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

water. Each of the gauges is 40 in. in depth. The rainfall alongside them is measured by an ordinary 5-in. Snowdon rain-gauge. The total rainfall recorded for the year 1921 was 17.86 in. In 1920 it was 32.25 in.; the average is probably about 30 in., but we have not yet obtained a record over a sufficiently long period to establish a trustworthy average. No. 1 drain-gauge is unmanured, and the figures quoted below refer to it. The drainage for the year from this gauge was 4.93 in. No drainage at all came through from early June to nearly the end of October, and during seven months, from the middle of May to the middle of December, the total drainage was 0.046 in., or less than one-twentieth of an inch. On the other hand, in 1920, when the rainfall was 32.25 in., the drainage was 18.09 in., and there were only two months, July and August, when there was no drainage.

In many parts of this district springs failed which were never known to have failed before, and there was great difficulty in many places in obtaining a sufficient water-supply. The reason for this is apparent when we find that from the middle of May until the end of the year practically no water passed through the subsoil.

Although the total rainfall for the year was so low, it was well distributed throughout the year and rain fell in every month. Quite a good crop was grown upon Craibstone Farm. The drain-gauges themselves as well as the surrounding field were under turnips, and both yielded a good crop.

The year 1922 so far as it has gone provides a great contrast to 1921. During the month of January more drainage came through No. 1 gauge than during the whole of the previous year. The rainfall recorded was 5.61 in., while the drainage from No. 1 gauge was 5.69 in. There were only two days during the whole month on which rain or snow was not recorded. The underground water-supplies are now being well replenished, and, although all the springs have not yet responded, there is no doubt that after the rainy month of January they should soon begin to recover.

JAMES HENDRICK.

Agricultural Department, Marischal College,
Aberdeen, February 3.

Scientific Literature for Russia.

At the beginning of last year a British committee was formed with the object of sending books and other publications to men of letters and science remaining in Russia.

The committee was assured that any such works, if addressed to the House of Science or the House of Literature and Art in Petrograd, would reach their destination and would be much appreciated by literary and scientific men meeting there who were cut off from the intellectual life of the rest of the world.

An appeal was therefore made for funds to purchase works of a non-political type for dispatch to Petrograd, and Prof. Oldenburg, permanent secretary of the Academy of Sciences, furnished a list of books and other publications much needed by Russian savants. The books particularly desired were those which included accounts of current problems and developments of pure and applied science.

As the result of this appeal the sum of 448*l.* 17*s.* 5*d.* was subscribed, and several scientific societies, including the Royal Society, entrusted the committee with their publications for transmission to Petrograd. The Russian Trade Delegation undertook the dispatch of the books, and ten cases have been forwarded.

Prof. Oldenburg, writing on December 21 last,

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expressed the deepest gratitude of scientific workers in Petrograd for this stimulating intellectual aid, and says that they have been placed in a special reading-room at the House of Savants, where they are consulted by a large number of students throughout the day, and have been the means of reviving scientific interests and work. He sends the most cordial thanks of men of science in the city to all who have contributed towards the stimulus to scientific investigation which the new publications have given them.

Having thus established contact with scientific men in Russia and enlightened them as to the progress of research from which they have been separated by political circumstances beyond their control, the committee is of the opinion that its task has been accomplished. Of the fund remaining in its hands the sum of 50*l.* has been expended upon books desired by the University of Latvia, and a small balance will be handed over to the Universities Committee of the Imperial War Relief Fund.

The committee gratefully acknowledges the generosity of the response to its appeal, and believes that the intellectual relief thus afforded will do much to strengthen Russian scientific life.

A statement of accounts, audited by Messrs. W. A. Browne and Co., chartered accountants, will be sent to anyone who desires a copy.

R. A. GREGORY,

Chairman.

C. HAGBERG WRIGHT,

Hon. Secretary and Treasurer.

British Science Guild Offices, 6 John Street,
Adelphi, London, W.C.2, February 11.

Cyclic Conditions and Rejuvenation in Hydroids.

SEVERAL colonies of *Tubularia indivisa* which have lived in the aquaria for three years are noticed as exhibiting alternating periods of activity and rest. Broadly speaking, the hydranths die off about midsummer and reappear about midwinter, the times in one particular case for the growth of new lengths of hydrocaulus and for the formation of new hydranths being December, 1919, January, 1921, and January, 1922, and in another January, 1920, January, 1921, and December, 1921, the hydranths in each case finally dying off in the intervening periods between the end of May and July. Colonies obtained from moderate depths in January generally show clearly marked new ends to their hydrocauli, such new growth often being an inch or more in length.

At the same season died down colonies of *Staureidium* and *Meliceridium* in the aquaria, and *Clava*, *Syncoryne*, *Campanularia*, *Antennularia*, *Plumularia*, *Halecium*, etc., in the sea are found showing signs of rejuvenation.

In a paper on "The Effect of Hydrogen-ion Concentration and Oxygen Content of the Water on Regeneration and Metabolism in Tadpoles" (*Journ. Exper. Zool.*, 1920), M. E. Jewell shows that rate and amount of regeneration increase with increase of oxygen content of the water, but decrease with decrease in temperature, and that the optimal P_H for regeneration is at or near neutrality. In connection with these experimental results it is interesting to note that the above regenerations begin when the sea temperature is approaching its minimum, at which time the oxygen content is greatest, and continue with increasing rapidity during spring, when increasing alkalinity further stimulates growth and an ever-increasing food supply is available.

In view of our incomplete knowledge of the inter-relations of physical factors in the sea it is extremely