their own way, with such advice or assistance as may be asked for, the problems entrusted to them.

The appointment of a head for each department of science with the powers of a dictator would be the surest means of encouraging mediocrity, and of warning off just that type of original thinker and independent investigator whose services would be of inestimable value to the State. It may be contended that any State scheme, whether concerned with routine duties or original work, must be under some central direction, but there is no reason why the direction should be of such a kind as would be tantamount to asking every researcher to place himself, body and soul, under a dictator.

A. C. SEWARD.

Botany School, Cambridge, February 26.

The Constitution of the Elements.

IN continuation of my letter on the above subject in NATURE of December 18, 1919, several more elements have been subjected to analysis, yielding interesting "mass-spectra."

Argon (atomic weight 39·88 Ramsay, 39·91 Leduc) gives a very strong line exactly at 40, with double charge at 20 and triple charge at $13\frac{1}{3}$. The last line, being closely bracketed by known reference lines at 13 and 14, provides very trustworthy values. At first this was thought to be its only constituent, but further photographs showed an associated faint line at 36. This has not yet been proved an element by double and triple charges, as the probable presence of OH_2 and the certain presence of C prevent this, but other lines of reasoning make it extremely probable that this is a true isotope, the presence of which to the extent of 3 per cent. is enough to account for the fractional atomic weight quoted.

Helium was compared with O++ (8) by a special system of bracketing, and directly with C++ (6) by extrapolation. Both methods give its mass as 4, with an accuracy of 2 or 3 parts in 1000.

By the same methods H_3, H_2, and H_1 all give consistent results for the mass of the hydrogen atom as 1·008 within experimental error, agreeing with the value given by chemical analysis, and, incidentally, confirming the nature of H_3 beyond doubt. *These three lines are the only ones diverging from the whole number rule to a definite and measurable extent.*

Nitrogen is apparently a "pure" element, its doubly charged atom being 7 exactly.

Krypton (atomic weight 82·92) has no fewer than six constituents: 78, 80, 82, 83, 84, and 86. The last five are strong lines most beautifully confirmed by double- and triple-charged clusters, which can be compared with great accuracy against A (40) and CO (28). These reference lines obliterate one of each group, but not the same one. The 78 line has not yet been confirmed in this way owing to its faintness, but there is no reason to doubt its elemental nature. Krypton is the first element giving unmistakable isotopes differing by one unit only.

The partial pressure of xenon (atomic weight 130·2) in the gas used was only sufficient to show its singly charged lines clearly. These appear to follow the whole number rule, and rough provisional values for the five made out may be taken as 128, 130, 131, 133, and 135.

Further examination of the multiply charged mercury clusters indicate the probability of a strong line at 202, a weak component at 204, and a strong band including 197 and 200, unresolvable up to the present.

F. W. ASTON.

Cavendish Laboratory, Cambridge, February 25.

Deflection of Light during a Solar Eclipse.

PROF. ANDERSON has suggested in NATURE that the apparent displacement of stars observed during the solar eclipse may be ascribed to an unusual form of refraction in the terrestrial atmosphere. The discussion which has followed shows some lack of agreement as to the importance of such a refraction effect. I wish to suggest that it might, perhaps, be possible to form an estimate of the magnitude of this effect by making measurements of the apparent diameter of the moon during the eclipse. Star photographs would seem to be somewhat unsuitable, although one diameter of the moon may leave a clear enough trace on the plates (a diameter at right angles to the apparent motion of the moon relative to the stars). It should be possible, however, to obtain sharp silhouette images of the moon on plates devoted to this particular purpose; perhaps such photographs are already available. The nature of the clockwork drive needed is dependent on the necessary exposure, and need not be discussed.

J. A. ORANGE.

MR. ORANGE'S point is, of course, that we should use the one object in the field of which the light has not been through the sun's gravitational field in order to get rid of the Einstein disturbance; also of the suggested refraction by gases near the sun. I have talked the matter over with Mr. C. Davidson, who agrees with me that nothing is to be done with existing photographs in this direction—the exposures were too long, and the moon's limb too ill-defined; but it is possible that in future eclipses short exposures, given specially for the purpose, might yield something of interest. The chief difficulty is that we do not know the moon's dark photographic diameter. It cannot be assumed equal to the bright photographic diameter, for irradiation (and other similar actions) go in the reverse direction.

A. C. D. CROMMELIN.

55 Ulundi Road, Blackheath, S.E.3, February 28.

Perimeter of an Ellipse.

THE following approximate formula for finding the perimeter of a fairly flat ellipse may be found practically useful. Suppose $a=1$, then the length of a quadrant of the ellipse is nearly

$$1+0{\cdot}6b^3,$$

where a is the major, and b the minor, axis. The formula works best from about $b=0{\cdot}2$ to $b=0{\cdot}5$, after which the formula of Boussinesq is more accurate, viz.

$$\frac{\pi}{4}\left\{\tfrac{3}{2}(1+b)-\sqrt{b}\right\}$$

But the formula I give is for practical purposes quite satisfactory up to $b=0{\cdot}6$, the relative error never being large. It does not work if the ellipse is nearly circular. Boussinesq's formula is of no use if the ellipse is flat.

Other more accurate formulæ could be given, but the above has the advantage that it can be calculated very rapidly, and, within the range mentioned, I doubt if higher accuracy is ever required in practice.

R. A. P. ROGERS.

Trinity College, Dublin, February 16.