The last critical list of British beetles, by Sharp and Fowler, was published eleven years ago, and we heartily recommend the present list to British entomologists.

A Preliminary Course of Practical Physics. By C. E. Ashford, M.A. Pp. 48. (London: Edward Arnold, 1904.) Price 1*s.* 6*d.*

THIS little book on practical physics is of a kind familiar to teachers of the subject. The experiments are simple and well within the power of schoolboys, but so far as we have examined them they differ little from those to be found in well known books. Indeed, in his preface the author says it is impossible adequately to acknowledge the debt "to those from whose books many of the experiments have been derived." But though the book contains much in common with previously published first courses of practical physics, the author has compiled a logical and useful manual of experiments which will serve to introduce boys to the study of physical science. The volume may be recommended to the attention of teachers deciding upon a book to place in the hands of their pupils.

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.*]

On the Radio-activity of Natural Gas.

IN a paper by Mr. E. F. Burton, recently published in the *University of Toronto Studies, Physical Science Series,* an account is given of some experiments with a highly radio-active gas obtained from crude petroleum. In this investigation it was found that air drawn through crude petroleum became charged with a radio-active emanation which, from the rate at which its activity decayed and from the nature of the induced radio-activity which it produced, the author concluded to be an emanation from radium.

The present writer has extended this investigation to an examination of the natural gas from different wells in western Ontario. The gas from every well examined, which included those in the Welland district, in the neighbourhood of Niagara Falls, as well as those near the city of Brantford, was found to be charged with a radio-active emanation. The activity of this emanation in all the gases tested was found to decay or die out to one-half its original intensity in about three days, and the intensity of the induced radio-activity which it produced died down to one-half value in about forty minutes.

The wells examined varied in their depths, but the amount of active emanation present was found to be practically the same in all wells coming from the same horizon. In the Welland district, the gas from those wells which had their source in the stratum known as the Niagara formation, and which were about 500 feet deep, possessed the highest initial conductivity. On an arbitrary scale this conductivity is represented by about 2000

The gas of those wells which had their source in the Clinton limestone, 750 feet deep, possessed an initial conductivity of about 300 on the same scale, while that from wells coming from the Medina formation, about 900 feet deep, gave an initial conductivity of about 1200. One well, which had its source in the Trenton limestone, and had a depth of about 3000 feet, possessed an initial conductivity of about 200. The highest conductivity obtained in the investigation was that of the gas from a well near the city of Brantford, the conductivity in this case being about 9000. An investigation of this gas showed that, under the action of the emanation with which it was charged, there was produced, at normal pressure, about 15,000 ions per second in each cubic centimetre of its mass.

A test made on the conductivity of ordinary air, confined at atmospheric pressure in the receiver used in making the measurements on the conductivity of the different samples of natural gas, showed a production of 32 ions per cubic centimetre per second. J. C. MCLENNAN.

University of Toronto, May 28.

The Source of Radio-active Energy.

IN NATURE of June 2, Mr. Jeans brings forward the view that the energy manifested in radio-active processes is derived from the coalescence of positive and negative ions, thus involving an annihilation of matter. For some time it has seemed to me that some such fundamental change is needed to account for the observed phenomena, and I therefore venture to submit some general and numerical considerations bearing on this view.

Mr. Jeans is inclined (as I understand) to attribute the beginnings of the process to a change of type in advancing æthereal waves, arising from a lack of strict linearity in the equations of the electromagnetic field. It may be pointed out, however, that whether or not the circumstances of æthereal wave-propagation are strictly expressible by linear equations, there is a *universal tendency* towards loss of kinetic energy in orbitally moving systems of electrons. Unless the orbital periods are very long compared with the time taken by radiation to traverse the assemblage, there must be appreciable radiation of energy, and it is thus a necessary condition of permanence or quasi-permanence that *the orbital velocities should be very small compared with the velocity of light.* This view is confirmed by numerical consideration of simple cases in which the orbits are assumed to be of *atomic* dimensions; it is also borne out by the general optical properties of matter.

It should be remarked that as energy is dissipated and orbits become contracted, with corresponding rise of velocities, the total effective radiation will become more and more intense, so that conceivably very little time may be occupied in the transition from a quasi-permanent motion to a state of collapse and disintegration; indeed, once the orbital motions have begun to give out perceptible radiation, the life of the system must be excessively short.

Thus, whether we look for the main source of radio-active energy in enormous orbital velocities due to intra-atomic rearrangement, or in the constitutive electrostatic energy of individual electrons set free by mutual annihilations, the conditions favourable to radio-activity in any given atom must be confined to a momentary phase—momentary, that is, as measured by ordinary standards. It is not a long step from this conclusion to an exponential law of decay of radio-active matter.

If we adopt provisionally Dr. H. A. Wilson's very interesting suggestion (NATURE, June 2) that, the positive and negative electrons having numerically equal charges, the greater mass of the positive electron is due to its smaller diameter, it follows that *any* isolated electron has electrostatic energy $=\frac{1}{2}m.3V^2$, where m is the mass of the electron (when moving slowly) and V is the velocity of light. In other words, when matter of mass M is annihilated, energy $=\frac{1}{2}M.3V^2$ is set free—initially as an electromagnetic pulse of great intensity. *A further assumption involved in this estimate is the validity of the ordinary electrostatic-field relations for such enormous intensities as obtain in the neighbourhood of an electron.*

If annihilation of matter furnishes the energy of radio-activity, it follows from our estimate that, in the case of radium, the coalescence of one pair of electrons causes the break-up of a large number of radium atoms (something of the order of one hundred), otherwise the total energy emitted by radium would be much greater than that which has been observed by Curie and Laborde.

If the assumption in italics above is very wide of the mark (which is conceivable), our estimate of the energy of annihilation is probably in excess.

It may be supposed that some neighbouring atoms, which are not actually broken up by the pulse arising from a pair of coalescing electrons, receive a sufficient access of kinetic energy to *prolong* their existence. "Metabolons" of short average life may be conceived of as consisting of assemblages the orbital motions of which are especially liable to be damped out rapidly by radiation of energy.

Cambridge, June 9. C. V. BURTON.