head or dagger, of chalcedony, 6 inches in length. Judging from the point of fracture, the weapon may have been of considerably greater size. Weapons of this character are virtually absent from the mounds of the Ocklawaha and of the St. Johns though the type is not unknown in Florida. Some years ago a hoard of similar ones was unearthed by the workmen of a construction train, not far from Palatka. The find, seven in all, if our memory serves, was unfortunately scattered, though one, which we have seen, is in the possession of Andrew E. Douglass, Esq., of the Museum of Natural History, New York, and one of the smaller specimens, which also we have examined, of milk white chert, 11 inches in length, is owned by Mr. Fry, of Palatka.

An arrow head of chalcedony lay at a depth of 6.5 feet. Throughout the mound were various chippings of chert.

COPPER.

In caved sand was a bead .25 of one inch in length, of copper somewhat thicker than the usual sheet copper of the mounds of the St. Johns.

A massive bead, or rather a pendant of copper, has a maximum diameter of .86 of one inch; maximum thickness of band, .34 of one inch; maximum width of band, .58 of one inch. A groove showing continued wear was apparent on the inner surface (Fig. 79). During all our work on the St. Johns River we have found no ornaments of copper other than those wrought from thin sheets, and why beads of the Ocklawaha, which are made in the same manner, as their overlapping margins testify, are more generously supplied with metal, we are unable to decide.

CONCLUSIONS.

Nothing from the Gamble mound suggested an origin other than pre-Columbian.

HOPSON MOUND, LAKE COUNTY.

At Emerald, in the orange grove of Robert L. Hopson, Esq., of that place, to whom we are indebted for cordial permission to investigate, was an interesting little mound. It had long been under cultivation, and had suffered considerable diminution in height through the agency of the plow. It had sustained but little previous examination. Its height was 4 feet 2 inches; its base diameter, 42 feet. It was carefully dug through at a level considerably below that of the surrounding
CERTAIN SAND MOUNDS OF THE OCKLAWAHA RIVER, FLORIDA. 529

territory, since, in nearly all the Florida mounds examined by us, some sort of excavation seems to have been made previous to the erection of the mound proper.

The upper 3 feet was composed of yellow sand, beneath which was sand of a dark color to a depth of 2 to 3 feet. Charcoal was abundant, and numerous fire-places were encountered throughout the mound. Several pockets of sand colored red with Hematite were at various depths.

HUMAN REMAINS.

Human remains were numerous. The usual bunched burial prevailed, with, in addition, isolated bones scattered throughout the mound. None was in condition to justify preservation.

One foot from the surface, though of course originally at a considerably greater depth, lay a skull in fragments, the shaft of a femur, a large part of a humerus, and an os innominatum, entirely unaffected by fire, in immediate association with fragments of charcoal and small portions of calcined bones, some unmistakably human and others too small for identification.

At various other points in the mound were fragments of human bones affected by fire.

STONE.

Six polished "celts," as a rule unassociated, were found separately at from 3 to 6 feet from the surface. None exceeded 4 inches in length.

At various depths in the mound, separately, were twelve arrow points, while together, about 6 feet down, almost in contact with a fire place, were four arrow heads. These sixteen projectile points, all of chert or of chert breccia, were in each case in a more or less imperfect condition. We have noticed in many mounds a strong aboriginal tendency to be rid of imperfect objects through mortuary deposit and to discharge a duty with as little cost as possible.

Separately, were three pendants of quartz, grooved for suspension, none over two inches in length, one tapered to a point, somewhat resembling an arrow head.

At at least half a dozen points in the mound, sometimes associated with human remains and with other objects, were sheets of mica, some so large as 3.5 inches by 5 inches. One had the form of a circle with a diameter of 3.25 inches.

A few chippings of chert were scattered throughout the mound.

SHELL.

At various points, always with human remains, were beads of shell, at times in considerable numbers. Some were very minute, others nearly 1 inch in length.

As a rule, separately and at all depths, were a number of ellipsoidal objects of shell, imperforate, none over 1 inch in length.

A considerable number of mussel shells were at one point in the mound.
A small tubular bead of copper lay 3.5 feet from the surface, while, with a large number of shell beads 1 foot down, were minute fragments of thin sheet copper.

With human remains, 5 feet 2 inches from the surface, lay an ornament of sheet copper, 1.3 inches by 1.5 inches. Four flutings ran parallel to the lesser diameter. Unfortunately, this object was badly injured by a blow of a spade.

Five feet from the surface, with human remains and associated with many shell beads, a thin sheet of mica, a small shark’s tooth, three canines of some large carnivore (one perforated for suspension, the others broken at a point preventing determination), a pendant of quartz, and a small ellipsoidal object of shell, was a disc of thin sheet copper, about .66 of one inch in diameter, resembling certain ones taken by us from Mt. Royal, and figured in one instance in our account of that mound.

The chief feature of this interesting little mound was the earthenware with which it was filled. Sherds were abundant at all points, while vessels in fragments were numerous, and unbroken ware not uncommon. In the case of one sherd, interesting raised decoration was noticed around the aperture; another bore incised ornamentation; but with these two exceptions, the sherds, when ornamented, showed the use of crimson pigment exclusively, usually consisting of a uniform coat.

No gritty ware was present in the mound, and, as a rule, the pottery was of very inferior quality.

Three feet from the surface, unassociated, was a small globular pendant of earthenware, with projecting neck grooved for suspension.

Three neatly made beads of earthenware of about the same size, the dimensions of one being 1.1 inches by 1 inch by .8 of one inch, lay together with a portion of an arrow head, 3.5 feet from the surface.

Many vessels, some evidently of considerable size, were represented by portions only, and these, being in comparatively small fragments, were not preserved.

An interesting vessel, scaphoid in shape, imperforate as to the base, with inverted rim, had a uniform coat of crimson pigment inside and out. It was found unassociated, 3 feet from the surface. Length, 2.8 inches; width, 2.3 inches; average height, 1.4 inches; diameter of aperture, 2 inches by 1.3 inches (Plate LXXXVI, Fig. 1).

An undecorated circular bowl, with perforation of bottom made after baking, lay apparently unassociated, 3 feet 8 inches from the surface. Height, 2.2 inches; diameter of opening, 4.2 inches.

Near a fire-place, with charred human remains, 5 feet 2 inches from the surface, was a vessel of inferior ware but of interesting design, consisting of two
CERTAIN SAND MOUNDS OF THE OCKLAWAHNA RIVER, FLORIDA. 581

nearly circular bowls joined, originally with projecting handles 1 inch in length, one from the outside of each. One handle was missing through breakage. Each bowl had a portion of the base knocked out after completion. Dimensions of one bowl, applying to both in the main: height, 1.4 inches; length, 2.8 inches; width, 2.4 inches (Plate LXXXV, Fig. 2). This unusual form of a double bowl, may be a highly conventionalized form representing the open bivalve. We have seen the type before, on one occasion from Mt. Royal, and several times from the low mounds bordering the St. Johns between Jacksonville and the sea. General Thruston figures1 an artistic double vessel much more directly pointing to the shell, as from Tennessee.

Two and one-half feet from the surface was a globular bowl with perforation of base after baking. A small hole on either side of the mouth had served for the purpose of suspension. This vessel, with a height of 3.7 inches, a maximum diameter of 4.5 inches and a diameter at aperture of 3 inches, was completely filled with mussel shells. We do not recall the discovery by us before of any object in vessels from Florida mounds with the exception of certain pebbles in one instance, and an occasional vessel of inferior size placed within a larger one.

A globular vessel and a bowl, both undecorated and both wanting a portion of the bottom through breakage done after manufacture, lay together, 4 feet 8 inches from the surface.

Six feet down, beneath human remains, was an imperforate bowl with oval section, decorated with red pigment inside and out. Depth, 2 inches; length, 4.2 inches; breadth, 3.6 inches.

An unassociated vessel, 3 feet 6 inches down, with oval aperture and with portion of bottom knocked out, had a coating of red pigment on the outside and on the inside a band of the same color 3 to 4 inches in width, beginning at the margin. Height, 8 inches; average diameter of aperture, 10.5 inches. This vessel was somewhat broken by pressure of sand.

With fragments of a large bowl 1.5 feet from the surface, was an urn with flaring rim and red pigment decoration on outside and part way down the interior. Height, 7.7 inches; maximum diameter, 8.8 inches; width of top with rim, 6.8 inches; diameter of aperture, 5.5 inches. A portion of the bottom is missing through breakage after manufacture. Near this urn lay an undecorated globular vessel of ordinary type.

One foot three inches from the surface, with human remains immediately above, were two flaring basins of the same pattern and of approximately the same size, recalling in shape a basin from Thursby mound shown in Plate XXVI, Fig. 1, in Part II of our Report on the St. Johns mounds. Traces of red pigment are apparent on both sides of one and interiorly on the other. Height, 4.5 inches; maximum diameter, including the flaring rim, 18 inches. One bowl lay face down, while the other, also inverted, lay upon it, covering about one-half its base.

1 "Antiquities of Tennessee."
Associated with human remains, about 5 feet from the surface, were two trough-shaped vessels of earthenware. With them was another of similar pattern with one of the ends omitted in manufacture, while a fourth showed marked concavity of one end (Plate LXXXV, Fig. 5). These specimens of mortuary "freaks" in earthenware had each a perforation in the base made previous to baking. Traces of red pigment were apparent on some. But one of the four was in perfect condition. Largest, 6 inches by 3.5 inches by 1.5 inches high. Smallest, 4.1 inches by 2.8 inches by 1.2 inches high.

Five feet from the surface, though not at the same point as the vessels just described, the smaller inverted within the other, were two trough-shaped vessels nearly similar to the others but imperforate as to the base. The larger, 5.6 inches by 3.1 inches by 1.4 inches high, has traces of red pigment inside and out (Plate LXXXV, Figs. 3 and 4). The smaller is undecorated. Its dimensions are approximately 5 inches by 2.5 inches by 1.3 inches high. We have never before met with this curious type of earthenware.

At various depths were four other vessels of ordinary type, somewhat crushed by weight of sand but capable of restoration.

REMARKS.

Nothing in any way indicating contact with the Whites was discovered in the Hopson mound.

MOUND NEAR HIGLEY, LAKE COUNTY.

About one mile south of Higley, on property belonging to Mr. Hart, in whose absence we are indebted to Mr. W. J. Young, of Higley, for permission to investigate, was a mound in pine woods, within sight of the western bank of Lake Yale, 5 feet 4 inches in height, with a diameter of base of 65 feet. This mound had previously been dug into to a considerable extent, the immediately central portion having been removed. The mound had doubtless in former times been of considerably greater altitude.

It was totally destroyed.

It was composed of yellow sand with occasional pockets of white sand and sand scarlet from admixture of Hematite.

Human remains, fragmentary and much decayed, were infrequently met with. Sherds were mostly plain, though one of good material showed very neat square stamped decoration, separated at intervals by parallel, perpendicular, incised lines (Plate LXXXVI, Fig. 2).

With human remains, 2 feet from the surface, about 1 foot apart, were two polished hatchets. One arrow head came from a depth of 3 feet. From a like depth was taken an oblong, flat, perforated pendant of shell, with rounded corners, 1.7 inches long, 1.2 inches wide, .7 of one inch thick.

Beyond these, no objects of interest were encountered.
CERTAIN SAND MOUNDS OF THE OCKLAWAHA RIVER, FLORIDA. 533

REMARKS.

The amount of previous investigation sustained by this mound renders accurate conclusions impossible.

MOUND NEAR UMATILLA, LAKE COUNTY.

This mound, about two and one-half miles west of Umatilla, lay in the grove of Mr. R. McS. Byrnes. Mr. J. F. Holton, superintendent of the grove, kindly consented to the investigation. The mound had long been under cultivation, and was evidently much reduced in height. It had, moreover, sustained much pre-

![Fig. 50. Pendant of shell with antero-posterior section. Mound near Umatilla. (Full size.)](image1)

![Fig. 51. Pendant of shell. Mound near Umatilla. (Full size.)](image2)

vious examination with a reported yield of numerous objects of interest. Its height was 4 feet; its basal diameter, 46 feet. It was completely dug through.

No stratification was apparent, yellow sand with the usual admixture of charcoal composing the mound. Occasional fire-places were scattered throughout. Scattering pockets of white sand and numerous streaks and pockets of sand, pink from the use of the red oxide of iron, were present.

Human remains in the usual bunched form of burial were abundant.

From depths indicating original deposit came: one small bowl of earthenware, imperforate as to base, with single perforation for suspension on either side below the margin and with punctate and incised linear decoration, as shown in Plate LXXXVI, Fig. 3 (height, 2.3 inches; maximum diameter, 2.4 inches); a small,
ruled, undecorated, oblong vessel with rounded corners and perforation of base subsequent to completion; separately three arrow heads, thin and carefully made; two shell pendants, one wrought from the lip of the great marine univalve, Strombus gigas (Fig. 80), the other, diamond shaped, from the body whorl of the conch (Fulgur) (Fig. 81); a number of shell beads with human remains.

REMARKS.

Nothing from this mound gave evidence of other than aboriginal art.

MOUND NEAR FORT MASON, LAKE COUNTY.

About one mile northwest of Fort Mason, just south of Lake Yale, on the property of Mr. G. D. Jackson, was a mound 50 feet in diameter of base and 2 feet in height, though considerable depressions from which material had been taken gave the mound the appearance of greater altitude.

The mound was completely demolished, the excavation being carried to a level considerably lower than that of the surrounding territory. Mr. W. J. Gladwell, manager of the property, to whom, in the absence of the owner, we are indebted for permission to dig, informed us that the land containing the mound had been cleared by him two years previously, and that subsequent cultivation had lessened the height of the mound by about one foot.

Unlike other mounds demolished by us on the Ocklawaha, the method of burial in this mound was in anatomical order in various forms of flexion. In all, fifteen skeletons were encountered, in such condition, however, that no cranias were preserved. In the majority of cases, skeletons lay from 1 foot to 18 inches beneath the surface.

Sherds were fairly numerous, but not in association with human remains. They lay loose in the sand, and were probably gathered with it from the surface during the formation of the mound. The majority were undecorated; the square stamp appeared upon one or two occasions, and once a punctate decoration.

With one burial was an iron spike; with another, an iron or steel hunting knife 9 inches in length, including the projection for the handle, no other trace of which remained. Both knife and spike were badly affected by rust.

Three skeletons had each one polished stone "celt" in association. Another "celt" lay loose in the sand.

With a skeleton, in contact with the lower jaw and cervical vertebrae, were: beads of shell and numerous minute shells (Olivella) longitudinally perforated for use as beads; a carbonized ball about 1 inch in diameter, of bark or some kindred material many times rolled upon itself; a tubular bead of sheet silver with overlapping edges, 1.3 inches in length and .3 of one inch in diameter, and a tubular bead of sheet copper 2 inches in length and .25 of one inch in diameter. Whether this copper bead was wrought from metal obtained from the Whites or was a
CERTAIN SAND MOUNDS OF THE OCKLAWAHA RIVER, FLORIDA. 585

purely aboriginal ornament made from native copper, we have not determined by analysis, which, however, could readily be done.

It may not be out of place here to explain to the reader who may not have seen our monograph on aboriginal copper, contained in Part II of our Report on the St. Johns River mounds, that chemical analysis can readily distinguish native copper from the product of smelting of any ores obtainable in Europe during any possible mound-building period. In the first place, native copper, in use among our aborigines, was purer than the copper resulting from early smelting processes. And again, lead, almost universally present in the products of European smelting, is never found in native copper. Moreover, any copper that has been in a state of fusion contains a small percentage of combined oxygen which is entirely absent from native copper. Still further, most native copper is free from arsenic, while in Europe the copper supply was obtained from highly arsenical sulphide ores. Even now, arsenic cannot be totally eliminated from copper and was much less readily excluded in early times.

To return to the mound. A large shell bead wrought from the lip of Strombus lay with a skeleton, while elsewhere in the mound were a Fulgur perversum and a curved cylindrical ornament of shell, with tapering ends, possibly for use in the lobe of the ear.

On the surface of the mound was a copper or brass-coated convex bit of wood, almost circular, with double perforation.

Throughout the mound were four arrow heads and a number of chippings and flakes, of chert; also a small chipped "celt" somewhat broken.

With human remains was a small bowl with stamped decoration, the bottom of which had been knocked out subsequent to manufacture.

REMARKS.

In this interesting little mound we have a good example of the tumuli raised in undoubtedly post-Columbian times for mortuary purposes. Here we have the polished "celt" at the same depth in the mound as iron, and other objects probably of European origin are found side by side with articles purely aboriginal. It is interesting to note the survival of the perforation of the base in pottery—the killing of the vessel—to a comparatively late period.

MOUND ON LAKE EUSTIS, LAKE COUNTY.

On the northern shore of Lake Eustis, about one mile west of Fort Mason, in a field belonging to Mr. J. T. Wofford, were two low mounds about fifty yards

1 The reader will recall that native copper is copper found in nature, with no elements in chemical combination.

2 In all the mounds examined by us in Florida, including virtually every known tumulus on the St. Johns River, in addition to those described in this paper, we have encountered but two mounds this, and one near Bayard Point, Clay County, about 4 feet in height—where articles of European make were other than superficial. July, 1895.

68 JOURN. A. N. S. PHILA., VOL. X.
apart. The larger one, the nearer to the lake, was completely dug through by permission of the owner. Its height was 2 feet 5 inches; its base diameter, 48 feet.

The most careful search failed to reveal any trace of human remains.

Loose throughout the sand were: numbers of chips and flakes, of chert; two bits of quartz; a hone of sandstone with double groove, and several rude cutting and piercing implements of chipped chert, whole and fragmentary.

**Mound near Tavares, Lake County.**

In the "scrub," about one mile southwest from the town of Tavares, the county seat of Lake, was a mound about 5 feet in height and about 50 feet across the base. It had sustained considerable previous investigation. It was completely dug down by us.

Its composition was peculiar. The northern portion, unstratified, was of pure white sand, while the section to the south was made up of sand of a brownish yellow color. The usual charcoal and fire-places were present.

Bunched burials were in considerable numbers. The very fragmentary condition of the bones rendered useless any attempt at preservation.

No whole vessels were discovered nor any represented by a full complement of fragments. Sherds were fairly numerous and at times indicative of large vessels. Undecorated fragments and those adorned with red pigment predominated. One, with somewhat striking ornamentation, is shown in Plate LXXXVI, Fig. 4.

A portion of a small oblong dish with rounded corners had the somewhat unusual addition of feet.

No copper was met with in the mound but a portion of a human clavicle dyed a bright green indicated the former presence of the metal.

Two and one-half feet from the surface, with human remains, together, were a number of shell beads and four ellipsoidal objects shaped from columnæ of marine univalves, 3 inches to 5 inches in length. Singly, in various portions of the mound, were five similar objects of shell; two pear-shaped pendants of like material, and two shell beads of considerable size.

A cube of galena, 1.4 inches by 1 inch by .7 of one inch, apparently shows wear on one side.

As in the case of the Gamble mound, the feature of the mound near Tavares was pendent ornaments.

A graceful ellipsoidal pendant of fine-grained, compact rock of igneous origin, 1.3 inches in length, is perforated at one end for suspension (Fig. 82). Another, of a compact crystalline igneous rock, *Dolerite or Diorite*, pear-shaped, has a rim for suspension.

A small pendant of banded red jasper lay loose in the sand.

Found separately, but from the same portion of the mound, were four pendent
CERTAIN SAND MOUNDS OF THE OCKLAWAHA RIVER, FLORIDA. 537

ornaments, two of syenitic and two of sedimentary rock, ranging in length between 3.4 inches and 2.9 inches, each perforated at one end, three transversely, one from front to back, and more or less rounded at the other end (Figs. 83, 84, 85, 86). In one instance, one side has an incised longitudinal line. In the case of three others the line is represented by a deep groove. One is highly polished. This type is new to us, though we have figured something similar in Part I as coming from the low mound in the pine woods back of Duval's, Lake County, a duplicate of which, as to type but larger, is shown in "The Archaeological Collection of the United States National Museum," Charles Rau, figure 322, page 90.

An interesting discovery, since the type, we believe, is hitherto unreported from Florida, was an effigy of igneous rock, probably Diorite, representing a bird at rest. The length is 2.1 inches; maximum width, 1.2 inches. The wings are clearly defined, while the tail spreads out to afford a means for suspension. The head, unfortunately, is missing. This type, the bird amulet, is well known to

CERTAIN SAND MOUNDS OF THE OCKLAWAHA RIVER, FLORIDA.

archaeologists as found in many sections,¹ though this particular specimen offers many points of variation from the forms usually encountered (Fig. 87).

Separately, in two cases with human remains and once in caved sand, were three polished "celts," one having a length of 10 inches.

At various depths were: several fragmentary arrow heads of chert; two small and gracefully shaped points of like material; a lance head of chipped chert, 4.7 inches in length; another slightly larger, of red jasper, with a high polish on either side, a very unusual feature (Fig. 88).

A number of chippings of chert lay scattered throughout the mound.

We see no reason to ascribe to this mound an origin other than pre-Columbian,

"Smithsonian Arch. Coll.," Charles Rau, page 53.
"Primitive Industry," Abbott, chap. XXVI.
CERTAIN SAND MOUNDS OF THE OCKLAWAHA RIVER, FLORIDA. 539

though a much smaller mound in the neighborhood, completely dug through by relic hunters, is generally reported to have contained articles of brass or of bronze, while at the time of our visit glass beads were present on its surface.

MOUND AT BARCLAY'S, LAKE COUNTY.

On the southernmost extremity of Lake Harris is the property of Mr. C. M. Barclay, upon which was a mound 2.5 feet in height with a diameter at base of 55 feet. It had long been under cultivation. A trench nearly traversing the mound and other excavations had been made by members of the family of Mr. Barclay, to whom our thanks are due for permission to demolish the mound.

The mound was composed of yellowish and brownish sand intermingled; the "dumps," or individual loads, being unusually well marked. In the northernmost portion streaks and pockets of brick-red sand were present, as was the usual charcoal throughout, often in pieces of considerable size.

But few interments were encountered by us, though the bunched form, scattered bones, and in one case, an original burial plainly in anatomical order, were present.

At various depths, always with human remains, were five polished hatchets of stone, three separately, two with the same burial.

Loose in the sand, were various flakes, chippings and broken arrow heads of chert, and four small, delicate ones of the same material.

Sherds were undecorated, or stamped in squares or diamonds. One small vessel, considerably broken, with bottom knocked out, had beneath the rim two encircling lines of punctate markings.

We obtained from Mr. Barclay, whose son, he assured us, found it in the mound, a bead of copper, 1.8 inches in length, with a maximum diameter of .6 of one inch. The shape is nearly ellipsoidal, though the ends do not agree as to diameter. It is made of copper hammered over in the usual fashion, and is more massive than any ornament of copper met with by us on the St. Johns, recalling in weight though not in shape, a heavy copper ornament from the Gamble mound.

A number of small shells (Olivella) used for beads, lay with one skeleton.

Two beads of blue glass, were picked up on the immediate surface, but most careful search failed to reveal any in the body of the mound. One point noticeable in the majority of the Florida mounds was clearly emphasized in this one. While the height of the mound was but 2.5 feet above the surrounding level, it was necessary to go down 6 feet 4 inches from the surface before evidence of artificial construction came to an end, showing that, before the building of the mound, an excavation of some sort had been made. This custom obtained upon the St. Johns also, where, it will be remembered, when mounds were built upon pre-existing shell-heaps, one layer of burials was placed in the shell.
Richmond Mound, Lake County.

The Richmond mound, at Helena, near the southwestern shore of Lake Harris, was 12 feet high and 90 feet across the base. Pines of large size grew upon its surface. Though considerable previous investigation had been attempted in a desultory way, yet, so great was the bulk of the mound, that comparatively little material had been removed and the mound presented a symmetrical appearance.

Former explorers and residents of the neighborhood concurred in reporting negative results from previous investigation. Testimony of this character in relation to mound work may usually be accepted with safety.

We are indebted to the Reverend John F. Richmond, whose residence is near Helena, for cordial permission to investigate, and to his family for many courtesies.

The mound was totally demolished during six and one-half days of seven hours each with an average force of sixteen men surrounding the mound and throwing back.

There was no uniformity of stratification. The level of the surrounding territory was marked by a layer of brownish sand with a certain intermixture of charcoal and an occasional fire-place. Above, the body of the mound was composed of yellow sand of irregular thickness surmounted by a number of feet of brown sand. From the base almost to the summit were pockets and local layers of sand artificially colored a brick-red. One of these layers, from 1 to 6 inches in thickness, began on the southernmost side and continued at least half-way through the mound.

During the entire investigation, evidence of not exceeding ten interments, apparently of the bunched variety, was met with. During the second day, two crania were found separately at about 3 feet from the surface. On the fourth, a burial was found 9 feet down, while during the last day's work an interment was encountered at no great distance from the base. The burials were all in the last stage of decay, and were associated with no relics of any sort.

During the fifth day's work, one polished stone hatchet was met with near the surface. On the sixth day, five were discovered, of which four were comparatively superficial, while one was in caved sand. Six arrow heads lay separately, loose in the sand, one at a depth of 7 feet.

Sherds were of extreme rarity. On the base with charcoal, were two fragments of earthenware with a square stamped decoration.

Remarks.

The Richmond mound is another example of the mass of sand sometimes thrown up for comparatively few interments. The hatchets found 2 or 3 feet from the top, were doubtless put in in a general way at the completion of the mound.
CERTAIN SAND MOUNDS OF THE OCKLAWAHA RIVER, FLORIDA. 541

One would look for more interments and for a greater supply of art relics in a mound of this size where such care was shown as to construction.

**Low Mound near Helena, Lake County.**

In the grove of Messrs. Steiner Brothers, near Helena, was a mound which years of cultivation had reduced to a height of less than 2 feet and whose diameter, excluding later additions from above, was about 45 feet. We are indebted to Mr. William Henry Bennett, superintendent of the grove, for permission to investigate.

The mound, which was entirely dug through at a level considerably below that of the surrounding territory, was of yellowish sand, brownish at places, probably through admixture of organic matter.

The usual fire-places and fragments of charcoal in the sand, were observed.

Interments and art relics were virtually confined to the northwest portion of the mound, continuing well in toward the center; first, single burials, then almost a continuous layer. In all, fully thirty bodies were at least partially represented.

Sherds were abundant, both plain and decorated, with red pigment and a few ornamented with punctate curves. No whole vessels were discovered.

Numbers of flakes, chips and cores and imperfect and broken arrow heads lay at all points throughout the mound. With one burial were minute remnants of an ornament of thin sheet copper, while with another were small fragments of the metal with two flat oblong bits of earthenware, about 1 inch by 1.3 inches each, with rounded edges and central perforation, evidently cut from a broken vessel. These had not been overlaid with the copper, but simply interred in association (Fig. 89.)

With a single burial, not far from the northwestern margin was a highly polished and beautifully made pendent ornament of a rock which we have not identified through hesitation to mutilate so beautiful a specimen. In type it resembles one from the mound at Tavares, though in addition to the median groove on one side, it has incised line decoration at the upper end while the lateral perforation unites with one from the top to allow perfect perpendicularity of suspension. Length, 3 inches; maximum diameter, about .4 of one inch (Fig. 90).
542 CERTAIN SAND MOUNDS OF THE OCKLAWAHA RIVER, FLORIDA.

MOUND NEAR OLD OKAHUMPKA, LAKE COUNTY.

About one-half mile, in a northwesterly direction from Old Okahumpka, in the orange grove of Robert A. Green, Esq., of Ocala, was a low mound, for years under cultivation and doubtless much reduced in height. Its altitude at the time of its total demolition by us was less than 2 feet above the surrounding level though most of the human remains and accompanying art relics came from a depth of from 3 feet to 4.5 feet from the summit of the mound. The diameter of the base was about 40 feet.

The mound was composed of brownish sand apparently changed from the yellow of the surrounding territory by admixture of organic matter. It was un-stratified. The usual scattered bits of charcoal and fire-places were present.

Human remains were numerous, the bunched form of burial being indicated.

In this mound, all art relics were in immediate contact with human remains. Pockets and streaks of sand colored by Hematite were not present.

STONE.

Numerous chips of chert were present in the mound, also one arrow head of the same material.

Seven “celts” of the usual rocks were found separately with human remains, and upon one occasion two lay in contact with long bones, one on either side of the mass.
CERTAIN SAND MOUNDS OF THE OCKLAWAHA RIVER, FLORIDA. 543

With a bunched burial was a rude "celt" of sandstone, associated with a copper ornament.

EARTHENWARE.

Sherds, plain or decorated with red pigment, were very numerous. No vessels, whole or approximately so, were encountered.

We have obtained from Mr. Russell W. Bennett, of Helena, a sherd which he informs us was ploughed up from this mound. This fragment of earthenware, shown in Fig. 91, is of considerable interest, as possessing the only plastic effigy of the human face ever seen by us in Florida. This face, apparently modeled by hand, appears to have been constructed separately, and pressed onto the clay of the vessel previous to baking.

The reader will recall that this joining of heads to earthenware was prevalent in other sections. Upon but one other occasion in Florida have we seen a head of any sort serving as a decoration on the side of a vessel of earthenware and in that case a portion of a vessel from a low mound near the mouth of the St. Johns had the head of a duck, not added to it by pressure, but repoussé.

COPPER.

With bones tinged green from contact and in association with a few small shell beads were the remains of a long tubular bead of copper overlaid on a cylinder of fibrous wood.

Eighteen inches from the surface was a heavy bead of copper .7 of one inch by .6 of one inch, in contact with a human lower jaw which formed part of a bunched burial.

With a burial about 4.5 feet from the top of the mound was a sheet of copper, 2.8 inches by 6 inches, bent under and crumpled at one end. The two shorter and one larger side show a clean-cut edge, but the uneven appearance of one larger side proves but a portion of the plate to have been inhumed. The state of this copper sheet precludes inspection of the entire ornamentation which is repoussé and seems to be of an interesting character, entirely dissimilar from the usual lines of semi-perforations. With it were bark and some fibrous material, a rude "celt" of sandstone and a small core of chert.

SHELL.

With a burial were fifty-six beads of shell, many of unusual size, the largest 1.9 inches in length. Many were not symmetrical but were apparently perforated portions of great marine univalves such as are figured as massive beads in Holmes' "Art in Shell." With the beads was a polished stone hatchet.

REMARKS.

There seems to be no reason to connect this mound with a period subsequent to the coming of the Whites.
INDEX TO GENERA, ETC.

Anaptomorphus, 275
Anthropidae, 275
Anthropopithecus, 418, 422, 423
Arca, 62
Arctopitheci, 275, 288
Avahis, 275, 293, 300, 302, 306, 328
Brachyrus, 276
Callithrix, 276, 300
Cardium, 188, 478, 493
Catarrhini, 275
Cebidae, 276
Cebinae, 276
Cebus, 255, 275, 292, 321, 317, 318, 320, 324, 335
Cercopithecus, 275, 276, 299, 300, 307, 313, 317, 318, 320, 324, 334, 335
Cheirogaleus, 275
Cheirogaleidae, 275
Cheirogali, 275
Cheiroptera, 254
Chiroptera, 275
Chiroptidae, 275
Chiroptera, 439
Chrysothrix, 275, 276, 280, 289, 293, 296, 300, 302, 305, 315, 318, 329, 331, 333
Colobus, 276
Cynomorpha, 275
Cynopithecinse, 276
Delphinus, 349
Diestyles, 348
Elephas, 167
Eriolus, 276
Fasciolaria, 13
Felidae, 253
Fulgar, 11, 12, 20, 25, 34, 60, 62, 63, 148, 152, 162, 179, 181, 196, 201, 450, 466, 479, 471, 476, 477, 479, 516
Galaginae, 275
Galago, 275
Gorilla, 418, 419, 422, 423
Gryzoecephala, 254
Hapale, 276, 292, 300, 305, 328
Hapalemur, 275
Hapalinae, 276
Hylobates, 275, 276, 289, 326, 336, 418, 422, 423
Hyrax, 254
Indris, 275, 293, 300, 302, 306, 317, 328
Indrisinae, 275
Insectivora, 254
Lagostrix, 276
Leiotrichi, 275
Lemur, 276, 293, 300, 302, 306
Lemuridae, 275, 288
Lemurinae, 275
Lemurini, 275
Lepilemurinae, 275
Loris, 275
Lorisinae, 275
Macacus, 275, 276, 289, 297, 318, 320, 325, 327, 328, 332, 334, 335, 358, 359
Marginella, 477
Margaretiphora, 26
Marsupialia, 254
Midas, 276, 292, 328
Modiola, 188, 469
Monotremata, 254
Murex, 60
Myctes, 276
Mycticine, 276
Nycticeps, 275
Nyctipithecinae, 276
Nyctipithecus, 276
Olivella, 466, 477
Orycteropus, 254
Paludina, 6, 19, 26, 36, 51, 83, 503
Pectes, 62
Pectunculus, 62
Perodicticus, 275
Phascolomya, 254
Pithecanthropus, 407
Pithecia, 276
Pithecia, 276
Pithecia, 275
Platyrrhini, 275
Propithecus, 275, 293, 300, 302, 306, 315, 328
Pteropus, 254
Rohdea, 254
Semion, 276
Semnopithecinae, 276
Semnopithecus, 275, 276
Simia, 276, 418, 422
Simiidae, 275, 276, 288
Strombus, 26, 148, 470
Tarsius, 275
Tarsius, 275
Trogloodytes, 275, 276
Unio, 19, 26, 47, 452, 491
Unionidae, 64
MOORE: FLORIDA SAND MOUNDS

COPPER BREAST-PIECE, MT. ROYAL, FLA.

PARTIAL RESTORATION,— TWO-THIRDS NATURAL SIZE.
MOORE: FLORIDA SAND MOUNDS

1. SHerd, Dunn's Creek Mound (Full Size.)
2. SHerd, Dunn's Creek Mound (Three-Quarters Size.)
3. SHerd, Dunn's Creek Mound (Full Size.)
4. SHerd, Dunn's Creek Mound (Full Size.)
MOORE: FLORIDA SAND MOUNDS

1. Earthware Vessel, Dunn's Creek Mound (Full Size.)
2. Earthware Vessel, Dunn's Creek Mound (Full Size.)
3. Earthware Vessel, Mt. Royal (Three-Quarters Size.)
MOORE: FLORIDA SAND MOUNDS

1. OBLONG EARTHENWARE BOWL, MT. ROYAL (FULL SIZE.)
2. DECORATED EARTHENWARE VESSEL, MT. ROYAL (FULL SIZE.)
3. DECORATED EARTHENWARE VESSEL, MT. ROYAL (FULL SIZE.)
MOORE: FLORIDA SAND MOUNDS

1. TUREEN-SHAPE EARTHENWARE VESSEL, MT. ROYAL (FULL SIZE.)
2. EARTHENWARE VASE WITH FLARING MOUTH, MT. ROYAL (ONE-HALF SIZE.)
3. EARTHENWARE BOWL WITH PERFORATED HANDLE, MT. ROYAL (FULL SIZE.)
4. EARTHENWARE BOWL WITH PERFORATED HANDLE, MT. ROYAL (FULL SIZE.)
MOORE: FLORIDA SAND MOUNDS

1. UNIDENTIFIED OBJECT OF POTTERY WITH APERTURE AT EITHER END. MT ROYAL (FULL SIZE.)
2. SMALL EARTHENWARE BOWL, MT. ROYAL (FULL SIZE.)
3. SMALL EARTHENWARE BOWL, DECORATED, MT. ROYAL (FULL SIZE.)
MOORE: FLORIDA SAND MOUNDS

1. Earthenware pot, Mt. Royal (full size.)
2. Decorated fragment, Mt. Royal (two-thirds size.)
3. Earthenware dish, Mt. Royal (full size.)
MOORE: FLORIDA SAND MOUNDS

1. SMALL SEMIVOID VESSEL OF POTTERY, MOUND AT DUAUL'S. (FULL SIZE.)
2. VESSEL OF EARTHENWARE, MOUND TWO MILES WEST OF DUAUL'S. (FULL SIZE.)
3. HEAD OF EARTHENWARE ANIMAL EFFIGY, MOUND TWO MILES WEST OF DUAUL'S (FULL SIZE.)
4. SPOOL-SHAPED OBJECT OF POTTERY, UNIDENTIFIED, MOUND TWO MILES WEST OF DUAUL'S (THREE-QUARTERS SIZE.)
MOORE: FLORIDA SAND MOUNDS

1. SMALL UNIDENTIFIED OBJECT OF POTTERY, MOUND TWO MILES WEST OF DUVAL'S (FULL SIZE.)
2. UNIDENTIFIED OBJECT OF POTTERY WITH BASE APERTURE, MOUND TWO MILES WEST OF DUVAL'S (THREE-QUARTERS SIZE.)
3. SHerd, MOUND TWO MILES WEST OF DUVAL'S (TWO-THIRDS SIZE.)
MOORE: FLORIDA SAND MOUNDS

ANIMAL EFFIGY OF POTTERY.

MOUND TWO MILES WEST OF DUVAL'S (TWO-THIRDS SIZE.)
MOORE: FLORIDA SAND MOUNDS

PORTION OF VASE.

MOUND TWO MILES WEST OF DUVAL'S (FULL SIZE.)
MOORE: FLORIDA SAND MOUNDS

1. FRAGMENT OF EARTHENWARE VESSEL DECOATED WITH RED PIGMENT, MOUND NEAR VOLUSIA (ONE-HALF SIZE.)

2. FRAGMENT OF EARTHENWARE VESSEL DECOATED WITH RED PIGMENT, MOUND NEAR VOLUSIA (ONE-HALF SIZE.)
MOORE: FLORIDA SAND MOUNDS
VESSEL OF EARTHENWARE.

DECORATED WITH RED PIGMENT. APERTURE AT TOP AND BOTTOM. MOUND AT VOLUSIA (TWO FIFTHS SIZE.)
MOORE: FLORIDA SAND MOUNDS
SAME AS PLATE XIII, SHOWING BOTH PERFORATIONS.
MOORE: FLORIDA SAND MOUNDS

1. FRAGMENTS OF EARTHENWARE VESSEL, TICK ISLAND MOUND (FULL SIZE.)
2. FRAGMENT OF EARTHENWARE VESSEL, TICK ISLAND MOUND (FULL SIZE.)
3. DECORATED SHERD, TICK ISLAND MOUND (FULL SIZE.)
4. EARTHENWARE HEAD OF VULTURE, GINN'S GROVE MOUND (FULL SIZE.)
5. DECORATED SHERD, GINN'S GROVE MOUND (FULL SIZE.)
6. HANDLE OF EARTHENWARE VESSEL, GINN'S GROVE MOUND (FULL SIZE.)
MOORE: FLORIDA SAND MOUNDS

LOWER PLATE. COPPER BREAST-PIECE. MT. ROYAL, FLA.

PARTIAL RESTORATION.—TWO-THIRDS NATURAL SIZE.
BURIAL MOUND AT GINN'S GROVE. (From photograph by Author.)
LARGER MOUND, THORNHILL LAKE. (From photograph by Author.)
MOORE: FLORIDA SAND MOUNDS.

EARTHENWARE VESSELS.

PLATE XVII.
MOORE: FLORIDA SAND MOUNDS.

1, 2. Earthenware Vessels, Mt. Royal. (Full size.)
3, 4. Earthenware Tubes, Mt. Royal. (Full size.)
MOORE: FLORIDA SAND MOUNDS.

EARTHENWARE VESSELS, MT. ROYAL. (FULL SIZE.)
MOORE: FLORIDA SAND MOUNDS
EARTHENWARE VESSELS, MT. ROYAL.
(1, 3, FULL SIZE; 2, 4, HALF SIZE.)
MOORE: FLORIDA SAND MOUNDS.

1, 2. Earthenware vessels, Mt. Royal. (Full size.)
3. Earthenware vessel with animal head, Duval's. (Full size.)
MOORE: FLORIDA SAND MOUNDS.

1. BIRD EFFIGY OF EARTHENWARE, DUVAL'S. (FULL SIZE.)
2. VASE OF EARTHENWARE, DUVAL'S. (FULL SIZE.)
MOORE: FLORIDA SAND MOUNDS

1. ATRIPLEX VITELLA, VISTA. (FULL SIZE.)
2. ATRIPLEX VITELLA, VISTA. (FULL SIZE.)
3. CARTERETIANO STRAIN OF ROCK (FULL SIZE.)
MOORE: FLORIDA SAND MOUNDS.

1. VESSEL OF EARTHENWARE, TICK ISLAND. (FULL SIZE.)
2. DIPPER OF EARTHENWARE, TICK ISLAND. (FULL SIZE.)
3. FRAGMENT OF UNIDENTIFIED OBJECT OF EARTHENWARE, THURSBY MOUND. (ONE-HALF SIZE.)
MOORE: FLORIDA SAND MOUNDS.

1. EARTHENWARE BOWL, THURSBY MOUND. (ONE-HALF SIZE.)

2. FRAGMENT OF VESSEL OF EARTHENWARE, THURSBY MOUND. (THREE-QUARTERS SIZE.)
MOORE: FLORIDA SAND MOUNDS.

1. UNIDENTIFIED OBJECT OF EARTHENWARE, DAVENPORT. (FULL SIZE.)
2. PORTION OF UNIDENTIFIED OBJECT OF EARTHENWARE, DAVENPORT. (FULL SIZE.)
3. VASE OF EARTHENWARE, DAVENPORT. (FULL SIZE.)
4. UNIDENTIFIED OBJECT OF EARTHENWARE, DAVENPORT. (FULL SIZE.)
MOORE: FLORIDA SAND MOUNDS.

1, 2, 3, 4. VESSELS OF EARTHENWARE, RACEY POINT. (FULL SIZE.)
MOORE: FLORIDA SAND MOUNDS.

1. SHARD OF CORD MARKED, GRITTY WARE, MADISON MOUND. (FULL SIZE.)
2. HEART-SHAPED VESSEL OF EARTHENWARE, LARGER MOUND, BEAUCLERC. (FULL SIZE.)
3. VESSEL OF EARTHENWARE, LARGER MOUND, BEAUCLERC. (FULL SIZE.)
4. BOWL OF GRITTY WARE, LARGER MOUND, BEAUCLERC. (ONE-HALF SIZE.)
MOORE: FLORIDA SAND MOUNDS.

1, 2. SHARDS WITH STAMPED DECORATION, LARGER MOUND, SEACREST. (FULL SIZE.)
MOORE: FLORIDA SAND MOUNDS.

1. SHARD OF GritTY WARE WITH INTRICATE STAMPED DECORATION, LARGER MOUND, BEAUCLERC. (FULL SIZE.)
2. VESSEL OF EARTHENWARE, LARGER MOUND, BEAUCLERC. (FULL SIZE.)
3. UNIDENTIFIED OBJECT OF EARTHENWARE, GRANT MOUND. (FULL SIZE.)
PARKER MORPHOLOGY OF CEREBRAL CONVOLUTIONS.
Parker. Morphology of Cerebral Convolutions.
PARKER. MORPHOLOGY OF CEREBRAL CONVOLUTIONS.
PARKER. MORPHOLOGY OF CEREBRAL CONVOLUTIONS.
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PARKER. MORPHOLOGY OF CEREBRAL CONVOLUTIONS.
PARKER. MORPHOLOGY OF CEREBRAL CONVOLUTIONS.
PARKER. MORPHOLOGY OF CEREBRAL CONVOLUTIONS.
ALLEN: INDIAN SKULLS FROM FLORIDA.

ORIGINAL BURIAL. COLLECTION OF S. MOORE.

(FULL SIZE.)
ALLEN: INDIAN SKULLS FROM FLORIDA.

ORIGINAL BURIAL. COLLECTION C. B. MOORE.

(FULL SIZE.)
ALLEN: INDIAN SKULLS FROM FLORIDA.

ORIGINAL BURIAL. COLLECTION C. B. MOORE.

(FULL SIZE.)
Allen: Indian Skulls from Florida.
ALLEN: INDIAN SKULLS FROM FLORIDA.

ORIGINAL BURIAL. COLLECTION C. B. MOORE.
(Full size.)
F. V. ITERSON, DEL. ET LITH.

ALLEN INDIAN SKULLS FROM FLORIDA

ORIGINAL BURIAL. COLLECTION C. B. MOORE

[FULL SIZE]
ALLEN: INDIAN SKULLS FROM FLORIDA

ORIGINAL BURIAL. COLLECTION C. H. MOORE.

FULL SIZE.
ALLEN: INDIAN SKULLS FROM FLORIDA
ORIGINAL BURIAL. COLLECTION C. B. MOORE
(FULL SIZE.)
ALLEN: INDIAN SKULLS FROM FLORIDA.

ORIGINAL BURIAL. COLLECTION C. B. MOORE.

(FULL SIZE.)
ALLEN: INDIAN SKULLS FROM FLORIDA.

ORIGINAL BURIAL. COLLECTION C. D. HOOLE.

(FULL SIZE.)
ALLEN: INDIAN SKULLS FROM FLORIDA.

ORIGINAL BURIAL. COLLECTION C. R. MOORE.

(Full Size.)
ALLEN: INDIAN SKULLS FROM FLORIDA

ORIGINAL BURIAL, COLLECTION C. D. MOORE.

(FULL SIZE.)
ALLEN: INDIAN SKULLS FROM FLORIDA
ORIGINAL BURIAL. COLLECTION C. B. MOORE.
(FULL SIZE.)
INDIAN SKULLS FROM FLORIDA

ORIGINAL BURIAL—COLLECTION E. J. WOOD.

(FULL SIZE.)
ALLEN: INDIAN SKULLS FROM FLORIDA.

ORIGINAL BURIAL, COLLECTION C. B. MOORE.

(FULL SIZE.)
ALLEN: INDIAN SKULLS FROM FLORIDA.

ORIGINAL BURIAL. COLLECTION C. B. MOORE.

(FULL SIZE.)
ALLEN: INDIAN SKULLS FROM FLORIDA.

ORIGINAL BURIAL. COLLECTION C. B. MOORE.

(FULL SIZE.)
ALLEN: INDIAN SKULLS FROM FLORIDA.

ORIGINAL BURIAL. COLLECTION C. H. MORGAN.
(FULL SIZE.)
ALLEN: INDIAN SKULLS FROM FLORIDA.

ORIGINAL BURIAL, COLLECTION C. B. MOORE.

(FULL SIZE.)
Allen: Indian skulls from Florida.
(Full size.)
MOORE: SAND MOUNDS OF DUVAL COUNTY, FLORIDA.

1, 2, 3. VESSELS OF EARTHENWARE, GILBERT MOUND. (FULL SIZE.)
MOORE: SAND MOUNDS OF DUVAL COUNTY, FLORIDA.

1. Earthware vessel with curious incised decoration, Gilbert Mound. (Full size.)

2. Sherd with complicated stamped decoration, Monroe Mound. (Full size.)
MOORE: SAND MOUNDS OF DUVAL COUNTY, FLORIDA.

1. BOWL OF HEAVY EARTHENWARE, MONROE MOUND. (FULL SIZE.)
2. CURIOUS EARTHENWARE VESSEL WITH THREE COMPARTMENTS, MONROE MOUND. (FULL SIZE.)
3. MORTUARY VESSEL OF EARTHENWARE, GRANT MOUND. (FULL SIZE.)
MOORE: SAND MOUNDS OF DUVAL COUNTY, FLORIDA.

1 and 2. Mortuary vessels of earthenware, Grant mound. (Full size.)

3. Fragment of perforated vessel, Grant mound. (Full size.)
MOORE: SAND MOUNDS OF DUVAL COUNTY, FLORIDA

1. Curious vessel of earthenware, Grant mound. (FULL SIZE.)

2 and 3. Mortuary vessels of earthenware, Grant mound. (FULL SIZE.)

4. Vase of earthenware, mound A, low mounds south of Grant mound. (FULL SIZE.)
MOORE: SAND MOUNDS OF DUVAL COUNTY, FLORIDA.

VESSEL OF CLAYEWARE, LOW MOUND SOUTH OF GRANT MOUND. MOUND E (SEVENTH FROM THE HUE).
MOORE: SAND MOUNDS OF DUVAL COUNTY, FLORIDA.

OVOID URN OF EARTHENWARE, LOW MOUNDS SOUTH OF GRANT MOUND, MOUND E (FULL SIZE).
MOORE: SAND MOUNDS OF DUVAL COUNTY, FLORIDA.

Gourd-shaped vessel of yellow ware, low mounds south of Grant mound, mound E. [Full size].
MOORE: SAND MOUNDS OF DUVAL COUNTY, FLORIDA

1. Earthware vessel with two compartments and handle, low mounds south of Grant mound, mound E. (Full size).

2. Cup of earthware, incised and punctate decoration, Broward mound. (Full size.)

3. Sherd with complicated stamped decoration, larger mound, Redde point. (Full size.)
MOORE: SAND MOUNDS OF DUVAL COUNTY, FLORIDA

FRAGMENTS OF EARTHENWARE VESSELS WITH COMPLICATED STAMPED DECORATION, LOW MOUND AT ALEX, MOUND B. (FULL SIZE.)
MOORE: SAND MOUNDS OF DUVAL COUNTY, FLORIDA.

1 AND 2. SHARDS WITH COMPLICATED STAMPED DECORATION, LOW MOUNDS AT ALICIA, MOUND B. (FULL SIZE.)

3. VESSEL OF HEAVY WARE, LOW MOUNDS AT ALICIA, MOUND B. (FULL SIZE.)
MOORE: SAND MOUNDS OF DUVAL COUNTY, FLORIDA.

VASE OF EARTHENWARE, INDIRED AND PUNCTATE DECORATION. LOW MOUNDS AT ALICIA, MOUND B. (FULL SIZE.)
MOORE: SAND MOUNDS OF DUVAL COUNTY, FLORIDA

VESSEL WITH INCISED DECORATION AND REPOUSSE DUCK HEAD, DENTON MOUND. (FULL SIZE.)
MOORE: SAND MOUNDS OF DUVAL COUNTY, FLORIDA.

1. FRAGMENT OF EARTHENWARE VESSEL, DENTON MOUND. (FULL SIZE.)
2. BEAN-SHAPED VESSEL OF EARTHENWARE, WITH HORIZONTAL SECTION OF PORTION OF MARGIN, LARGEST MOUND, FLORAL BLUFF. (FULL SIZE.)
MOORE: SAND MOUNDS OF OCKLAWAHA RIVER, FLORIDA.

1. VESSEL OF EARTHENWARE WITH BASAL SUPPORTS, MOUND NEAR SILVER SPRINGS. (FULL SIZE.)

2. VESSEL OF EARTHENWARE WITH DOUBLE COMPARTMENT, HOPSON MOUND. (FULL SIZE.)

3. OBLONG DISH OF EARTHENWARE, HOPSON MOUND. (FULL SIZE.)

4. TRANSVERSE SECTION OF NUMBER 2. (FULL SIZE.)
MOORE: SAND MOUNDS OF OCKLAWAHA RIVER, FLORIDA.

1. BOAT-SHAPED VESSEL OF EARTHENWARE, HOPSON MOUND. (FULL SIZE.)
2. SHERD WITH STAMPED AND INCISED DECORATION, MOUND NEAR HILEY. (FULL SIZE.)
3. VESSEL OF EARTHENWARE, INCISED AND PUNCTATE DECORATION, MOUND NEAR UMATILLA. (FULL SIZE.)
4. SHERD, MOUND NEAR TAVARES (FULL SIZE).