radio-active changes, it would follow that the energy given out in such changes must be greater in strong gravitational fields than in weak.

F. G. DONNAN.

University College, London, December 10.

A Helium Series in the Extreme Ultra-Violet.

IN NATURE for November 20 Prof. Lyman reports his observation of a helium line at 1640·1, as well as a weak one at 1215·1, close to the strong one 1216, and refers them to orders 3, 4 in the series $4N\{1/2^2 - 1/m^2\}$. If the correct reading for the strong line is nearer the 1215·1, the whole series $m=4$ . . . 8 is found in his list of ultra-violet lines given in the *Astro. Journ.* (vol. xliii., p. 89, 1916). The following is the list of observed lines with deviations (obs. – calc.) from the calculated values, with $N=109720$:—

Order	Intensity	λ	$d\lambda$
3	strong	1640·2	−0·34
4	10	1215·1	−0·11
5	5	1086·1	+1·08
6	4	1026·0	+0·66
7	3	992·0	−0·37
8	1	972·7	+0·59

The line 1084·9 is closer to the calculated with $d\lambda = -0{\cdot}11$, but its intensity of 2 is not in step with the others. In estimating possible errors, those of standards as well as of observation have to be considered. With uncertainties also of formula, the values of $d\lambda$ do not seem excessive.

W. M. HICKS.

Crowhurst, December 11.

The Constitution of the Elements.

IT will doubtless interest readers of NATURE to know that other elements besides neon (see NATURE for November 27, p. 334) have now been analysed in the positive-ray spectrograph with remarkable results. So far oxygen, methane, carbon monoxide, carbon dioxide, neon, hydrochloric acid, and phosgene have been admitted to the bulb, in which, in addition, there are usually present other hydrocarbons (from wax, etc.) and mercury.

Of the elements involved hydrogen has yet to be investigated; carbon and oxygen appear, to use the terms suggested by Paneth, perfectly "pure"; neon, chlorine, and mercury are unquestionably "mixed." Neon, as has been already pointed out, consists of isotopic elements of atomic weights 20 and 22. The mass-spectra obtained when chlorine is present cannot be treated in detail here, but they appear to prove conclusively that this element consists of at least two isotopes of atomic weights 35 and 37. Their elemental nature is confirmed by lines corresponding to double charges at 17·50 and 18·50, and further supported by lines corresponding to two compounds HCl at 36 and 38, and in the case of phosgene to two compounds COCl at 63 and 65. In each of these pairs the line corresponding to the smaller mass has three or four times the greater intensity.

Mercury, the parabola of which was used as a standard of mass in the earlier experiments, now proves to be a mixture of at least three or four isotopes grouped in the region corresponding to 200. Several, if not all, of these are capable of carrying three, four, five, or even more charges. Accurate values of their atomic weights cannot yet be given.

A fact of the greatest theoretical interest appears to underlie these results, namely, that of more than forty different values of atomic and molecular mass so far measured, all, without a single exception, fall on whole numbers, carbon and oxygen being taken as 12 and 16 exactly, and due allowance being made for multiple charges.

Should this integer relation prove general, it should do much to elucidate the ultimate structure of matter. On the other hand, it seems likely to make a satisfactory distinction between the different atomic and molecular particles which may give rise to the same line on a mass-spectrum a matter of considerable difficulty.

F. W. ASTON.

Cavendish Laboratory, December 6.

The Deflection of Light during a Solar Eclipse.

THE fall of temperature that may occur in the higher strata of the atmosphere during an eclipse is somewhat doubtful, but can scarcely exceed half a degree. An attempt was made to measure it directly during the partial, but nearly total, eclipse in England on April 17, 1912, but of the instruments sent up one only was recovered, so that no comparison could be made.

On the average, the solar heat absorbed by the earth's surface and the atmosphere during one day is capable of raising the whole atmosphere about 1·5° C., and, of course, about the same amount must be lost per day by radiation. There is direct evidence that the daily change of temperature as we know it at the surface does not extend to more than 1 km. or 2 km., and from 2 km. to 20 km. the daily range can scarcely reach 1° C. In these circumstances the fall of temperature of the upper strata during an eclipse must be small, say $\frac{1}{4}$° or $\frac{1}{2}$° at the outside.

Our direct observations of atmospheric temperature very seldom exceed 20 km., and above that height we know neither the value nor the changes to which it is subject. This is perhaps of little consequence since at 20 km. more than 94 per cent. of the whole mass has been passed.

It must also be remembered that the line of lowest temperature will not be the axis of the shadow-cone, but will lag considerably behind it.

W. H. DINES.

Benson Observatory, Wallingford.

THE correction to the Einstein effect indicated by Mr. W. H. Dines's estimate of the depression of temperature in the eclipse shadow is even less than 10^{-11} radians or 10^{-6} seconds of arc. For a vertical ray the deflection caused by a horizontal temperature-gradient of $d\theta$° C. in dx cm. is approximately

$$(\mu - 1)_G \cdot H \cdot \frac{d \log_e \theta}{dx},$$

where $(\mu - 1)_G = 28 \times 10^{-5}$ is the refractivity of air at normal density, and H is the height of the homogeneous atmosphere. For two rays at a mean distance in the atmosphere of a kilometre apart—a liberal estimate—the difference in deflection would be in c.g.s. units

$$28 \times 10^{-5} \times H \times 10^{5} \cdot d^2 \log \theta / dx^2.$$

If the shadow may be considered to have a radius of 500 km., then $d^2 \log \theta/dx^2$ would be of the order of 10^{-18}. From this the initial statement follows.

That is, assuming $\partial H/\partial x = 0$. But more simply conveniently, and accurately the bending of a vertical ray can be expressed in terms of the surface pressure-gradient because the refractivity is simply proportional to the density. So that five barometers, one at the eclipse station and four distributed around it, would yield the corrections for a single ray. The bending