F.R.S., as editor, in the *Quarterly Journal of Microscopical Science* for October, in reference to my studio and agency for the supply of microscopic organisms. Of course I have to thank him most sincerely for calling the attention of naturalists to my efforts, and so strongly calling on them to support me, but he has given me credit in some directions which is due to other naturalists to whom I am under considerable obligations. I wish to correct this view at once by writing to your periodical in preference to waiting till the next number of the *Quarterly* can appear. Prof. Lankester's language may lead those who have not seen other reports to put down the actual first finding of several organisms new to the British fauna to me, whereas several of them were first picked up by others.

The *Leptodora* was found at Olton during a visit made by a party of the Birmingham Natural History and Microscopical Society on July 26. Whilst the president, Mr. Graham, the curators, Messrs. Levick and Lloyd, some other members, and myself, were searching the pool from a boat, Mr. Levick's unusually sharp eyes first called the attention of the others to some lively organism in his bottle, which he at first thought to be a larva, and Mr. Graham was, I believe, the first to suggest that it was probably a larval form of an Entomostracan. After this they were collected in large numbers with the net. As soon as possible I asked my friend Mr. Forrest to make a drawing, which I had printed, and drew up a short account of it for my subscribers, describing it as a larval form of one of the Entomostraca; but before I had finished writing this I found one carrying four large eggs in the second segment of the body, which fact I added to my description, and which I pointed out would lead to the supposition that it was no larva, but a mature animal. I sent the specimens out on August 1, and the earliest notice I had from my subscribers was from Sir John Lubbock, F.R.S., who wrote by return to say he was much interested in the curious crustacean which he believed to be new to this country, and on August 6 Prof. Lankester wrote to say the crustacean I had sent was the *Leptodora hyalina*. In looking over the water in which we had taken the Leptodora, I found another Entomostracan which was new to me, and I called Mr. Forrest's attention to it, and gave him some specimens which he took home and studied, and finding no trace of them in Baird's "Entomostraca," he made a drawing of it and drew up a description of it for the *Midland Naturalist* of September, under the name of *Daphnia bairdii*. With permission of the editor I distributed copies of this plate and description, with living specimens, to my subscribers on August 8, and on the 13th Prof. Lankester wrote me to say "the beautiful *Daphnia bairdii* of Mr. Forrest is the already described *Hyalodaphnia kahlbergensis* of Schödler" (see Mr. Forrest's further remarks, *Mid. Nat.*, November, page 281). In looking over Prof. Lankester's remarks, I was surprised to see his account of the new Protozoon, which reminded me that on April 30 he had written to me saying that the Amœbæ gathering was very interesting, and asking me to send him a good lot more, as he thought he had found something new, but I could only send him a small tube more, as this, together with the large Amœbæ to which he refers, came from a small beaker aquarium in the study of my friend Mr. Levick.

I must apologise for having taken up so much of your space, but in fairness to Mr. Levick and Mr. Forrest, I could not well let the report pass without comment, giving them full credit of first finding the objects; but at the same time I cannot help thinking that the discoveries (if ever published) would have been much longer before they had been brought before the scientific world, had it not been for the distribution of the specimens through my agency. As it is, however, my wish not to take more credit than is due, I shall always be glad to point out the first finders of organisms which may be entrusted to me for distribution, and which may *afterwards* turn out to be of any special interest.

In furtherance of Prof. Lankester's kind appeal to naturalists for the pecuniary support of my agency, I must really ask them to act upon it, as, so far, my studio is not sufficiently remunerative to induce me to persevere with it much longer, as my receipts for the last year have barely covered my office rent, collecting, and incidental expenses.

THOMAS BOLTON

17, Ann Street, Birmingham, November 19

Intellect in Brutes

THE following is a curious instance of discrimination, which I have observed in my bullfinch. He is in the habit of coming out of his cage in my room in the morning. In this room there is a mirror with a marble slab before it, and also a very cleverly-executed water-colour drawing of a hen-bullfinch, life-size. The first thing which my bullfinch does on leaving his cage is to fly to the picture (perching on a vase just below it), and pipe his tune in the most insinuating manner, accompanied with much bowing to the portrait of the hen-bullfinch. After having duly paid his addresses to it, he generally spends some time on the marble slab in front of the looking-glass, but without showing the slightest emotion at the sight of his own reflection, or worthying it with a song. Whether this perfect coolness is due to the fact of the reflection being that of a cock-bird, or whether (since he shows no desire to fight the reflected image) he is perfectly well aware that he only sees himself, it is difficult to say.

SOPHIE FRANKLAND

"Asia Minor" in the "Encyclopædia Britannica"

IN the article on "Asia Minor" in the new edition of the "Encyclopædia Britannica," in speaking of Tchihatcheff's "Asie Mineure," the writer says: "But those [vols.] which should have contained the geology and the archæology have never been published." As this may mislead some of your readers it may be worth recording the fact that the part on geology was published in 1867-69; and the palæontological division in 1866-69.

J. B. B.

Oxford

ON THE SOLUBILITY OF SOLIDS IN GASES[1]

THIS investigation was undertaken in the hope that, by an examination of the conditions of liquid matter up to the "critical" point, sufficient knowledge might be gained to enable us to determine under what particular conditions liquids are dynamically comparable, in order that the microrheometrical method[2] (which the Royal Society has done one of us the honour of publishing in the *Philosophical Transactions*) might be applied to determine their molecular mass and energy relations. It seemed that as the laws relating to gases and liquids merge at what was called by Baron Cagniard de la Tour[3] "l'état particulier," and by Dr. Andrews[4] the "critical point," an examination of matter up to the limit of the liquid state would be likely to yield us much information. The time we have to devote to scientific work being very limited, we found that it was quite impossible to make much advance by using the apparatus devised by Dr. Andrews, as the time required to change from one liquid to another was more than we had at our disposal. We therefore devised a new apparatus, which will be described in a more lengthy communication, but which, we may state, can be opened, the liquid changed, and again closed for a new experiment, in about one minute.

The question as to the state of matter immediately beyond the critical point being considered by Dr. Andrews to be at that time incapable of receiving an answer, we imagined that some insight might be gained into its condition by dissolving in the liquid some solid substance whose fusing point was much above the critical point of the liquid, and noticing whether, on the latter passing its critical point and assuming the gaseous condition, the solid was precipitated or remained in solution. We found that the solid was not deposited but remained in solution, or rather in diffusion, in the atmosphere of vapour, even when the temperature was raised 130° above the critical point, and the gas was considerably expanded. When the side of a tube containing a strong gaseous solution of a solid is approached by a red hot iron, the part next the source of heat becomes coated with a crystalline deposit which slowly redissolves on allowing the local disturbance of temperature to disappear. Rarefaction seems to be the cause of this deposition, because if

[1] By J. B. Hannay, F.R.S.E., F.C.S., and James Hogarth. Read at the Royal Society, November 20.
[2] "On the Michrorheometer," *Phil. Trans* Roy. Soc., 1879.
[3] *Ann. Chim.*, series 2me, xxi. p. 127; xvii. p. 410.
[4] "Bakerian Lecture," *Phil. Trans. Roy. Soc.*, 1869, p. 588.

the temperature be raised equally and the volume retained at its original value, no deposition takes place. Those experiments have been done with such solvents as alcohol (ethyl and methyl), ether, carbon disulphide and tetrachloride, paraffins, and olefines, and such solids as sulphur, chlorides, bromides, and iodides of the metals, and organic substances such as chlorophyll and the aniline dyes. Some solutions show curious reactions at the critical point. Thus ethyl alcohol, or ether, deposits ferric chloride from solution just below the critical point, but re-dissolves it in the gas, when it has been raised 8° or 10° above that temperature.

It appeared to us to be of some importance to examine the spectroscopic appearances of solutions of solids when their liquid menstrua were passing to the gaseous state, but as all the substances we have yet been able to obtain in the two states give banded spectra with nebulous edges, we are only able to state that the substance does not show any appreciable change at the critical point of its solvent. Such was the case with anhydrous chloride of cobalt in absolute alcohol. It was suggested to us by Prof. Stokes that the substance obtained by the decomposition of the green colouring matter of leaves by acids, and which yields a very fine absorption spectrum, might be useful for our purpose. We have prepared the substance according to the careful directions so kindly furnished us by Prof. Stokes, and find that it shows the phenomenon in a marked manner, whether dissolved in alcohol or ether. The compound is easily decomposed by heat under ordinary circumstances, and yet can be dissolved in gaseous menstrua, and raised to a temperature of 350° without suffering any decomposition, showing the same absorption spectrum at that elevated temperature as at 15°.

We considered that it would be most interesting to examine by this method a body such as sodium, which, besides being an element, yields in the gaseous state sharp absorption lines. An opportunity seemed to be afforded by the blue solution of sodium in liquefied ammonia, described by Gore,[1] but we found that, on raising the ammonia above its critical point, the sodium combined with some constituent of the gas, forming a white solid, and yielding a permanent gas, probably hydrogen.

There seems, in some cases, to be a slight shifting of the absorption bands towards the red, as the temperature rises, but we have as yet been able to make no accurate measurements.

When the solid is precipitated by suddenly reducing the pressure, it is crystalline, and may be brought down as a "snow" in the gas, or on the glass as a "frost," but it is always easily redissolved by the gas on increasing the pressure. These phenomena are seen to the best advantage by a solution of potassic iodide in absolute alcohol.

We have, then, the phenomenon of a solid with no measurable gaseous pressure, dissolving in a gas, and not being affected by the passage of its menstruum through the critical point to the liquid state, showing it to be a true case of gaseous solution of a solid.

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ON PHOTOGRAPHING THE SPECTRA OF THE STARS AND PLANETS[2]

FOR many years it has seemed probable that great interest would be attached to photographs of the spectra of the heavenly bodies, because they offer to us conditions of temperature and pressure that cannot be attained by any means known at present on the earth. The especial point of interest is connected with considerations regarding the probable non-elementary nature of the so-called elementary bodies. There has long been a suspicion in the minds of scientific men that one or more truly elementary bodies would be found from which those substances which have not as yet been decomposed are formed. The recent publications of Lockyer have attracted particular attention to this topic.

The most promising laboratory processes for accomplishing the dissociation of our present elements depend upon the action of heat, especially when accompanied by electrical influences, and upon relief of pressure. But the temperature we can employ is far below that found in the stars, which is comparable only with the heat of our sun, and when in addition the application of heat is restricted by the narrow range of circumstances under which we can also reduce the pressure, complete success seems to be impracticable in the laboratory.

But in the stars, nebulæ, and comets, there is a multitude of experiments all ready performed for us with a variety of conditions of just the kind we need. It remains for us to observe and interpret these results, and this is the direction I have sought to pursue.

There is but one mode of investigation that can add materially to the knowledge astronomy has given us of the heavenly bodies that is the spectroscopic. This in its turn is capable of a subdivision into two methods, one by the eye, the other by photography. Each of these has its special advantages and each its defects. The eye sees most easily the middle regions of the spectrum, and can appreciate exceedingly faint spectra; by the aid of micrometers it can map with precision the position of the Fraunhofer lines, and by estimation it can with tolerable accuracy approximate to the relative strength, breadth, and character of these lines. The character of the spectrum lines is, however, of great value for the purposes we are now speaking of, and the greatest precision is needed. Photography, on the other hand, as applied to faint spectra, deals mainly with the more refrangible region, and cannot at present be employed in stellar work below the line F. Fortunately there is no break in the spectrum between the place where the eye leaves off and photography begins, and hence the two methods lend one another mutual assistance. The photograph, when suitably accommodated with a standard reference spectrum from some known source, gives valuable indications as to the positions and all the peculiarities of the lines.

But the application of photography to the taking of stellar spectra is surrounded by obstacles. These are partly due to the small quantity of light to be dealt with, and partly to the fact that it is necessary to overcome the motion of the earth and other causes, such as atmospheric refraction, which seem to make a star change its place continually. The exposures of the sensitive plate require to be sometimes for two hours, even with a large telescope; and if during that time the image of the star at the focus of the telescope has changed place $\frac{1}{300}$ of an inch, the light no longer falls on the slit of the spectroscope. The changes of the earth's atmosphere in regard to photographic transparency, as well as by fog, also offer impediments and promote the chances of failure. There is often a yellow condition of the air, which may increase the length of exposure required forty times or more.

It will from what has been said above, be readily perceived that a research such as this consumes a great deal of time; in fact, these experiments and the preparations for them have extended over more than twelve years. A large telescope is required, and for many reasons the reflector at first seems most suitable. Recently, however, I have found that the refractor has also some special advantages.

In 1866 I had already constructed a silvered glass reflector of $15\frac{1}{2}$ inches aperture, which was commenced in 1858, and had taken with it many hundreds of photographs of the moon. But as the mounting had been

[1] *Proc. Roy. Soc.*, vol. xxi. p. 145.
[2] Read before the National Academy of Sciences, October 28, by Henry Draper, M.D.