Letters to the Editor

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NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 439.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Age of the Universe

ONE of the most important problems of present-day astronomy is that of the age of the universe, and one of the most important pieces of evidence is provided by the orbits of binary stars. The ages which need to be seriously considered fall into two groups; the first is that of the so-called 'long' time scale, which is of the order of 10^{13} years, the time the stars would need to have reached their present condition by annihilation of their substance; the second is that of the 'short' time scale—which is of the order of 10^{10} or 10^{11} years, the time needed for the universe to have expanded from small beginnings to its present size. The motions of the stars ought to provide a means of deciding between the two. For dynamical discussion shows that with the long time scale both the linear motions of single stars and the orbital motions of visual binaries ought to show a reasonably good approximation to equipartition of energy; the short time scale, on the other hand, gives nothing like enough time for such an approximation to be established. Thus if the motions of the stars are found to show any marked approximation to equipartition of energy, it is exceedingly difficult to do other than decide in favour of the long time scale.

It is not easy to test the linear motions of the stars for equipartition of energy, for this requires a knowledge of stellar masses, and these are very imperfectly known. Nevertheless, so far back as 1922, Seares found that the linear motions of the stars show a tolerable approximation to equipartition of energy. It is far easier to test the orbital motions, since I have shown that if these conform to the law of equipartition, the number of orbits whose eccentricity is less than e will be proportional simply to e^2. The material collected in the recent new edition of Prof. Aitken's book "The Binary Stars" makes it possible to test this requirement with some accuracy. The agreement with the equipartition law is shown in the following table:

Orbits of Visual Binaries classified by Eccentricity

Limit of e	Observed	Equipartition
$e < 0{\cdot}1$	0	2
$e < 0{\cdot}2$	11	9
$e < 0{\cdot}3$	20	21
$e < 0{\cdot}4$	34	37
$e < 0{\cdot}5$	58	58
$e < 0{\cdot}6$	83	83
$e < 0{\cdot}7$	89	113
$e < 0{\cdot}8$	102	148
$e < 0{\cdot}9$	109	187
$e < 1{\cdot}0$	116	231

In the last column, the total number of stars has been taken to be 231, so as to make the number of orbits of eccentricity less than 0·6 equal to the number actually observed.

Inspection of the table now shows that up to this eccentricity, observation agrees well with the predictions of the law of equipartition; above it there is a marked deficiency of observed orbits. This deficiency can readily be explained by the well-known difficulty of detecting binaries of high eccentricity, and the still greater difficulty of measuring the elements of their orbits with sufficient certainty to justify their inclusion in a catalogue.

The agreement seems to me far too good to be accidental, so that the new material collected by Prof. Aitken would seem to provide strong evidence in favour of the long time scale.

Dorking. J. H. JEANS.
Aug. 31.

Blood Group Inheritance

FOULKES EDWARDS and Etherington[1] put forward a theory of blood-group inheritance which amounts to the postulation, in addition to Bernstein's three allelomorphic genes causing the presence of one agglutinogen A or B or neither of them, of a fourth allelomorph producing both. This is intended to account "for the observed occurrence of a small percentage of groups AB and O in the offspring of $AB \times O$ matings".

Now supposing such occurrences to be inexplicable by "mistaken parentage or faulty technique" which the authors invoke in other exceptional cases, they might still be explicable by trisomy or by mutation. If AB individuals from such matings are much commoner than A or B individuals from $O \times O$ matings, the mutation hypothesis must be rejected. On the hypothesis of trisomy, the anomalous AB individuals have three chromosomes carrying the A, B and R genes, instead of the normal two. Such trisomy has, of course, been observed both in plants and animals.

The new theory may readily be tested. In the first place, no $AB \times O$ or $O \times AB$ mating should ever give more than two types of offspring, whereas on the hypothesis of crossing-over all four types might be expected. Secondly, an anomalous AB individual from such a mating should give only AB and O children when mated to a member of group O. On the hypothesis of trisomy, about two thirds of the offspring in such families should belong to groups A or B.

Similarly, the hypothesis of trisomy could be tested by Chrustschoff's[2] technique of observing mitoses in leucocyte cultures. Until one or both of these tests has been applied, it would seem that a suspension of judgment is desirable, Bernstein's theory being retained with the proviso that it may ultimately need modification.

University College, London, W.C.1. J. B. S. HALDANE.
Aug. 30.

[1] NATURE, **136**, 297, Aug. 24, 1935.
[2] Chrustschoff, *J. Genet.*, **31**, 243; 1935.