LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Heat developed during the Absorption of Electricity by Metals.

IN 1901 (O. W. Richardson, Camb. Phil. Proc., vol. xi., p. 286) one of the present writers showed that the phenomena attending the emission of negative electricity by hot metals could be explained on the assumption that the electrons which, on the electron theory of metallic conduction, move freely inside the metal attain sufficient kinetic energy at high temperatures to enable them to overcome the forces tending to keep them inside the surface and so escape. From the way in which the thermionic current varied with the temperature of the metal it was shown that the difference in the value of the potential energy of an electron when outside and when inside a metal could be calculated. Somewhat later (O. W. Richardson, Phil. Trans., A, vol. cci., p. 497) it was shown that the existence of this difference in the potential energies would involve a loss of thermal energy by the substance when the electrons were being given off, and it was pointed out that this effect would increase very rapidly with the temperature, so that at sufficiently high temperatures the loss of energy due to this cause would be greater than that arising from thermal radiation. An effect of this character has recently been discovered by Wehnelt and Jentzsch (*Ann. der Physik*, iv., vol. xxviii., p. 537).

Another consequence of the existence of this difference of potential energy is that when electrons possessing negligible kinetic energy pass into a metal an amount of heat should be liberated which is equal in magnitude to the difference in the potential energy for each electron multiplied by the number of electrons entering the metal. Experiments which have been carried out by the writers show that this effect exists, and is of the expected order of magnitude.

The method adopted was to cause the electrons emitted by two hot osmium filaments to flow on to a grid of fine platinum wire, which acted as a bolometer, and was placed in one arm of a double Wheatstone's bridge. The double bridge arrangement enabled the galvanometer to be balanced for the thermionic current into the bolometer in each experiment. The change in the resistance of the bolometer per unit thermionic current was measured when different voltages were maintained between it and the negative ends of the filaments.

In order to standardise the bolometer a known variation of current through it was produced, and the resulting change of resistance due to heating measured. By making use of this datum the energy received by the bolometer per unit thermionic current can be expressed in terms of the fall of potential which the electrons would have to undergo in order to produce the observed effect. The value thus obtained may be denoted by the "effect in volts."

When the effect in volts E is plotted as ordinate against the negative potential of the negative end of the filaments V as abscissa, the relation between them appears to be a linear one. The line, however, which is obtained does not intersect the axis of ordinates at E=0, but in the neighbourhood of E=3 volts, showing that when the electrons fall through no difference of potential due to the field they are still able to produce a heating effect equivalent to that due to the energy they would have received in falling through a difference of potential of about 3 volts. Inasmuch as Richardson and Brown (*Phil. Mag.* [6], vol. xvi., p. 353) have shown that the natural kinetic energy with which the thermions are emitted corresponds to only about 1/39 volt, the conclusion is inevitable that there is a liberation of potential energy when the electrons enter the metal comparable with that which would be acquired by falling through a difference of potential of about 3 volts.

Experiments have, so far, been made with applied potentials varying from +2 to −9 volts, the potential drop along the filaments due to the heating current varying from 3 to 3·7 volts. Changes are now being made in the experimental arrangements which, it is believed, will lead to greater accuracy of measurement. It seems likely that, owing to certain defects in the present apparatus, the values which have so far been obtained are somewhat too low.

O. W. RICHARDSON.
H. L. COOKE.
Palmer Physical Laboratory, Princeton University,
Princeton, N.J., December 21, 1909.

Malaria and Ancient Greece.

IN his scholarly "Malaria and Ancient Greece," reviewed in NATURE of December 16, 1909, p. 192, Mr. Jones has apparently overlooked what seems to be, though modified for dramatic purposes, a description of an acute attack of ague, *i.e.* that given by Sophocles of the sufferings of Philoctetes in his play known by that name. Here, just as he is about to accompany Neoptolemus to the ships, Philoctetes is seized with a sudden attack (line 730). He recognises the prodromal symptoms of what he describes to Neoptolemus as a recurrent attack of his malady (ἥκει γὰρ αὕτη διὰ χρόνου, line 758). The attack appears to be ushered in with pain or discomfort (line 730) and shivering (735). The symptoms become increasingly acute (καί τι προσδοκῶ νέον, 784) until they become almost unendurable (790). Soon, however, from previous experience, Philoctetes can foretell that the worst is over (808), and that the attack will pass away during the sleep which always supervenes. λαμβάνει γὰρ οὖν ὕπνος μ', ὅταν περ τὸ κακὸν ἐξίῃ τόδε, 766.

Later on, as he is falling asleep, Neoptolemus directs the attention of the Chorus to the profuse perspiration which bathes his body (823). The periodicity, suddenness, and ingravescence of the symptoms, the sleep and sweating followed by a passing feebleness on waking (880), present a clinical picture the vividness and truth of which are not surpassed in any literature. The congeries of symptoms in this description must be based upon actual experience of disease. It will, of course, be urged that Sophocles makes all the symptoms dependent upon the uncured wound in the heel caused by the snake-bite at the shrine of Chryse. Here there need be, however, no difficulty in the acceptance of the ague theory, for this would be in full accord with the accepted pathology of the period. The Greek physicians were probably well acquainted with the characteristic results of non-fatal snake-bite—the pain, sloughing with foul discharge, and delayed healing.

Without attempting to labour the point further, from a strictly clinical point of view the imposition of a malarial infection upon a chronic condition such as that described would, without doubt, give rise to periodic exacerbations of the inflammatory conditions. This is probably the explanation of the statement of Hippocrates quoted by Arndt (*cp.* Jebb, *Philoctetes*, p. 241) that the "ulcers become especially inflamed on these alternate days."

The *Philoctetes* was performed in 409 B.C., just when, according to Mr. Jones's theory, malaria was becoming widely disseminated through Greece, and nothing would be more natural than that Sophocles, in his wish to draw the sympathies of his audience to his long-suffering hero, should represent him as wracked with all the horrors of the new and strange disease, which appeared to lend themselves peculiarly to his purpose. There can scarcely be a sight more pitiable than that of a person in an acute paroxysm of malaria.

It is much to be regretted that the loss of their respective plays prevents a comparison with the manner in which Æschylus and Euripides treated the subject. That Sophocles had a keen clinical grasp of the salient features of disease is noticeable in his description of the Acute Delusional Insanity of Ajax—a description of a form of mental aberration which is extraordinarily true to nature, and one which from a clinical standpoint far surpasses the delineations of madness by Shakespeare, as might indeed be expected from a consideration of the relative positions of medicine as a science at the times of the respective poets.

GEORGE A. AUDEN.
Birmingham.