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.* $\frac{1}{4}$. It should, therefore, be equal to $\frac{1\cdot42}{4}=0\cdot192$ (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='139).	Ratio to H.	Error per cent.
Helium [1] ...	0·1238		$\frac{1}{4}$	−4.4
Neon [1]	0·2345		$\frac{1}{2}$	+0·9
Hydrogen [1] ...	0·4733		1	
Argon [1] ...	0·968		2	−2·2
Krypton [1] ...	1·450		3	−2
Mercury [2] ...	1·893	0·556	4	0
Xenon [1]	2·364		5	+0·1
			Ratios to Cl=2	
Chlorine [3] ...		0·768	2	
Bromine [4] ...		1·125	3	−2·4
Iodine [4] ...		1·920 Violet 2·050 Red	5	0
			(Ratio to O=1)	
Oxygen [3] ...		0·270	1	
Sulphur × 3 [2]		1·629	2	+0·6
Nitrogen [3] ...		0·297		
Phosphorus [2]		1·364		
Arsenic [2] ...		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.

[1] Ramsay and Travers, *Phil. Trans.*, cxcvii., A. 1901.
[2] Le Roux, *Ann. Ch. et de Ph.*, lxi., p. 385, 1861.
[3] Mascart, from Dufet, "Recueil des Données numériques," i., p. 75.
[4] Hurion, *Ann. de l'Ecole Normale, sup.* (2e 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. lxvi. 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 $vdt\{1-(u/v)\cos\theta\}$. 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

becoming obliterated." At Mr. Jeffs's suggestion, a Committee of the British Association was appointed at the Bath meeting, charged with the duty of obtaining geological photographs, which were to be duly preserved, catalogued, dated and described. The Committee commenced its labours by inviting contributions from all British geologists, and its appeal met with a most generous response. Photographs at once began to flow in, and have continued to do so ever since, so that a vast mass of valuable material is now accumulated in the Museum of Geology, Jermyn Street, which was selected as the home of the collection.

The usefulness of the collection has now been largely increased by the action of the Committee in resolving to publish a selected number of its best photographs, and geologists are greatly indebted to the secretary of the Committee, Prof. W. W. Watts, for the admirable manner in which he has carried this resolution into effect. The success of his efforts is witnessed by the first issue, now before us. It comprises twenty-two photographs, contained in a neat portfolio case; each is accompanied by descriptive letterpress, the date when it was taken and the name of the photographer. The descriptions are terse and to the point, as might be expected when it is added that they are all contributed by well-known geologists; among others, we notice the names of Sir Archibald Geikie, Prof. Bonney, Mr. J. E. Marr and Prof. Watts himself. To show how thoughtfully even smaller matters have been attended to, we may point out that a duplicate copy of the letterpress is provided, printed on one side of the paper only and gummed on the other, so that when mounted each photograph may bear its own description secured to it. Further, in addition to the paper prints, which are platinotype and therefore permanent, there is another

FIG. 1.—Carboniferous Limestone resting unconformably on Ludlow Slates; Arco Wood Quarry, west side of Ribblesdale, about four miles north of Settle, Yorkshire. Photographed by Prof. S. H. Reynolds, 1889. The horizontal beds at the base of the Mountain Limestone here rest unconformably on the upturned and denuded edges of the Ludlow Slates. The latter formed a plane of marine denudation which quickly subsided, causing the absence of mechanical sediments. The district furnishes evidence that many thousands of feet of Lower Palæozoic rock were denuded before the deposition of the Carboniferous strata. An inconstant conglomerate, a few feet in thickness, with pebbles of Lower Palæozoic rock in a calcareous matrix, is found in places, but it is absent in the section photographed. The Ludlow beds are seen dipping south at a very high angle. A marked bedding-plane is seen at the south (left) end of the photograph (above the initials S.H.R.). The more prominent planes visible in the photograph, traversing the slates, are cleavage planes, inclined to the north at an angle higher than that of the bedding. The straight face of the limestone is due to dominant joints. The cliff, from the base of the quarry to the sky line, is many scores of feet in height. JOHN E. MARR.

issue in the form of lantern slides, which should prove of great value in the lecture room.

Where all are excellent it is difficult to choose, and the accompanying photographs, which, with the kind permission of their photographers, we select for reproduction on a reduced scale, are no better or worse than the remainder of the series.

The issue is the first of three, the second of which may be expected to appear before the end of the current

FIG. 2.—Widened joints ("grikes") and rain-gullies in Carboniferous Limestone; Hampsfell, near Grange, Lancashire. Photographed by Mr. Godfrey Bingley. The top of Hampsfell, near Grange, presents a weird and desolate aspect. There is no soil, the surface being barren limestone, whereupon but a few stunted bushes contrive to grow. Chemical denudation is at work, every joint and small crack in the limestone is widened, and its edges smoothed off by the solvent action of "carbonated water." The limestone is so pure that little argillaceous matter is left, after solution, to support vegetation, so that instead of the usual soil and grass-covered surface we have an arid corrugated waste, more resembling in appearance the "frozen fury" of a cooled lava-flow than the gentle undulating outlines we are accustomed to associate with weathered surfaces of stratified rocks in these islands. A. S. REID.

year. The price of these photographs is so small that they are sure to be much used in museums, colleges and schools for teaching purposes. The subscription list is nominally closed, but we understand that subscribers will still be admitted on the original terms until the end of November.

In congratulating the Committee of the British Association and its secretary on this admirable piece of work, the hope may be expressed that now the way has been shown, foreign societies, if they have not already done so, may follow suit; the subject is one that might well be brought before the notice of the International Geological Congress at its meeting next year in Vienna.

THE CRUISE OF THE "GAUSS" FROM CAPE TOWN TO KERGUELEN.

THE second part of the joint publication of the Berlin Institutes for Oceanography and Geography contains the official report of the work of the German Antarctic expedition on board the *Gauss* on its outward voyage from Cape Town to Kerguelen. The stay in Cape Town was prolonged in order to caulk the ship, which was leaking considerably though not to a dangerous degree, and to make certain changes in the gear and fittings which experience showed to be desirable. Six members of the crew were landed at their own request or as undesirables, and substitutes for them had to be found, and at the last moment two Norwegian volunteers were also taken on board. Prof. Drygalski acknowledges very warmly the hearty reception given him by the authorities at the Cape, which culminated in a military band playing German airs at the pierhead as the *Gauss* took her departure on November 27, 1901.

A course was set for Kerguelen, and the scientific work *en route* was reduced so as not to cause undue delay; still, the opportunity was taken to make thirteen deep-sea