cipally in the United States, "but is not restricted thereto."

THE London *Times* reports that Professor Maiuri, superintendent of excavations in the Campania, has been granted funds from the British Government for carrying out excavations on the island of Capri. He proposes to reveal and display, so far as possible, the ancient topography of the island, as it was in the Roman era. The many Roman buildings which lie buried and have only been partially excavated so far are to be laid bare, the roads of access to them are to be made more practicable, and a general work of embellishment undertaken so that the ruins may be presented in a setting worthy of their past glory. In the days of the Emperor Tiberius there were twelve palaces in the island, named after twelve gods, and the emperor is supposed to have lived in a different one during each month of the year. The most important of these is the Villa Jovis, which lies at the extreme eastern point of the island overlooking the Sorrentine Peninsula. It is built on a peak, and from the cliffs on which it stands there is a sheer drop of about 700 feet to the sea. It is on the ruins of this palace that Professor Maiuri began work early in October.

THE U. S. Bureau of Fisheries is making a study of fish migration in the waters of the Chesapeake Bay. Dr. John C. Pearson, assistant aquatic biologist, who has been stationed at Annapolis for the purpose of clamping identification bands on any fish which he can obtain for labeling and liberation purposes, tagged a rockfish and released it off Hackett Point, Annapolis. Two days later the same fish was caught about thirty miles up the bay, near the mouth of the Seneca River. Other fish bearing the identification tags have been caught in the vicinity of Havre de Grace and the Northeast River. Thus far the results of the study show a tendency of the fish to make for the head of the bay.

THE Chilean Nitrate of Soda Educational Bureau has again made provision for the Chilean Nitrate of Soda Nitrogen Research Award. These awards were designed to foster search on the rôle of nitrogen in economic crop production. Any research worker in the United States or Canada is eligible. In selecting candidates for the award attention is given to both the merits of research already accomplished and to the promise for future work. The award is administered by the nitrogen research award committee of the American Society of Agronomy. The amount of the award is decided by the committee in each individual case. Any one wishing to call the attention of the committee to their own work or that of any other worker should communicate before November 1 with the chairman of the committee, Dr. Richard Bradfield, Department of Soils, Ohio State University, Columbus, Ohio. The award will be made at the annual meeting of the American Society of Agronomy in Chicago, on November 19 and 20.

DISCUSSION

ON A POSSIBLE EXPLANATION OF THE DIFFERENCE IN WAVE-LENGTHS OF THE SPECTRAL LINES OF A GIVEN ELEMENT PRODUCED ON THE SUN AND ON THE EARTH

IT has been shown that all electric charges on the earth are due to a potential difference between an insulated body and the electrostatic field in which it is immersed.[1] When this potential difference changes, the magnitude or the sign, or both, of the charge on the insulated body changes. It is immaterial and sometimes not discoverable whether the change in potential difference is due to a change in the electron content of the insulated body or to a change in the electrical state of the surrounding field.

Since the potential of the earth's electrostatic field changes with a change of altitude above the earth, the charge of an insulated body will change as its altitude in the earth's electrostatic field changes. This fact was discovered by Paul Erman in 1803,[2] though it was not interpreted in this manner. Erman believed the charges upon his electroscope to be induced by the charge of the earth, but we know that no insulated body can have a charge induced upon it. The most that can happen to it by induction is to have a redistribution of its charge over its surface.

An uncharged, insulated body when raised above the earth acquires a negative charge. If retained in that position and put into electrical contact with the earth it loses its negative charge. If then lowered to the earth it acquires a positive charge. If raised to a greater height than before without discharging its positive charge it again becomes negatively charged.

If two small insulated spheres be charged, one positive and one negative, to a potential difference from the earth of 100 volts each, they will then attract each other with a force proportional to the product of their opposite charges. Let them be raised to a height where the potential of the earth's field is 100 volts positive to the earth. One of the spheres will then be charged to a negative potential of 200 volts and the other will be uncharged. There will be no attraction due to the product of their charges.

1 *Bulletin* of the Terrestrial Electric Observatory of Fernando Sanford, Vol. 6, p. 8, and "Terrestrial Electricity," p. 100.

2 Gilbert's Annalen, 15, 386 (803).

Let them now be raised to a height where the potential of the earth's field is 200 volts positive. One sphere will now be charged negative to a potential of 300 volts, and the other will be negatively charged to a potential of 100 volts. They will now repel each other with a force proportional to the product of their like charges. This was virtually Erman's fundamental experiment.

Suppose a negatively charged particle to be in orbital revolution about a positively charged particle near the surface of the earth. Other conditions remaining unchanged, the frequency of revolution will change with every change of the product of their opposite charges. The same will be true for other forms of oscillation of the two particles; hence any change in their altitude above the earth will cause a change in their vibration frequency.

If the same laws apply within the atom, the wave-lengths of its spectral lines will vary with a change of potential of the electrostatic field in which it is placed. Thus, if the electrostatic field of the sun is different from that of the earth, the wave-lengths of the spectral lines in the sun's electric field will be different from those of the same kind of atom in the earth's field. We know that they are appreciably different.

We believe that the Fraunhofer lines in the solar spectrum are due to the absorption of gases at different elevations above the photosphere. Accordingly, these gases are differently charged. May not the broadening of some of the absorption lines be partly due to this cause?

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BOTTOM TEMPERATURES IN DEEP LAKES[1]

ALMOST without exception, published accounts of temperature cycles in lakes fail to mention the effect of pressure on the temperature of water at maximum density. That increased pressure lowers the point of maximum density has been known to physicists for half a century. Results obtained by various workers are not in complete agreement. According to Amagat[2] the lowering effect is in the neighborhood of 0.0235° C. per atmosphere, although the relationship is probably not strictly linear. Since a depth of 10.33 meters corresponds roughly to one atmosphere of pressure, it follows that deep lakes may have bottom temperatures below 4.0° C. in summer. A number of such observations have been made in this country and many more have been made elsewhere.

The first observations in North American lakes which have come to the attention of the writer were made in Lake Superior during August, 1871.[3] Most of the bottom readings were 3.8°or 3.9°; two very low readings were obviously erroneous. Yoshimura,[4] in a recent review of this subject, reported a temperature of 3.7° at 300 m for Lake Ontario in the same year, but the source of the data is not evident. Drummond[5] reported temperatures in Georgian Bay in 1886 which were well below the minima possible according to the calculations of Amagat. In the summer of 1889 he found 3.7° at 128 m and 3.9° at 115 m on different days and at different stations. In 1911 Hamberg,[6] noting similar records from European lakes, pointed out that they could be explained by the effect of pressure on the temperature at maximum density.

In Crater Lake, Kemmerer et al.[7] found 3.5° at 600 m, and all temperatures at 100 m or deeper were less than 4.0°. Kindle[8] reported 3.3° at 96 m and 1.1° at 130 m in Lake Ontario in late September. These readings are so low that they must be regarded as errors, and they cast doubt upon the accuracy of a reading of 3.9° at 121 m at another station.

During the summer of 1930 a large number of temperature observations were made from the Bureau of Fisheries vessel *Fulmar* in Lake Michigan. Of 26 readings in water over 100 m deep, nine gave 3.9°, one gave 3.8°, and the others were 4.0° or more. One station showed 3.9° water from a depth of 75 m to the bottom at 145 m. The greatest depth at which observations were made was 168 m and lower temperatures may be expected in the deepest part of the lake (264 m).

Summer temperatures below 4.0° have not been reported for Lake Erie or for Lake Nipigon. The same is true of Lake Tahoe,[5] with a depth of 501 m. Obviously very deep lakes can have bottom temperatures well above the minima possible under pressures corresponding to their depths.

While the number of lakes showing bottom temperatures below 4.0° in summer is not large and the lower temperatures probably have little biological significance, the phenomenon is worthy of mention, even in elementary texts. Ignorance of it may lead an inexperienced observer to question the accuracy of his thermometers.

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[1] Published by permission of the U. S. Commissioner of Fisheries.

[2] E.-H. Amagat, *Ann. Chim. et Phys.*, (6), 29: 570, 1893.

[3] W. R. Nichols, Proc. Bost. Soc. Nat. Hist., 21: 53, 1880–1882 (1883).

[4] S. Yoshimura, Umi to Sora, 10 (12): 423, Kobe, 1930.

[5] A. T. Drummond, Can. Rec. Sci., 4: 77, 1890.

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[7] G. Kemmerer, J. F. Bovard, and W. R. Boorman, Bull. Bur. Fish., 39: 51, 1923.

[8] E. M. Kindle, Trans. Roy. Soc. Can., 19: 47, 1925.