still brighter than Venus at its maximum brilliancy, like a suddenly appearing flame in a white colour. The bursting-point I could sharply determine 1½° below the middle of the line *α Pisc.* – *γ Ceti*, in the given direction; the mistake being not greater than one degree.

Accident having favoured me, looking sharply as I was in the direction of the phenomenon, my observation will, perhaps, have some importance, if positions of the same fire-ball have been taken by English observers. H. T. H. GRONEMAN

Groningen (Netherlands), March 4

Sunshine

IT may interest your readers and the Fellows of the Meteorological Society to know that "the sun is always shining somewhere," even though we have so little demonstration here. In a letter received from Adelaide, from a reliable observer, I note the following:—

"Last Tuesday, January 20, was a cooker! 113°·5 in the shade, and 172° in the sun, the highest ever registered here; the latter being within 40° of the boiling-point of water."

CHAS. COPPOCK

Grosvenor Road, Highbury New Park, March 5

Lines of Force due to a Small Magnet

REFERRING to my communication in NATURE, vol. xxi. p. 370, the value of y, for which the radius of curvature (ρ) is a maximum, should have been $y = \cdot 317\ C$, not $432\ C$ as stated.

Glasgow, February 27 JOHN BUCHANAN

Artificial Diamonds

I READ with great surprise a paragraph in NATURE, vol. xxi. p. 409, referring to an investigation which I am now making on the artificial production of various crystalline forms of carbon, and I write to disclaim all responsibility for statements which have been published without my knowledge or consent.

R. SYDNEY MARSDEN

University College, Bristol, February 27

[The correspondent who sent us the paragraph in question sent it in good faith, believing the matter to be to that extent public. —ED.]

JAS. ROCK.—The galls which your gardener found growing on the *root* of an oak-tree, about six inches below the surface of the ground, are probably galls produced by *Biorhiza aptera*.

J. W. WYATT.—The appearance in the specimen of a decayed ash bough is caused by the mycelium of *Helotium æruginosum*, Fr. [= *Peziza æruginosa*, Fr.]. See Cooke, "Handbook of British Fungi," pp. 708, 709; "Official Guide to the Kew Museums," p. 81.

PICTET'S PROPOSAL TO DISSOCIATE THE METALLOID ELEMENTS

THE task set before me is to expound in as simple and intelligible language as possible the remarkable train of reasoning which has led M. Raoul Pictet, of Geneva, to the conclusion that the so-called metalloids are really not elementary bodies at all, but capable of dissociation into simpler forms. During the last two years M. Pictet has published several important memoirs upon different branches of thermo-dynamics, and has, as is well-known, in his researches on the liquefaction of oxygen and of hydrogen shown the fruitfulness of the ideas which have thus occupied him. He is at the present moment engaged upon a large volume entitled *Synthèse de la Chaleur*, a work in which it is sought to deduce all the known laws of heat from the general principles of theoretical mechanics, by finding true mathematical definitions for the quantities which hitherto have been usually expressed as simple experimental matters. Thus the terms "temperature," "specific heat," "latent heat," &c., are capable of exact definition in a manner which enables the relations between them to be investigated analytically. These relations thus investigated are found by M. Pictet to be capable of experimental verification, and the complete acccordance of deduced theory with observed fact justifies him in giving the name of *Synthesis of Heat* to this new advance in thermo-dynamics.

To understand aright the views of M. Pictet with respect to the possible dissociation of the metalloids we must notice briefly the fundamental points of his theory of heat. If the atoms of a body are in absolute rest and equilibrium, their temperature will be at *absolute zero*. If however, kinetic energy is imparted to these atoms and they are set vibrating, the *temperature* of the body will be represented by the *mean amplitude* of the oscillations, and the total *quantity of heat* in the body will be the quantity of energy thus imparted.

Now the great decomposing force in nature is heat. It is heat which changes solids to liquids, liquids to vapours. Heat breaks up chemically combined substances and reduces them to simpler forms. It is quite certain that the limits of the power of the chemist to decompose the substances that pass through his hands are those which correspond to the temperatures which he can produce in his laboratory. We shall explain at a later portion of this article how this comes to be the case. Yet there are in nature temperatures far more elevated than the highest artificial temperature. To take the most striking example, the surface of the sun must be enormously hotter than even the hottest of the electric arcs in which even the most infusible of metals is vaporised. We know this upon evidence which accumulates evety day, and of which the most important is that afforded by the spectroscope. The researches of Kirchhoff and J. W. Draper, and the later work of Cornu, Mascart, and Lockyer, establish incontestably that the radiation emitted by a glowing substance varies with the temperature of the substance, and that at higher temperatures new rays of shorter wave-length and more rapid oscillation appear, while the intensity of all the emitted rays is also greater. The solar spectrum is much more rich in violet and ultra-violet rays at the more refrangible end of the scale than the spectrum of any artificially heated substance. The irresistible conclusion is that its temperature is far higher.

But the spectrum of the sun when scrutinized with the most elaborate skill and knowledge reveals another very striking circumstance. A large number of the substances regarded by the chemist as *elements* have now been recognised by the characteristic absorption lines of their spectra as existing in the heated matters surrounding the sun. The researches of Mr. Lockyer show that nearly forty of the metals are thus to be detected. But *not a single metalloid* is thus discoverable. Indeed so marked is their absence that the presence of hydrogen in such great abundance is held by no less an authority than Mr. Dumas to be a convincing proof that hydrogen is a metal and not a metalloid. It is true that Mr. Henry Draper of New York, has announced the discovery of *bright* lines corresponding to oxygen amongst the dark absorption lines of the solar spectrum: but it is far from certain whether the coincidence he has pointed out is real or apparent only, and all other evidence points to an adverse conclusion.

Putting together these two capital facts of solar spectroscopy, the irresistible inference is that the surface of the sun is too hot for metalloids to exist there; or in other words, *its temperature is higher than the temperature of the dissociation-points of the metalloids*. This term dissociation-point is justified by analogy with the terms boiling-point and melting-point, with which we are familiar, and with which we associate the notion of definite temperatures.

Let us examine, following M. Pictet's fundamental principles, how far this analogy can be followed out and justified. Those fundamental principles are that in hot