The results thus far obtained are given by the following equations :

$$He^+ + Ne = Ne^+ + He,$$
$$Ne^+ + A = A^+ + Ne.$$
$$A^+ + NO = NO^+ + A,$$
$$He^+ + NO = NO^+ + He.$$

The ionisation potentials of He, Ne, A, and NO are 24·5, 21·5, 15·4, and 9 volts respectively.

With diminishing pressure the above reactions take place to smaller extent and, in each case, the ratio of the relative amounts of the two ions, extrapolated to zero pressure, is that due only to electron impact ionisation. This extrapolated ratio gives the relative probabilities of ionisation of the different ions. The results thus obtained are in agreement with those of K. T. Compton and C. C. Van Voorhis (*Phys. Rev.*, 27, 730, 1926).

H. D. SMYTH.
G. P. HARNWELL.
Princeton University, Princeton, N.J.
T. R. HOGNESS.
E. G. LUNN.
University of California, Berkeley, California.

Photo-electric Polarimetry.

WITH reference to the letter from Dr. J. Kenyon published in NATURE of February 27, 1926 (vol. 117, p. 304), which I have only just happened to see, I should like to add the following.

H. von Halban and K. Siedentopf in July 1922 applied for a German patent for methods of photo-electric polarimetry. The patent was granted as No. 386,537 and taken up by the optical works of R. Winkel, Göttingen.

The processes described in their specification were critically examined by K. Mayrhofer. This investigation was finished by July 1924 and the results were embodied in a Würzburg dissertation in 1924.

The best results were obtained with an arrangement in which the variations of luminosity of the source (mercury lamp) were compensated by using two cells.[1]

The light emerging from a monochromator was split up by a quartz plate. The transmitted ray passed through a polarimeter specially built by Messrs. Winkel on a potassium photo-electric cell with argon filling, while the reflected ray fell direct on a similar cell. The voltages on the two cells were so distributed that the photo-electric currents balanced, as shown by a single-fibre electrometer. Thereupon similar vessels with the solution to be tested were introduced into the two beams. This cancelled the loss of light by absorption and left only the change due to polarisation, which was then compensated by rotation of the nicol.

With this method measurements were made on the mercury lines down to 2536 Å.U. The readings could be reproduced with an accuracy of 0·01° in the strong ultra-violet lines, and rather less accurately in the feeble lines.

The same method can of course also be used for absorption measurements, and results were obtained for potassium chromate which agree well with those obtained by other methods.[2]

If, however, only absorption measurements are required, it will be found better to use the two-cell method of von Halban and Siedentopf (*ibid.*), since the polarimeter, with its many reflecting surfaces, introduces much loss of light.

A detailed publication of Mayrhofer's measurements will appear shortly in the *Zeitschrift für physikalische Chemie.*

H. VON HALBAN.
Physico-Chemical Laboratory,
Deutsche Gold- und Silber-Scheideanstalt,
Frankfurt a. M.

[1] E. Meyer u. H. Rosenberg, *Vierteljahrsschrift d. astronom. Ges.*, **48**, 3, 210 (1913). H. v. Halban u. H. Geigel, *Z. f. phys. Chemie*, **96**, 214 (1920). H. v. Halban u. K. Siedentopf, *Z. f. phys. Chemie*, **100**, 208 (1922). H. Rosenberg, *Z. f. Physik*, **7**, 18 (1921).

[2] H. v. Halban u. K. Siedentopf, *Z. f. phys. Chemie*, **100**, 208 (1922).

The Double Normal State of the Arc Spectrum of Fluorine.

IN NATURE of December 4, p. 804, Mr. de Bruin suggests that Millikan's complex hot spark lines of fluorine, at λλ607,657, are to be attributed to FI. The components of these lines exhibit intervals which, within the rather wide range of experimental error in this difficult region, are equal to the intervals Δ^4P_{12}, $\Delta^2P'_{12}$, and Δ^2P_{12} occurring among the red lines of FI, but it does not appear possible to form the groups into complete multiplets in such a way as to give the equalities undoubted significance. The assignment of these groups to FI is very hazardous, in view of the fact that they have been produced only under the extreme conditions of the hot spark. It may be recalled that Millikan at first assigned them to FVII.

In a recent paper (*Proc. Roy. Soc.*, A, 113, p. 323) I have given evidence that the ionisation potential of the neutral fluorine atom is approximately 17 volts. The ultra-violet groups in question correspond to excitation potentials of about 20 volts and 19 volts respectively. It would appear, therefore, that if Mr. de Bruin's assignment is correct, the groups must require the simultaneous excitation of two or more electrons for their production. This is unlikely, in view of the satisfactory correlation of the terms involved with those predicted by the Heisenberg-Hund theory on the supposition that only one 2_2 electron is excited. It therefore seems probable that the extreme ultra-violet lines are emitted by a fluorine atom which has been ionised one or more times.

HERBERT DINGLE.
Imperial College of Science and Technology,
South Kensington, S.W.7, Dec. 6.

Rate of Work done by Athletes.

IN an article by Dr. J. S. Haldane and Dr. Y. Henderson in NATURE of August 28, p. 309, are references to the rate at which a man in good physical training can do work. For example, in a mile and a quarter rowing race the rate was 0·57 horse-power; and again, Douglas and Haldane, for short bursts of climbing, reached a rate of 0·9 horse-power.

It occurred to us that these rates might be exceeded by a runner raising his own weight against gravity when dashing up a flight of stairs with a running start. These experiments were easily carried out with a stop watch, and the rates obtained by a young man aged twenty-five years were, for a height of stairs mounting to 7½ feet, 13 feet, and 125 feet vertically, 1·87, 1·70, and 0·87 horse-power. The last experiment is a severe tax on the heart, and is not one to be recommended.

An interesting question is the efficiency per pound weight of the athlete. This resolves itself into the simple question of the vertical velocity, and in such experiments a man would probably have to take second place to a dog, a cat, or a sparrow. What is the most efficient living creature ?

A. S. EVE.
A. J. FLEMING.
McGill University, Montreal
Nov. 27.