

## LETTERS TO THE EDITOR.

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## Refractivities of the Elements.

IN NATURE for October 16 I drew attention to the relation which exists between the refractivities of the inert gases of the atmosphere and that of hydrogen. Further comparison with the values obtained for other elements shows that the occurrence of simple ratios between the refractivities of allied elements is so frequent as to reduce greatly the possibility that they may be due to chance.

Thus, in the table previously published, there was a gap between krypton and xenon to be filled by an element the refractivity of which should be four times that of hydrogen. This condition is exactly fulfilled by mercury, the vapour of which is also monatomic. The refractivities of chlorine, bromine and iodine are almost exactly in the ratio of 2, 3, and 5, corresponding to those of argon, krypton and xenon; and it is remarkable that the latter trio occupy places in the periodic table which are adjacent to those of the former trio respectively. I cannot find that the value of the refractivity of fluorine has yet been directly determined; but, if there is any law connecting these figures, it should probably bear the same relation to that of chlorine which the refractivity of neon bears to that of argon, *i.e.*  $\frac{2}{3}$ . It should, therefore, be equal to  $1.4^{\frac{2}{3}} = 0.192$  ( $H = 0.139$ ).

Again, making allowance for the density of sulphur vapour (96), the refractivity of sulphur is to that of oxygen as 2 is to 1.

The following are the figures:—

Element.	Refractivity (Air=1.)	Refractivity (H=0.139).	Ratio to H.	Error per cent.
Helium <sup>1</sup> ...	0.1238		$\frac{1}{4}$	-4.4
Neon <sup>1</sup> ...	0.2345		$\frac{1}{2}$	+0.9
Hydrogen <sup>1</sup> ...	0.4733		1	
Argon <sup>1</sup> ...	0.968		2	-2.2
Krypton <sup>1</sup> ...	1.450		3	-2
Mercury <sup>2</sup> ...	1.893	0.556	4	0
Xenon <sup>1</sup> ...	2.364		5	+0.1
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			Ratios to Cl=2	
Chlorine <sup>3</sup> ...		0.768	2	
Bromine <sup>4</sup> ...		1.125	3	-2.4
Iodine <sup>4</sup> ...		1.920 Violet 2.050 Red	5	0
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			(Ratio to O=1)	
Oxygen <sup>3</sup> ...		0.270	1	
Sulphur $\times 3$ <sup>2</sup>		1.629	2	+0.6
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Nitrogen <sup>3</sup> ...		0.297		
Phosphorus <sup>2</sup> ...		1.364		
Arsenic <sup>2</sup> ...		1.114		

The values for Hg, S, P and As were published by Le Roux in 1861 and do not appear to have been verified since. At least, no other determinations are published either by Dufet or by Landolt and Börnstein. Iodine shows anomalous dispersion, and the choice of the value 1.920, which represents the refractive index of the least refracted rays, is arbitrary.

The values for N, P and As do not fit into the scheme, and a redetermination of them would be interesting.

CLIVE CUTHBERTSON.

9 York Terrace, N.W., November 3.

<sup>1</sup> Ramsay and Travers, *Phil. Trans.*, cxvii., A. 1901.

<sup>2</sup> Le Roux, *Ann. Ch. et de Ph.*, lxi., p. 385, 1861.

<sup>3</sup> Mascart, from Dufet, "Recueil des Données numériques," i., p. 75.

<sup>4</sup> Hurion, *Ann. de l'Ecole Normale, sup.* (2<sup>e</sup> série), t. vi., p. 380, 1877.

## Artificial Mineral Waters.

I THANK you for your kindly notice of my little book in your issue of October 16 (vol. lxxvi. p. 602), and I am quite content to leave your reviewer's remarks concerning its blemishes to the judgment of your readers with the one exception of that dealing with the precautions for preventing the contamination of the carbonic acid gas with ammonia. If your reviewer will call to mind the fact that in the generating vessel there is a mixture with an alkaline reaction until the charge is exhausted, he will not consider it as so very astonishing that ammonia may pass into the gas holder. At all events, manufacturers of mineral waters have suffered too much in time past from the presence of gaseous impurities in the carbonic acid gas to permit them to allow the smallest trace of such impurities to contaminate the waters. The conditions of manufacture are such as not to warrant the expectation that either the alkali or the acid in the generator will suffice to hold back traces of either acid or alkaline gases.

WILLIAM KIRKBY.

I UNDERSTAND that Mr. Kirkby objects to the statement I made, in my recent review of his book on "The Evolution of Artificial Mineral Waters," to the effect that precautions to avoid the contamination of the carbonic acid gas with ammonia derived from such traces of ammonium salts as might exist in the sodium bicarbonate employed were unnecessary. In reference to this I would point out that sodium bicarbonate does not decompose ammonium salts under the conditions in question, and that any tendency to become converted into the normal carbonate owing to rise of temperature is effectually checked by the constant production of carbonic acid gas in the liquid in the generator. This is what I meant by saying that the acid used constitutes a sufficient precaution, and if Mr. Kirkby will try the experiment, as I have done, he will find that no trace of ammonia passes from the generating vessel. That manufacturers of foods and beverages should take every possible precaution to avoid the contamination of their products is, of course, highly desirable, but any precautions specially taken for the purpose of avoiding the presence of this particular impurity are, I still maintain, quite unnecessary.

THE REVIEWER.

## Light-Therapeutics.

As a constant reader of your valuable and interesting paper I shall esteem it a favour if any of your scientific correspondents can inform me what is the action of the red rays of light on the hair, and what authority is there for supposing that they have a beneficial effect on the scalp.

In what periodicals, &c., could I find reference to this question?

P. H. BAILY.

Leadenhall House, London, E.C., November 6.

## Waste of Energy from a Moving Electron.

IN my last week's letter, I observe some corrections are required. Equation (11); the depth of the shell should be  $v \lambda \{1 - (u/v) \cos \theta\}$ . Equation (13); insert the factor  $(1 - u^2/v^2)$  on the right side. Equation (14); divide the second term on the right by R.

OLIVER HEAVISIDE.

## BRITISH ASSOCIATION GEOLOGICAL PHOTOGRAPHS.

PROBABLY no instrument—not including the bicycle—has more facilitated the labours of the geologist than the photographic camera, which has for some time past become almost as necessary a part of his outfit as the indispensable hammer. Professional and amateur workers alike carry it, and photographs of geological features do increasingly abound. This was already true in 1888, when the happy idea occurred to Mr. Osmund W. Jeffs of forming a public collection of geological photographs, which should be lodged in some central and readily accessible place. As he rightly pointed out, "photographic records of sections and other geological features . . . are not only invaluable aids to geological instruction, but serve also to preserve for future reference the details of many exposures of strata and other landscape features, which in course of time . . . are in danger of