the building, and build large masses of stone or brick upon which piers for delicate instruments could be placed. The conditions for steadiness, however, in the Jefferson physical laboratory, are fulfilled sufficiently for practical purposes.

The laboratory, together with its heating and lighting arrangements and engines, cost a hundred and fifteen thousand dollars. This sum was given by Mr. Thomas Jefferson Coolidge, on condition that seventy-five thousand dollars more should be raised for maintaining the laboratory. Many friends of the university contributed to this income fund.

The laboratory is named in honor of Thomas Jefferson, the ancestor of Mr. Coolidge. Jefferson, while president of the United States, evinced great interest in the promotion of university education in America, — an interest which took a practical form in the foundation of the University of Virginia; and the seed thus sown, it will be seen, bears fruit even unto this day. JOHN TROWBRIDGE.

EVIDENCES OF BEACHES IN THE CINCINNATI GROUP.

THE presence of old beaches above present water-level is readily perceived on many modern lake and ocean margins, notably around Great Salt Lake and on the Peruvian and Chilian coasts of South America. The evidence of similar beaches in geological groups cannot be considered so decisive, nor is it so conspicuous.

That most of the strata of the Cincinnati group were deposited in deep water is probable. They contain many fossils whose modern relatives live in deep seas, and it is not likely that it was different with the ancient forms. Brachiopods, crustaceans, bryozoans, polyps, are all inhabitants of comparatively deep water, at least; and these forms are found in extraordinary abundance in the Cincinnati group.

Two apparently well-defined shore-lines have been noticed in the rocks in the vicinity of Cincinnati. One of these was first referred to by Dr. Locke some forty years ago. It crops out about three hundred feet above low-water mark, and is characterized by the dumb-bell fossil known as Arthraria. It is apparently to this horizon that Miller refers in the *Cincinnati quarterly journal of science*, i. 64, where he speaks of wave-lines in the rocks. He says, —

"These wave-like rocks are composed in a very large part of fragments of crinoids, principally of the Heterocrinus simplex, and appear to have been formed by the action of the waves in first breaking to pieces the animal skeletons, and then leaving them in ridges, as if to mark for all future time the course of the waves. These rocks are found in all the hills about Cincinnati, and as far east as Plainville [nine miles]. A number of fossils are found below these rocks that have thus far not been found above them; and, on the other hand, many have been found above that have not been found below. . . . The fossils which are common to both elevations comprise more than half of all those found below these rocks. And yet, on further examination, it may appear that the causes which led to the formation of these waves in the rocks, also caused a considerable change in the animals which inhabited the ocean at that time."

Here the probable existence of a shore-line is indicated. It seems to mark one of those periods of elevation which occurred during the deposition of the strata. The fact that many fossils are found above which are not common below, would indicate a serious disturbance of conditions, — a change which caused the extinction of many previously common species, and allowed the introduction of a few entirely new ones.

It is at about this horizon that rocks bearing marks of surface water-washings, and evident traces of the action of trickling water, are found. There are also indications in the rocks of the rippling of water, such as could occur only along the margin of a shallow sea. These marks have been described as Algae under various names, but their true character has been shown by comparing them with modern marks of a known origin.

A second ancient shore-line, as it appears to be, crops out at various points in the vicinity of Cincinnati. Probably the best exposure is at Ludlow, Ky., along the Ohio River, opposite the city. Professor Orton, in speaking of the waved structure of the rocks, refers to this locality as follows: [1] —

"The rocks exhibiting this structure at the point named [river-quarries] are the most compact beds of the fossiliferous limestone. The bottom of the waved layer is generally even, and beneath it is al-

ways found an even bed of shale. The upper surface is diversified, as its name suggests, with ridges and furrows. The interval between the ridges varies, but in many instances it is about four feet. The greatest thickness of the ridge is six or seven inches, while the stone is reduced to one or two inches at the bottom of the furrow, and sometimes it entirely disappears" (see figure).

[1] Geology of Ohio, vol. i. p. 377.

One of the explanations offered for this wave-structure is "that the floor of the Cincinnati sea was acted on from time to time by waves, or similar movements of the ocean-waters;" but it seems just as probable that these ridges were made by the action of waves on the shore. The stratum is made up of fragments of crinoid stems, brachiopods, and other forms of life. It is just as if it had been exposed to the action of the weather and the waves for such a long period of time that a fine sand was formed of crinoidal and shelly fragments. It is well known that the continual dashing of waves on a shore will soon reduce a mass of shells to powder. Dr. Leidy mentions[1] that while at Atlantic City, the beach, after every storm, is strewn with immense numbers of shells: in a short time these become reduced to fragments, and eventually disappear.

Every one who has collected shells on sea-beaches is aware of the difficulty of procuring perfect specimens after they have been exposed to atmospheric agencies for a short time. Still in some places, notably in the Bay of Fundy, tracks left on the mud, raindrop impressions, traces of leaves, and other marks, are preserved in a perfect state. At the same time it seems unlikely that organic matters will be preserved from decay. For this to be effected, it is necessary that they be covered almost immediately, and so deep that they are protected from the air or atmospheric changes. Both these conditions — the one necessary for the preservation of tracks on mud, and the other to entomb perfect organisms — seldom seem to occur at the same time and in the same place: consequently it rarely happens that in the stratum where surface-marks, burrows, and trails occur, *perfect* fossils of any sort are found. While the whole surface of immense slabs of rock may be covered with trails, burrows, or impressions of organisms, *no complete fossils are preserved*. In the stratum above or below they may and do occur. But, while no perfect specimens are found, fragments innumerable remain. Small pieces of crinoid stems, fragments of trilobites and brachiopods, jumbled together in inextricable confusion, are the only signs of fossil organisms. Sometimes they lie in heaps, as if thrown together by a swirl in the tide; sometimes there is only a fragment here and there, and even it shows unmistakable signs of the action of the weather.

Mud-cracks, too, evidence the fact that the surface was exposed to the action of the sun long enough to dry and crack the deposit. These cracks, filled up by a subsequent deposit of mud, remain to tell of their origin. These fossil mud-cracks are found in the same locality as the burrows, trails, and other surface-markings.

Professor Newberry, in the 'Geology of Ohio,'[1] says that the fact that the Cincinnati arch was upheaved before the deposition of the upper Silurian rocks is shown by the strata of the upper Silurian terminating in a feather-edge on each side of the arch, and by the Devonian being so reduced as to render it doubtful if it ever covered the top of the rocks of the Cincinnati group. Therefore it is probable that the Cincinnati arch, "during the upper Silurian, and through most if not all of the Devonian ages, . . . formed an island raised above the surface of the sea."

If this was so, a shore-line would mark the conjunction of the lower Silurian and the Clinton; and along this shore-line would be the place to expect to find such markings as would be made on an ocean-beach. In this regard, Professor Newberry says,[2] —

> "In Adams county the interesting discovery was made by Professor Orton, that a part of the Clinton is formed of a conglomerate of well-rounded limestone pebbles and worn fossils of the blue limestone [Cincinnati group] series."

And lately Mr. U. P. James has found a slab of rock near the top of the rocks of the Cincinnati group which shows well-marked and unmistakable impressions of raindrops, — marks which could not, by any possibility, have been made and preserved, except on an exposed surface.

It is well known that the Clinton group of New York is the one where most of the trails, burrows, and beach-markings have been found. Professor Hall says in regard to them,[3] that

> "They occur in greater or less number and perfection throughout the entire extent of the group;" and that (*Ibid.*, p. 26) "from the character of the surfaces of the arenaceous beds in which they occur, I am inclined to the belief that many of them were made while the bed was exposed above water, and most of the others in very shallow water. In many instances the marks of what appear to be *wave-lines* are still preserved upon the surface of the layers. These markings have been regarded as a line of beach at the period of the Medina sandstone; and the strata under consideration follow in immediate succession to that period. They are, moreover, associated with pebbly beds which were probably littoral."

Thus, if the markings and the fossil remains found in the Clinton are to be regarded as made on exposed surfaces, and if these same markings, or similar ones, are found in the rocks of

[1] Proc. Philad. acad., 1884, p. 12.

[1] Vol. i. pp. 94 *et seq.*

[2] *Ibid.*, p. 103.

[3] Paleontology of New York, vol. ii. p. 27.

the Cincinnati group, the inference is just, that the markings from the latter had their origin under the same conditions. There is no reason for supposing that the Cincinnati Island was not subject to elevations and depressions alternately. The evidence here given, showing the presence of three former shore-lines, seems conclusive. Probably, were other localities and other groups examined in a similar manner, similar facts would be found.

JOSEPH F. JAMES.

HUDSON-BAY ESKIMO.

IN the report of the Hudson-Bay exploring expedition, it is stated that the only inhabitants of Hudson Strait and the northern part of the bay are the Eskimo, who have become quite familiar with the ways of civilization. The families are small, mothers having rarely more than two or three children, which, in consequence of the absence of farinaceous food, are suckled till three or four years of age. The number of Eskimo appears to be diminishing, as there are abundant traces of their former presence in force. About six miles south of Port Burwell are the remains of a large settlement, with subterranean dwellings, in a fair state of preservation, where remains of stone pots and implements are mixed with those of more modern date. At Port De Boucherville distinct remains of a very ancient Eskimo camp, in the form of heaps and circles of stones, are found on a raised beach at the head of what had been a cove when the sea-level was about thirty feet higher than at present. At another place in the same vicinity are more modern remains, consisting of rings of tent-stones, several rectangular walls a few feet high, and *caches* of a beehive form about six feet in height, such as are now used for storing meat, or as hiding-places from which to kill game. Around Port Laperrière, also, camping-places are found, which, from their elevation above the sea-beach, the decayed nature of the larger bones lying about, and the manner in which the circles of stones are embedded in moss and overgrown with lichens, must be from one hundred to three hundred years old. Still more ancient Eskimo works are discovered in the valley which comes down to the head of the harbor. These consist of a row of stones running athwart the brook at a contracted part of the valley, which would be suitable for the Eskimo method of trout-fishing if the sea were eighty feet higher than it is at present.

Along the Labrador coast the Eskimo gather in small settlements round the Moravian mission-stations; Nain, with a population of about two hundred, being the largest. Here they are educated, and the missions are self-supporting; the missionaries supplying the Eskimo, purchasing their catch and shipping it to London, and communicating with Newfoundland during the summer by a mail-steamer which makes occasional trips as far as Nain. Lieut. Gordon gives the Eskimo the highest character for honesty and docility.

PHYSICS IN THE SCHOOLS.

PROFESSOR WEAD has published the replies to a circular distributed by the commissioner of education, Mr. John Eaton, in regard to the best method of teaching physics in the secondary schools. The general impression obtained from these replies, which are from high-school teachers as well as from college professors, is that a certain amount of laboratory work in physics is desirable. Very few, however, of the teachers who have replied, can apparently speak from actual experience of the advantages of the laboratory method. Within a quarter of a century there has been a marked change in the views of those who have entered upon chairs of physics in our various colleges. The earlier professors of so-called natural philosophy looked at their subject from a semi-literary point of view, and did not descend into the laborious arena of the laboratory, where their half-brothers the chemists had long preceded them. To-day there are physicists who laugh at the old method of teaching physics; and, although we are somewhat conservative, we also are tempted to indulge in a sly laugh in our sleeve.

The problem of the best method of teaching physics in the secondary schools, however, can only be a faint reflection of the methods adopted in the universities. We are inclined to believe that it should aim to be a faint reflection, — popular lectures for stimulating the imagination of the boy, and rough experiments for the masses, in order to train the scientific instinct and the powers of observation.

The report contains valuable information in regard to the teaching of physics in England, Germany, and France. The general impression gained from this report is that the new methods of teaching physics have not been adopted in a large enough number of cases to warrant any conclusions from a study of those cases. The training of teachers is steadily improving, and every year our colleges and universities send out men imbued with modern methods of laboratory instruction. These men must have a marked influence on the future methods of teaching physics.

HALLUCINATIONS.

WHEN a patient is hypnotized, he imagines that he sees all things as they are suggested to him, provided he is a healthy subject. But in these hallucinations a person who has lost the chromatic sensibility cannot be made to see suggested colors to which he is naturally blind. If the achromatopsy be limited to one side, the left for instance, and the hypnotized subject has the right eye closed, he obstinately affirms that he does not see the suggested color, and cannot be made to see it until the right eye is opened.

There is a second thing which shows, better than the preceding, that hallucination and sensation have the same cerebral origin: it is the property which hallucinatory images have of provoking the same

Abstract of an article by BINET and FÉRÉ in the *Revue scientifique*.