tion. What I have to dwell on now is, that the absorption or sifting of light by different bodies is very like radiation in its results—that is to say, in some cases we have an absorption which deals equally with every part of the spectrum, and in other cases we have absorption which only picks out a particular part of the spectrum here and there to act upon. But there is one important point to be borne in mind; when dealing with absorption we must always have a continuous spectrum to act upon. If we had a discontinuous spectrum to act upon, the thing would not be at all so clear. Having this continuous spectrum, the problem is, what the action of the different substances on the light will be. Let me give you an instance of general absorption. If we take the continuous spectrum above referred to, and interpose a piece of smoked glass, or better, a piece of neutral-tint glass, you will find that the substance will cut off the light and deaden the spectrum, so to speak, throughout its whole length. This neutral-tinted glass, then, has the faculty evidently of keeping back the light, red, yellow, blue, green, violet, and so on; and is an instance of general absorption. A very dense vapour would furnish us with another similar instance. Now, instead of using the neutral-tint glass, we will introduce a piece of coloured glass, the action of which, instead of being general throughout the spectrum, will be limited to a particular part of it. I have now interposed a piece of red glass, which cuts off nearly all the light except the red; and now I interpose a piece of blue glass, which cuts off everything except the extreme violet. By introducing both these pieces in the beam, the spectrum is entirely obliterated.

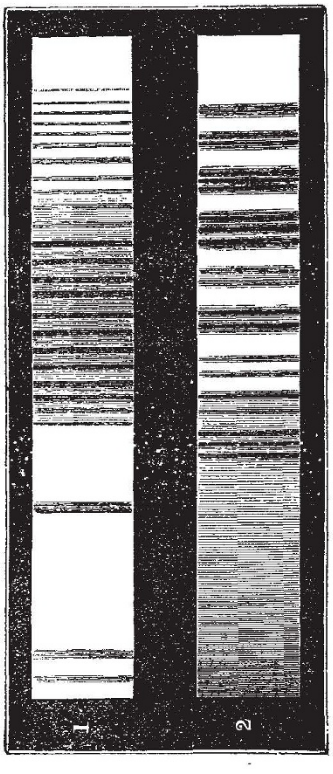

FIG 45.—Absorption spectra of iodine and nitrous fumes.

In these latter cases we have instances, not of general, but of selective absorption, one substance cutting off everything but the red, and the other cutting off everything but the violet. Now the fact that we can absorb any definite part of the spectrum by properly tinted glasses provides us with a practical application of spectrum analysis in the manufacture of the coloured glass used for lighthouses or signals. Further, if astronomers could find a glass of a certain red, or a glass of a certain green colour, we should be able to see the solar prominences every day without a spectroscope.

The first practical application which springs out of these phenomena of absorption is this, that as different substances are known by the effects which they produce on radiation, so also chemists find it perfectly easy to detect different substances by means of their absorption; for instance, the absorption spectrum of nitrous fumes can be shown by taking first our continuous spectrum, which we must always have to start with, and introducing some nitric peroxide between the source of light and the prism. The nitric oxide, immediately it comes in contact with the air, produces dense red fumes, and numbers of fine black lines will be seen immediately crossing the spectrum at right angles to its length, and to a certain extent resembling the solar spectrum with its Fraunhofer lines. Iodine is another substance which gives a coloured vapour, the absorption spectrum of which is very definite and well defined. Fig. 45, Spectrum No. 1, shows the absorption spectrum of iodine vapour, and No. 2 that of nitrous fumes. We are not limited to these substances; we will try something else—blood, for instance, about which I shall have something more to say presently. We shall find that the action of blood upon the light is perfectly distinct from the action of those fumes which we have spoken of; and instead of having typical lines in the green and blue parts of the spectrum, we have two very obvious lines in the more luminous part of the spectrum. The colour of a solution of blood is not unlike the colour of a solution of magenta; but if, instead of using a solution of blood, we use a solution of magenta, we should have only a single black band. The absorption spectrum of potassic permanganate solution is another beautiful instance. We have here something totally unlike anything we had before. Instead of the two dark bands which we saw in the case of the blood, or the single band in the case of magenta, we have four very definite absorption bands in the green part of the spectrum. So that you see the means of research spectrum analysis affords as far as regards radiation, is entirely reproduced in the case of absorption, and it is perfectly easy, by means of the absorption of different vapours and different substances held in solution, to determine not only what the absorbers really are, but to determine the presence of an extremely small quantity. Further, by allowing the light to pass through a greater thickness of the absorbing substance, the absorption lines are thickened and new regions of absorption are observed. This fact was discovered by Dr. Gladstone, who used hollow prisms containing the substance.

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(To be continued.)

PROFESSOR ZOLLNER ON THE CONNECTION BETWEEN COMETS AND METEORS

PROFESSOR F. ZÖLLNER alludes in the commencement of his paper read before the members of the "Kön. Sächs., Gesellschaft der Wissenschaften" to the epoch which Schiaparelli's discovery of the concordance of the orbits of some small comets with those of periodically returning showers of shooting stars has made in the astronomical world. He quotes an instance in proof of this, namely, Biela's Comet. On November 27, last year, the earth was crossing the exact spot in her orbit, which had been cut by Biela's Comet two and a half months before. Observers aware of the coming event were on the alert with their instruments, but no good results were obtained owing to the unfavourableness of the weather.

From these facts, he says, we must naturally conclude that the physical constitution of these bodies is the same, and we are strengthened in our conclusions by Schiaparelli's discovery of the identity of the envelopes and tails of comets with clouds of meteors seen by reflected sunlight, the separate elements of which only become visible at a shorter distance.

Observations, however, with the spectroscope, contradict this assumption; the light given out by comets is found not to correspond with that of the sun; it is a light peculiar to them, like that of a glowing gas.

Further on he quotes Schiaparelli's own words to some length, with respect to the attraction exercised by other bodies on the matter composing the nuclei of comets, which is drawn from them in directions other than that of their orbits. Schiaparelli maintains most distinctly that the tails of comets and meteoric aggregates are not identical.

Professor Zöllner points out that if we are not to suppose that the physical constitution of both phenomena is the same, there only remains their identity of origin as an explanation of the remarkable coincidence of these bodies in space. Pursuing this argument and accepting its veracity, there is no reason to disbelieve the materials of which they are formed, to be the same. Schiaparelli supposes the nuclei of comets to consist of a solid substance, which being subject to a kind of "weathering process," finally becomes broken up into separate pieces, which are turned into a meteoric swarm by the attraction and atmospheric resistance of a large planet. To this effect he again quotes Schiaparelli. Further on he expresses it as his opinion that comets and meteorites are the remains of planets, the former being their fluid and the latter their solid constituents. It must be left to future observers to decide whether the apparent disappearance of Biela's comet has any connection with the rich fall of stars observed on November 27, last year.

It is possible that the vapour left in consequence of the gradual evaporation of a comet would condense, in the absence of any powerful centre of attraction, into a number of separate centres, as a cloud is dissolved into raindrops on the increase of cold. In this way the condensed portions of cometary vapour would present the phenomenon of numerous shooting stars as they penetrate the earth's atmosphere in a solid or perhaps still fluid condition.

PHYSICO-CHEMICAL RESEARCHES ON THE AQUATIC ARTICULATA *

IN NATURE, vol. iv. p. 245, we gave a brief notice of some investigations M. Plateau had been making on the above subject. Since that time he has been continuing his researches in the same direction, and sends us an abstract of the results so far as concerns three problems in the life of aquatic Articulata.

I. Experiments to ascertain the length of time that aquatic insects can remain under water without coming to the surface to breathe.

The swimming aquatic Articulata which breathe air come frequently to the surface to renew their supply. The questions, How long may they with impunity remain submerged? what is their power of resisting asphyxia, as compared with that of terrestrial insects? are answered by the following experiments. At the bottom of an open vessel, of one litre capacity, full of ordinary fresh water, is placed a very small vessel, containing about 200 cubic centimetres. A piece of cotton netting so covers the mouth of the latter, that an insect, placed in the small vessel, is in reality in the general mass of the water, but cannot ascend to the surface. Terrestrial insects placed in these conditions, impelled by their specific lightness, rise to the lower surface of the network; the movements of their legs soon cease, they do not appear to suffer, and they quickly grow torpid. The Coleoptera and aquatic Hemiptera, on the contrary, instead of submitting passively to their fate, endeavour to quit their prison, swim rapidly about, exert themselves to come to the surface, and keep struggling until their strength is enfeebled, and end by lying at the bottom as if dead.

In order to recover from its state of general torpidity an insect which has been submitted to prolonged immersion, it is necessary, after having taken it out of the water, to place it upon absorbing paper. If the time of its immersion has not passed a certain limit, the animal gradually recovers its energy, retaining no sensible trace of the experiment to which it has been submitted. M. Plateau repeated the experiment upon many individuals and for various lengths of time, for the purpose of discovering, in the case of each species, the limit of time beyond which immersion caused the death of the insect. He arrived at two curious conclusions, supported by a great number of trials :—

1. The terrestrial Coleoptera recovered from complete submersion continued for a very long time, in several cases for 96 hours. 2. The aquatic swimming Coleoptera and Hemiptera, far from presenting a greater resistance to asphyxia by submersion than the terrestrial insects, in most cases succumbed very much sooner.

The cause of this unexpected inferiority in the case of the aquatic insects M. Plateau thinks is due exclusively to their greater activity in the water, causing as a consequence a more rapid loss of oxygen.

II. Influence of Cold: Effects of Freezing.

The results of M. Plateau's experiments in this direction are that the aquatic Articulata of the latitudes of Belgium exist for an indefinite period in water maintained at zero (centigrade) by means of melting ice; while they cannot remain alive in ice for any length of time—not for half an hour at the utmost. The latter phenomenon appears to be accounted for by the fact that the insects are completely deprived of all power of motion, thereby losing completely their animal heat.

III. Action of Heat.

Under this head M. Plateau tries to show the maximum temperature of water in which fresh-water Arachnoids can live. He finds that the highest temperature they can endure without injury oscillates between 33°·5 and 46°·2 centigrade. Comparing these results with those which have been obtained by experimenting with animals belonging to other groups, M. Plateau finds that the greatest temperature which aquatic vertebrata, articulata, and molluscs can support probably does not exceed 46° centigrade.

* By M. Felix Plateau.

NOTES

WE have received a communication from Dr. Rein, Director of the Lenckenberg Society of Naturalists at Frankfort, which amusingly illustrates the perils that accompany the honours of the translation into a foreign language of a scientific work. Our informant relates that the well-known publisher, M. R. Oppenheim, of Berlin, having recently obtained the sanction of Mr. Poulett Scrope for the publication of a German translation of his work on "Volcanoes," of which a new issue lately appeared in this country, confided the work of translation to Prof. G. A. von Klöden, who accordingly performed the task. The translation was printed, together with a preface written by M. von Klöden himself—which preface, in the hurry of business, and in reliance, of course, on the good faith of the translator, the publisher forebore from examining. The volume in due course appeared, and was circulated by the publisher; and not till then was it discovered that the preface aforesaid consisted of a severe and indeed bitter critique of the work to which it was prefixed, and of the author's views as therein stated of the theory of volcanic energy, and its external development in the formation of cones and craters, &c. The explanation is that Prof. von Klöden happens—unluckily for the author whose work he undertook to translate—to have been all his life an earnest advocate and teacher of the famous "Erhebungs-Krater," or "upheaval crater" theory of Humboldt and Von Buch, which Mr. Scrope, together with Sir C. Lyell, Constant Prevost, and other geologists have persistently opposed, and are, we believe, generally considered to have satisfactorily refuted. Of course it is open to Prof. von. Klöden to expound and defend his own opinion on this subject to the fullest extent in any independent publication; but it does seem to be stretching the liberty of free expression on