difference does not appear to be due to error in the density determinations for the mass found in different experiments, for a constant volume of the same specimen of mercury is constant to one part in a million, and with special care it is constant to a few parts in ten millions.

These experiments indicated, too, that any process of distillation would give some separation of the isotopes of mercury, and the question naturally arose: Upon what evidence has the density of mercury been regarded as constant? The matter had been investigated at the International Bureau of Weights and Measures by M. Marek in 1883, and he writes of the results which he obtained: "It is noticed in comparing these figures that the density of mercury varies slightly from one sample to another according to the method of purification. This result has already been obtained by Dr. H. Wild in a study of this subject specially undertaken." The results which Dr. Wild published in 1874 are not available to us. M. Marek, however, quotes results communicated to him by Dr. Wild, which, although ambiguously stated, make it appear as not improbable that Dr. Wild more than forty years ago separated mercury into specimens of different density.

T. H. LABY.
W. MEPHAM.

Natural Philosophy Department, University of Melbourne, December 30.

Where did Terrestrial Life Begin?

THE question raised by Dr. Macfie in his letter in NATURE of January 26 concerning the place of origin of life on the earth is not one which directly concerns the meteorologist, but Prof. J. W. Gregory's comments upon it seem to call for discussion from the meteorological point of view. Dr. Macfie suggests that in the gradual cooling of the earth mountain-tops would first reach a temperature to make them habitable for human life, while the sea would for further centuries remain above the critical temperature. Prof. Gregory feels hesitation in accepting the conclusion reached that life would first be found on the mountains, considering that while "the mountain summits would have stood like islands above a sea of hot mist . . . any wind would have at times submerged the mountain summits beneath the lower atmosphere, and they would have been subject to violent fluctuations in temperature and moisture which would have been unfavourable to primitive life."

Now with an atmosphere of homogeneous composition it is impossible to warm a mountain summit by immersing it in warm air drawn from the lower layers; if the conditions are initially stable, adiabatic cooling sees to it that the warm bath of air becomes a cold one before the summit is reached. We must therefore assume that in these early days the earth's atmosphere was not homogeneous, but that hot layers of dense gas occupied the lower levels, while lighter constituents of low temperature floated above. In these circumstances a stirring up of the lower layers might raise the temperature at higher levels temporarily, but is there any evidence that such a condition existed? No trace of separation and stratification of the different gases under gravity is found in the troposphere at the present time, atmospheric turbulence being sufficient to maintain a similar constitution at all heights. If the gases were stratified in the manner suggested it would afford proof that vertical turbulence did not occur, and thus the very existence of stratification would show that the layers below never rose to the mountain-tops

Meteorological evidence does not seem to support Prof. Gregory's conclusion that the mountain-tops would be subject to such violent fluctuations of temperature as would render life impossible.

J. S. DINES.

66 Sydney Street, S.W.3, February 6.

DR. MACFIE'S letter (NATURE, January 26, p. 107) accepts the common idea that the surface of the earth was formerly very hot—an assumption which is probably not well founded. If the earth was formed by accumulation of meteoric matter, it began its existence as a cold body the interior of which afterwards became heated by condensation, aided by atomic disintegration, while its surface was kept at a moderate temperature by radiation. It is difficult to believe that a globe so small, comparatively, as the earth could produce enough heat to raise its surface temperature anywhere near to the melting point; all igneous rocks are probably formed at some distance beneath the surface.

I imagine the first beginnings of life to have occurred at a very early epoch in the earth's evolution, namely, as soon as (1) the surface became warm enough and (2) elements capable of forming labile energy-storing compounds were present. It is not certain that solar radiation was necessary at first; the kinetic energy (heat and electricity) may have been derived from the earth itself.

Life at this stage would be of the humblest kind; we should scarcely recognise it as life nowadays. There would be no definite organisms, only diffuse substances trading in energy. Between this stage and the development of *cellular* organisms an immense period may have elapsed, and that period may have witnessed many intermediate stages. The achievement of the cell-form in living organisms must have marked a most important epoch in the history of life.

Chlorophyll may have been evolved at quite a late stage, as the culmination of a series of attempts at the formation of energy-fixing pigmentary bodies, most of which probably had iron as an essential ingredient.

The high stage of development shown in the earliest known fossils suggests that the geological period occupied by their evolution was vastly greater than the period since. The dawn of life may have occurred before there were either mountains or seas; all evidence of such early life has been obliterated by the metamorphosis and fusion of the deeper rocks.

Further discussion on this subject may be found in a paper by the present writer in the Proceedings of the Birmingham Natural History and Philosophical Society, vol. 11, pt. 1.

F. J. ALLEN.

8 Halifax Road, Cambridge, January 28.

Rainfall and Drainage in 1921.

I HAVE read with interest the letter of Mr. W. D. Christmas in NATURE of January 26 concerning the rainfall and drainage at Rothamsted during the very dry year 1921.

A few years ago three rain-gauges were installed at Craibstone, the experimental farm of the North of Scotland College of Agriculture. Like the Rothamsted gauges, each of these is one-thousandth of an acre in area, and contains a block of soil which has been enclosed in its natural condition without disturbance. The soil at Craibstone differs greatly from the heavy loam of Rothamsted, and is composed of sharp granitic drift which is easily pervious to