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.