It may be that if each day, or, better still, twice each day, a more detailed map of the wind provinces were drawn, and as much information of the upper currents obtained as possible, it would assist to elucidate many obscure questions relating to rainfall.

Of late years the steady improvement of the charts given in the Weekly Weather Reports of the Meteorological Office has been very noticeable. If the charts were twice the size and the evening observations dealt with as fully as the morning, a great step in advance would be made. R. M. DEELEY.

Abbeyfield, Salisbury Avenue, Harpenden, November 13.

Amœbocytes in Calcareous Sponges.

WHEN Prof. Dendy, in NATURE of December 4, writes that "the Amœbæ referred to by Mr. Orton . . . possibly . were . . . metamorphosed collared cells," he must have failed to notice the dimensions given by Mr. Orton.

A cell "with slightly rounded ends" "80 μ long and 40 μ broad," and (say) only 10 μ thick, would contain some sixty of even the large collar-cells of *Grantia compressa*. GEO. P. BIDDER.

Cavendish Corner, Cambridge, December 14.

MR. BIDDER is perfectly right. The Amœbæ described by Mr. Orton are far too large to be metamorphosed collared cells or even young amœboid germ cells. The only cells in the sponge (*Grantia compressa*) which compare with them in size are the full-grown oocytes, and although these are amœboid and put out long pseudopodia, it is scarcely likely that they would find their way into the gastral cavity, as I have never seen them except in the mesoglœa between the chambers. My data, from which the actual size of the amœbocytes could be calculated, were not at hand when I wrote my letter, and as I had been working with a magnification of 1650 diameters, my ideas of a "rather small" Amœba had come to differ considerably from Mr. Orton's. Knowing how abundant amœbocytes frequently are in the flagellated chambers of the sponge it seemed almost certain at first sight that any obtained from the gastral cavity would be of the same nature, but evidently I was mistaken, and I am much obliged to Mr. Bidder for directing my attention to the fact. ARTHUR DENDY.

University of London, King's College, December 16.

Reversibility of Ferment Action.

IN NATURE of December 4 last there is a letter from Sir Lauder Brunton, correcting a misstatement in a former issue in connection with a paper by Prof. Bourquelot on the reversible nature of ferment action.

Sir Lauder Brunton's letter points out a mistake that might have been prejudicial to me; but your original article was not quite fair also to Prof. Bourquelot, for he, so far from claiming priority for himself, gave me in his paper full recognition.

Since I first showed that the action of a ferment was a reversible one, many observers have done confirmatory work. The earliest to do so were Profs. Kastle and Löwenhart, of the United States, and among the more recent, Prof. Bayliss in this country has done valuable work.

I am glad that Prof. Bourquelot by his own good work has become convinced.

ARTHUR CROFT HILL.

169 Cromwell Road, S.W., December 19.

THE ORIGIN OF CLIMATIC CHANGES.

THE discussion of meteorological observations shows clearly that climates undergo variations of short duration, but such records as the presence of old lake beaches and the existence of well-marked glacial moraines, and other geological evidence distinctly point to climate changes covering long intervals of time. The evidence is not sufficient to characterise the variations as periodic, but the ice ages are sufficient to point to times when the conditions reached were extreme.

What may reasonably be assumed to be the chief established facts about such extensive changes may be summed up briefly as follows:—Climatic changes were several, and probably many. Similar simultaneous changes occurred over the whole earth, or, in other words, it was warmer or colder over the whole earth simultaneously. These times of warmth or coldness were unequal in intensity and duration, and of irregular occurrence, and, lastly, they have taken place from very early, if not from the earliest geological age down to the present. Numerous theories, both probable and improbable, have been suggested from time to time to account for the origin of such world-wide changes, and while each has its advocates, perhaps only three may be said to claim attention to-day. These may be briefly stated as the Eccentricity Theory (Croll), depending on the eccentricity of the earth's orbit; the Carbon Dioxide Theory (Tyndall), based on the selective absorption and variation in amount of carbon dioxide; and thirdly, the Solar Variation Theory, on the assumption of solar changes of long duration. A new theory, which may be called "The Volcanic Dust and Solar Variation Theory," has recently been put forward by Prof. W. J. Humphreys,[1] under the guarded heading, "Volcanic dust and other factors in the production of climatic changes, and their possible relation to ice ages."

The author carefully points out that the idea that volcanic dust may be an important factor in the production of climatic changes is not new, but "though just how it can be so apparently has not been explained, nor has the idea been specifically supported by direct observation." He remarks also that while the pioneers regarded the presence of volcanic dust in the atmosphere as an absorbent of radiation, and so lowered the earth's temperature, modern observation suggests the opposite effect, namely, the warming of the earth's surface.

In putting forward his views of the action of dust, Prof. Humphreys proceeds first to indicate that the dust that is effective is that which is situated in the atmosphere in the isothermal region or stratosphere. He then enters into the question of the size of the particles and probable time of fall, and concludes that particles of the size 1·85 microns in diameter would take from one to three years to get back to the earth if

[1] Journal of the Franklin Institute. August, 1913, vol. clxxvi., No. 2, p. 131; also Bulletin of the Mount Weather Observatory, August, 1913, vol. vi., part 1, p. 1.

they originally had been thrown up by a volcanic eruption.

Considering next the action of the finest and therefore most persistent dust on solar-radiation, he finds that the "interception of outgoing radiation is wholly negligible in comparison with the interception of incoming solar radiation."

Prof. Humphreys now turns his attention to the observational evidence of pyrheliometric records, such readings being functions of, among other things, both the solar atmosphere and the terrestrial atmosphere. He thus introduces a curve showing smoothed values of the annual average pyrheliometric values, and compares this with sun-spot frequency values (representing solar atmospheric changes) and number of volcanic eruptions (representing terrestrial atmospheric changes). The similarity of the last-mentioned with the pyrheliometric curve leads him to write as follows: "Hence it appears that the dust in our own atmosphere, and not the condition of the sun, is the controlling factor in determining the magnitudes and times of occurrence of great and abrupt changes of insolation intensity at the surface of the earth."

The action of the dust intercepting at times as much as one-fifth of the direct solar radiation leads him to inspect earth surface temperature values to inquire whether they are below normal on such occasions. The pyrheliometric and temperature curves suggest a relationship, but, as he states, "the agreement is so far from perfect as to force the conclusion that the pyrheliograph values constitute only one factor in the determination of world temperatures." A better agreement is secured when the combined effect of insolation intensity and sun-spot influence is considered.

The author then discusses the temperature variations since 1750 as influenced by sun-spots and volcanic eruptions, and indicates that the disagreement in the curves of temperatures and sun-spots is in every important instance simultaneous with violent volcanic eruptions.

Limitations of space will not permit us to remark on his references to the action of carbon dioxide in slightly decreasing the temperature or to probable great changes in level. Enough perhaps has been said to show that Prof. Humphreys, in his interesting attempt to show "that volcanic dust must have been a factor, possibly a very important one, in the production of many, perhaps all, past climatic changes . . .", has restarted a topic which will no doubt call for criticisms and discussions from many quarters.

BIOLOGY OF THE LAKE OF TIBERIAS.[1]

THAT natural history had its students among the ancient inhabitants of Palestine is clear from the book of the Levitical law and from the biography of King Solomon. But during the first century of our era there is nothing to show that the study excited the slightest interest in that locality. Fishes are mentioned for their economic use; mint, anise, and cummin as objects of taxation; the stars in the sky and the flowers of the field for their superficial beauty; crops are supposed to spring from dead seeds; pearls of impossible size are made the symbols of celestial splendour. It is only in modern times, and even now by strangers rather than natives, that a striking contrast to this apathy has been brought about. If the water of the Jordan is still carried westward for religious rites, samples from the Sea of Galilee are now collected with equal care for chemical analysis; Syrian Entomostraca are reared in England from mud out of the pool of Gihon at Jerusalem; from the Galilean lake, by the use of tow-nets, hand-nets, and special dredges, a varied fauna is obtained, such as might have excited the interested surprise of Solomon, but would probably have been viewed with disgust by the Sanhedrim of a later epoch.

Prof. Théodore Barrois, in his own interesting study of the Syrian lakes (1894), explains that the scientific exploration of them was begun in August, 1847, by Lieutenant Molyneux, R.N. By great efforts this officer succeeded in obtaining valuable hydrographical details, both in the lake of Tiberias and in the Dead Sea, only to succumb almost immediately afterwards to the exhausting effects of the climate, torrid and unwholesome at that season in the valley of the Jordan. In some future Dictionary of National Biography his name ought surely to find a place. His initial enterprise has been followed by the labours of many eminent naturalists. Dr. Annandale's present contribution to the subject was instigated by his desire to trace the genera of sponges and some other invertebrates "characteristic of the fresh waters of India and tropical Africa northwards up the Jordan valley, should they prove to have a distribution in any way similar to that of the Jordan fishes, whose African affinities have long been known." He concludes that "There is no reason to think that the sponge-fauna of the Lake of Tiberias is closely related to that of any other lake, but its affinities lie rather with that of Eastern tropical Asia, and possibly with that of the Caspian Sea, than with any in Europe and Africa."

His investigation of the Galilean fresh-water sponges leads Dr. Annandale to divide the Spongillidæ into two subfamilies, the Spongillinæ, in which microscleres are present, and the Potamolepidinæ, in which microscleres apparently are not produced. Of the former subfamily the lake of Tiberias provides only one species, the widely distributed *Ephydatia fluviatilis*, var. *syriaca*, Topsent. Of the latter it furnishes four species, allotted to two new genera, *Cortispongilla barroisi* (Topsent), only known from this lake, and *Nudospongilla reversa*, *N. mappa*, and *N. aster*, all new. These are described and figured, together with other species introduced for the sake of comparison.

Useful keys are provided for distinguishing the Galilean sponges one from the other, and for recognising various genera of the Spongillidæ.

[1] A Report on the Biology of the Lake of Tiberias. Series I. Journal and Proceedings, Asiatic Society of Bengal (New Series), vol. ix., No. 1, 1913.