Science at the Universities

MR. TIZARD'S address[1] to Section L (Educational Science) of the British Association calls for certain comments. In view of the existing unemployment among scientifically trained men and women, he calls for a reduction in the number trained in future, and suggests that it is a good policy deliberately to keep the supply somewhat short of the demand, at least in the case of biologists. This may be economically sound from the point of view of persons already trained in biology, who would thus acquire a scarcity value, like those pigs which have survived the recent massacre of their species in the United States.

But is it a sound policy from the point of view of the community, and should a biologist regard himself as a mere commodity? Whatever may be the case with engineering, I submit that training in pure science has value of another kind. A century ago the founders of this College wrote[2]: "It is rather for another class of sciences, the knowledge of which is not profitable to the possessor from the pecuniary point of view, but which exert a great influence on the well-being of society, that such an Institution was required." I find little trace of this idea in Mr. Tizard's address. Yet I believe that it is still true, and that a training in biology is of value not merely for success in science, but also for success in citizenship.

Whether or not this is true, many students, who are interested in science for its own sake, believe that they are regarded as mere commodities. This belief is one cause of the spread among them of revolutionary views, in which I fear Mr. Tizard's address, if it is taken as expressing the general views of university authorities, will go far to confirm them.

J. B. S. HALDANE.

University College,
London, W.C.1.
Oct. 2.

[1] NATURE, 134, 405, Sept. 15, 1934.
[2] Report of Council, 1833.

The Philosophy of Sir James Jeans

DR. JEFFREYS and I do not always agree; but I want to support him against H. D., who misses the point[1]. If in the days of the 'old' physics, there was in existence a 'philosophy' applicable to the 'new', that is evidence that there is not nearly as much difference between the old and the new as Jeans, Eddington and their followers pretend. That is what Dr. Jeffreys and I maintain; the argument is unaffected by the number of people who held the 'philosophy'.

I want to support him too concerning the neglect of inference. Indeed, I would go further than he. The only way to discover what science means is to study how its conclusions are reached. Interpretations of science that are not based on a theory of inference are worthless. Unfortunately, Dr. Jeffreys and I differ concerning inference; and so, at the risk of self-advertisement, I want to point out that his argument, restated above, supports my view.

My doctrine of inference, expounded in my "Physics", depends on an essential distinction between laws and theories, which everyone else ignores, and leads to a particular view of the logical structure of theories. The doctrine was based on a study of the 'old' physics; but Dirac's great book (which is the Bible of the 'new') might have been written (of course it was not actually written) to illustrate the doctrine. Dirac starts, as I said he should, in defining his 'hypothetical ideas' and stating his 'hypothesis'; he then formulates his 'dictionary' in a separate section. The only difference between a typical 'old' theory (such as the kinetic theory of gases) and a typical 'new' theory is that the 'analogy' is mechanical in the former, mathematical in the latter. But, as I pointed out, there were mathematical theories even in the old days.

NORMAN R. CAMPBELL.

155 Hagden Lane,
Watford, Herts.
Sept. 28.

[1] NATURE, 134, 499, Sept. 29, 1934.

Cosmic Rays and the Earth's Potential

IN a recent communication[1] I have outlined a theory of the origin of cosmic rays in which the earth is regarded as a magnetised sphere carrying an electric charge, and the cosmic rays as charged particles which are drawn to it by electrostatic attraction. I find, employing the dynamics of relativity, and assuming that the particles possess small energies at great distances from the earth, that the theory leads to the following conclusions: if the earth, regarded as an isolated sphere, has a potential of 3×10^{10} volts, particles bearing a single atomic charge can reach it only at magnetic latitudes greater than 60°, while if its potential exceeds $1{\cdot}5 \times 10^{11}$ volts, the earth's magnetic field does not greatly influence the geographical distribution of the intensity of the radiation. Consequently, the particles should arrive at the earth's surface each with an energy the value of which expressed in electron volts lies between these limits. A potential of 6×10^{10} volts is just sufficient to bring the particles to the magnetic equator.

Calculations by Lemaître and Vallarta[2], who suppose the earth to be magnetised but uncharged, and the particles to be projected towards it from all directions, afford the values 10^9 and 5×10^{10} electron volts for the corresponding limits of the energies.

It is significant that Kolhörster[3] has detected cosmic rays in a salt mine and concludes that the minimum energy of the primary cosmic rays must exceed 10^{11} electron volts, while Compton[4] states, "Regarding the more penetrating component, we must conclude that if they are electrified particles, they must have an energy of 3×10^{10} electron volts or more".

In addition to affording satisfactory numerical agreement with these observations, the theory of a charged earth gives a simple explanation of the fact that cosmic rays arrive with equal intensities from all regions of the heavens, so that it is unnecessary to adopt the somewhat unsatisfactory hypothesis that space is filled with particles moving with vast energies in all directions.

With the earth at a potential of 7×10^{10} volts, the particles would arrive at the equator at an angle of 60° with the vertical from a westerly direction if positively charged, but from the east if they carry negative charges, so that there exists a possibility