The Lake Laboratory, which is now permanently located at Put-in-Bay on Lake Erie, will open for the summer of 1920 on June 21. Its facilities will be available for investigators until the middle of August. Courses for students in both plant and animal ecology, entomology, the structure of fresh-water vertebrates, and in icthyology will be conducted until August 1. The staff will be composed of Professor R. C. Osborn, director, Dr. F. H. Krecker, acting director, Professor S. R. Williams, of Miami University, Professor M. E. Stickney, of Dennison University, and Dr. C. H. Kennedy, of the Ohio State University. Some studies on fisheries problems were carried on last year and others are to be started during the coming session. It is desired to have the laboratory as well supplied as possible with recent biological literature and therefore investigators will be of direct service to the laboratory by including it in their mailing list. All reprints of such articles and all correspondence should be addressed to the Lake Laboratory, Ohio State University, Columbus, Ohio.

UNIVERSITY AND EDUCATIONAL NEWS

A bill recently passed by the Maryland legislature combines the Maryland State College of Agriculture with the University of Maryland School of Medicine under the name of the University of Maryland. The legislature appropriated $42,500, each year, for the medical school for the next two years and in addition appropriated $186,476 for the other departments of the university for 1921, and $165,416 for 1922. An appropriation of $203,000 was made for buildings and equipment.

Dr. William H. Nichols, of the General Chemical Company, has given $100,000 toward the endowment fund of New York University.

It is planned to erect a new chemistry building at Dartmouth College, which will involve an expenditure of about $350,000. Construction will be begun immediately.

The board of trustees of the College of the City of New York has authorized the granting of degrees of chemical, civil, electrical, and mechanical engineer on the satisfactory completion of a curriculum requiring five years. The announcement of the details of the curricula will shortly be issued. This is one of the steps taken by the College of the City of New York in the direction of closer cooperation between industry and colleges and colleges and universities.

Assistant Professor George E. Nichols, of Yale University, has been appointed to the teaching staff of the University of Michigan Biological Station for the coming summer session.

DISCUSSION AND CORRESPONDENCE

SINGING SANDS

Professor Richardson's recent article about "Singing Sands" of Lake Michigan, suggests to me that in analyzing the beach sands the students may have taken needless trouble, for the cause is certainly not dependent on their composition.

The fascinating pages of Marco Polo have numerous references to this phenomena, more or less exaggerated and tinged with superstition, and many travelers have discussed and some scientists have studied it.

A volume by Hanns Vischer confirms the previous statements of Commandant Gadel, Concerning the "voice of the mountain" near the oasis of Bilma, he, Vischer, says:

> There is a dark and forbidding rock frowning over Bilma near the southern end of the oasis. This mountain warns the inhabitants of the approaching arrival of a caravan; when it "sings" the men then know that a caravan is close at hand. The noise is produced by the blowing of the wind from a certain direction through crevices of the torn rock.

Says Gadel:

> On the sixth of October in the morning, the old Liman came to tell me that the mountain had spoken. On the eighth of October, at ten in the morning, the first Asbin caravan arrived, consisting of 4,851 camels and 857 men. The mountain had not lied.

There is every probability that Mr. Vischer is mistaken in his guess that the sounds are made by the blowing of the wind through a crevice in the rock, as will be seen by a general consideration of the subject, before I attempt to set forth the *probable* scientific explanation of the phenomenon. It is not confined by any means to the Sahara, or for that matter to desert places.

Near the coast of one of the Hawaiian Islands is an old graveyard. The winds blow ceaselessly across its barren expanse and it is fast being buried by *coral* sands. Passing fisher boats give this shore a wide berth, for when the wind is right, there arises from the white expanse a strange wail, like the howl of a dog, which is attributed to the restless spirits of the departed.

On the coast of Lower California, there is a locality which emits, at times, a bell-like sound. Here too the winds have piled up fine sand, and the peons declare that under its mounds lie buried the ruins of a convent, the bells of which toll with muffled tones, at the hour of prayer.

The infrequent traveler in the region of Mt. Sinai, camping at the mouth of the Wady el Dér, sometimes hears at sunset, a deep musical, booming sound, descending from the heights above. It is the great wooden gong of a monastery, perched upon the cliff. Such a gong is common in Arabia and is named a "Nagous." On the borders of the Isthmus of Suez stands a hill known as "Jebel Nagous"; that is, the Mountain of the Gong. The Arabs tell of weird sounds heard at this mountain—in storms, loud and wild, audible from a distance; in more quiet weather, low and musical. Jebel Nagous is alluded to in the "Arabian Nights." The American scientist, the late Dr. H. Carrington Bolton, some years before his death, organized an expedition to visit the mountain. After four days' journey from Tor, they went into camp at the base of the hill, which was found to be about 950 feet high. Dr. Bolton heard the music—a song of several notes, rising and falling, with one continuous deep undertone, like an organ note, and was able to ascertain the cause. Here, as in the other places named above, it is due to singing sands. The winds continuously blow this sand up against the sides of the hill, and impelled by the wind, it rushes up the slopes, emitting a multitude of tiny, tinkling notes, which when combined, make a considerable volume of sound. Then, just as the waves of the sea driven up the beach, rush downwards again, so the sand blown up the steep incline continually slides back, the angle of rest being about thirty-one degrees. It is the returning flow that gives out the steady undertone, increased by the echo from a sandstone cliff, and varying with the ever-changing wind.

What are singing sands? Every one has noticed the musical note made by the runners of a sleigh on a cold, clear night, which is caused by the impact of the snow or ice particles upon each other under the pressure of the vehicle. No ear could detect the sound made by *two* ice crystals, but when this is multiplied a thousand-fold, the combined effect is that of an instrument of music, playing one rather shrill note. Something of the kind is observed on parts of many sea beaches or other sand deposits; when they are walked upon, they give forth a note which varies with the locality. Ordinary "singing beaches" or "musical sands" are rather common, and the phenomenon has often been described and scientifically studied. The sounds are usually like the musical note which may be evoked when the wetted finger is rubbed around the edge of a glass bowl. Up to 1908, seventy-four localities had been noted in this country and eighteen abroad. In spite of this study, the true cause of the phenomenon is not yet certainly understood. It does not seem to make any difference whether the sands have been formed from crystalline or amorphous rocks. They differ widely in different localities in their mineralogical constituents, yet on the same beach, one place will give out a sound when disturbed, while another, a few yards away, is silent though apparently identical in structure. The property may be quickly lost or may be retained for months. When the sand is kept in a paper bag, its quality is best preserved; shaking in a

tin or glass receptacle quickly dissipates it; once lost, it can not be restored. Observers have been able to detect the sound from a New England beach sand over 400 feet away, when a small bagful is suddenly shaken.

While the analogy to the snow crystals may account for part of the phenomenon in some cases, it can not account for the singing of limestone, coral or other non-crystalline sands. Moreover, when one walks barefooted on musical sands, or runs the hand through them, there is felt a distinct tingling sensation. To some, this has suggested an electrical property. The latest and most plausible theory is that upon clean, dry sands, atmospheric gases condense, just as gases will adhere to particles of some metallic minerals and not others, and that the sounds and the sensations described are due to the disturbance of these air cushions. At any rate, the sensation experienced when walking barefoot through a patch of musical sand is very similar to that felt when the hand is immersed in a solution in which nascent oxygen is being generated.

By the way, I wonder if it has ever occurred to any archeologist that a possible explanation of the "Vocal Memnon" which Strabo and other travelers attested some two thousand years ago, might be the presence near the colossi, of musical sands, long since buried by the drift from the Libyan Desert.

Albert R. Ledoux

MODERN INTERPRETATIONS OF DIFFERENTIALS

To the Editor of Science: Professor E. V. Huntington, in an article entitled "Modern Interpretation of Differentials" (Science, March 26), states with reference to the definition $\lim \Delta y = 0$, $\lim N\Delta y = dy$, that, "The inevitable consequence of such a definition is that $dy = 0$, which is futile." Every school boy in the theory of limits knows that this is not true when N varies.

To take his figure of a graph of a function $y = f(x)$, it is logically correct to denote a point on the graph by $P(x, y)$ without subscripts, and $P'(x + \Delta x, y + \Delta y)$ is any other point on the graph, where $PQ = \Delta x$, $QP' = \Delta y$. Produce PQ to $PR' = N\Delta x = \Delta' x$, and draw $R'S' = N\Delta y = \Delta' y$, parallel to OY. Then $S'(x + \Delta' x, y + \Delta' y)$ is any point on the produced chord PP' (*i. e., variation in the same ratio is along the chord*).

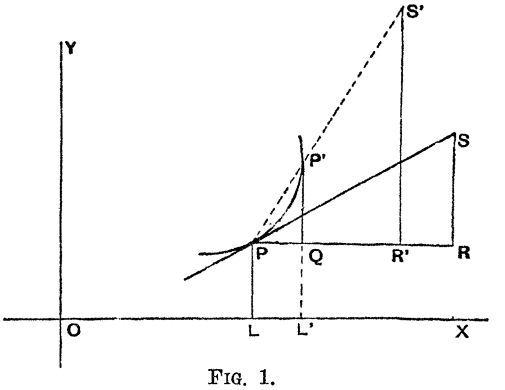

Fig. 1.

Professor Huntington asserts that $S'(x + \Delta' x, y + \Delta' y)$ inevitably approaches coincidence with $P(x, y)$ when Δx, Δy, approach zero, although it is obvious that it may, if N increase appropriately, approach any chosen point $S(x + dx, y + dy)$ *on the tangent at* $P(x, y)$, so that $\lim \Delta' x = dx$, $\lim \Delta' y = dy$. *Variation in the first ratio is therefore upon the tangent.*

Professor Huntington should also have investigated the historical questions involved before venturing to assert that the above theory of differentials "would prove highly misleading to the modern student." It is a sad commentary on the present state of the calculus in respect to its fundamental ideas, when we note the variety of explanations of these ideas by authors with little historical knowledge, all of whom, no doubt, would term their productions "modern," though most explanations will be found to date back several centuries, if they be anything more than vaporizing.

Sir William Rowan Hamilton in his Elements of Quaternions (Bk. III., p. 392) states that ordinary definitions by derivative methods do not apply in quaternions, and that after a careful examination of the Principia, he would formulate and adopt Newton's definition as follows: