following values for the second basic dissociation "constant" of arginine calculated from the experimental P_H values.

P_H.	p_{Kb}. Harris's Formula.	Van Slyke's Formula.
3·14	11·90	11·89
2·52	11·90	11·88
1·84	11·90	11·75

It was shown[3] that for amino-acids, results sufficiently accurate for most purposes could be obtained if α in equation (2) were taken as 0·9 when concentrations less than N/10 were dealt with. As recently emphasised by Cohn, P_H determined electrically is a measure of hydrogen ion "activity" rather than "concentration." I have obtained results sufficiently accurate for analytical purposes by taking for α Noyes and McInnes'[6] figures for the activity of KCl of the same concentration as that of the total HCl (titrant) added at each stage in the titration. Similar conclusions have been reached in titrating weakly acidic groups with soda. For highly accurate theoretical purposes I have calculated values of α for use in the presence of weakly basic or acidic groups of amino-acids from Sorensen's very careful P_H determinations of glycine—HCl and —NaOH buffers. My theoretical investigations relate mainly the one acidic and one basic group in glycine, and the one acidic and two basic groups in arginine: it is intended to publish a detailed report in due course.

LESLIE J. HARRIS.

School of Biochemistry, Cambridge,
and Carrow Research Laboratory, Norwich,
December 16.

[6] J. Amer. Chem. Soc., vol. 42, p. 239 (1920).

The Ages and Masses of the Stars.

IN his article on "The Ages and Masses of the Stars" (NATURE, December 6, 1924), Dr. J. H. Jeans, to account for the source of stellar radiation, considers the possibility of positive and negative charges falling together, annihilating each other, and passing away "in a blaze of glory," thus setting free enormous amounts of "sub-electronic" energy. Proceeding, he says, "Nothing in the suggestion appears to conflict with modern atomic physics" and gives his reasons.

This may be very true, since we have nothing to disprove such a theory; but to make an assumption of such a fundamental nature, and, as it seems to me, on insufficient grounds, is rather disconcerting to a conservative mind. It requires some imagination to think of an electron and a nucleus, the properties of which are so vastly different, as "cancelling" one another.

The author's one strong argument in favour of his theory is based on the loss of the mass of stars as obtained by Eddington (cf. NATURE, May 31, 1924). In support of his theory of the annihilation of matter, Jeans makes the highly contestable statement, that "we know of no normal process by which mass can escape except by radiation, whence we conclude that the diminution of mass is the equivalent of the energy radiated away." Objection to this can immediately be raised on the ground that we have direct evidence of a stellar body losing mass, in the case of the tails of comets. Moreover, it has been shown by Gouy (*Comptes rendus*, 157, 186, 1913) and Page (*Astrophys. Journal*, vol. lii. No. 2, September 1920) that, in the case of an atomic vibrator, the radiation pressure may very well exceed the gravitational attraction on the surface of our sun. It is, therefore, quite imaginable that the sun is losing mass from its surface in this way all the time. In a greater degree would this be the case on hotter stars, even though much more massive than the sun.

On the other hand, if we reject Jeans's hypothesis, we rob him of his nearly unlimited supply of energy; but could this not, in a small way, be compensated for by attributing to the stars a high degree of radioactivity, this source of energy, I take it, not having been included by the author in his computation of the "super-electronic" energy of the stars?

T. SCHUMANN.

Sloane Laboratory, Yale University,
New Haven, Conn., U.S.A.,
December 17.

THE merit I am inclined to claim for my hypothesis of sub-electronic energy is that this one simple hypothesis clears away a whole tangle of astronomical difficulties. The hypothesis may strike the physicist as unproved and unprovable, as it certainly is, but I think the following considerations will show that it ought not to be dismissed as fantastic.

A gram of every substance (except hydrogen) contains 3×10^{23} negative electrons and a corresponding quantity of positive electricity. Each gram of the sun's mass radiates 60 million ergs per annum, so that if sub-electronic energy is not drawn upon, each of these electric charges must fall through an average potential difference of 0·0012 volts. The fall for one year does not look big, but radiation for 10^9 years requires an average fall of 120,000 volts, representing a fall from infinity to only 10^{-12} cm. from a charge $\pm e$. The figure of 10^9 years is the absolute minimum that can be considered; evidence from the orbits of binaries and from the approximate equipartition of energy in stellar velocities calls rather insistently for 10^{13} or even 10^{14} years. Also giant stars radiate anything up to a thousand times as much per unit mass as our sun. It would be possible to find tolerably good reasons for replacing the above figure of 120,000 volts by 12×10^9 volts, and 10^{-12} cm. by 10^{-17} cm. If we have to contemplate positive and negative charges getting as near to one another as this, it would seem that they might as well go a bit farther. To my mind it is easier to imagine a few charges stumbling into one another than to imagine a whole lot falling through these enormous potential differences and then stopping.

Radioactive energy and energy of nuclear rearrangement can, of course, be covered by an argument of the same general type, except that we have to picture charges of the same sign starting at these infinitesimal distances from one another. There is nothing impossible in it, but neither, I claim, is there in the hypothesis of mutual annihilation. The inadequacy of the highest degree of radioactivity known to us has been pointed out by Lindemann and others, but it has to be conceded that substances of far higher radioactivity may exist in the stars.

A comet's tail can lose mass, and this loss of mass may be permanent, because the comet's own gravitational field is slight in comparison with the general field of the sun, but the conditions are different for a body of stellar mass. So soon as a particle expelled by radiation pressure loses or changes its period of vibration, it will fall back into the star. A cosmogony based on the conceptions suggested by Mr. Schumann would seem to me to create more difficulties than it removes, but others may think differently. Mr. Schumann's cosmogony would certainly fit in well with Prof. Lindemann's theory of the nature of spiral nebulæ.

J. H. JEANS.