NEW VARIABLE STARS.—*Wolsingham Observatory Circular*, No. 42, received from the Rev. T. E. Espin, announces that a red star of Secchi's Type III., magnitude 8·4, was detected at his Observatory on July 14, in R.A. 19h. 52·4m., Decl. 2° 11′ (1900). The star is probably a new variable, and is not in the southern *Durchmusterung*. The star designated Espin 1021 is also probably variable.

THE BRITISH MEDICAL ASSOCIATION.

AS already noted, the sixty-third annual meeting of the British Medical Association will be held in London next week. From the programme of final arrangements published in the current number of the *British Medical Journal*, it is evident that the meeting will be of exceptional interest and importance. The President-elect is Sir J. Russell Reynolds, Bart. An address in Medicine will be delivered by Sir William Broadbent, Bart.; an address in Surgery by Jonathan Hutchinson, F.R.S.; and an address in Physiology by Prof. Edward Albert Schäfer, F.R.S. The scientific business of the meeting will be conducted in fifteen sections:—Numerous papers have been received by each Section, and specific points have been selected for discussion. In the Section of Medicine, presided over by Dr. F. W. Pavy, F.R.S., the following subjects have been selected for discussion: (1) Diphtheria and its treatment by the antitoxin; acute lobar or croupous pneumonia, its etiology, pathology, and treatment; the causes of acute rheumatism and its relation to other affections. The President of the Surgery Section is Sir William MacCormac, who will make some introductory remarks, in which he will refer to the effects produced by modern rifle bullets on the human body. The following subjects have been selected for discussion: The diagnosis and treatment of fractures of the upper third of the femur, including the neck; the surgical treatment of cysts, tumours, and carcinoma of the thyroid gland and accessory thyroids. Sir William Priestley presides over the Section of Obstetrics and Gynæcology. The President of the Section of Public Medicine is Dr. Ernest Hart. The regular business of this Section will commence each day with a formal discussion by gentlemen who have been invited to open the debates. The subjects selected are as follows: Presidential address—Water-borne disease and its prevention; discussions upon the regulation of the slaughter of animals for human food and the inspection of animals before and during slaughter; the insecurity of tenure of extra-Metropolitan Medical Officers of Health under the Public Health Act, 1875. The Section of Psychology has for its President Dr. W. J. Mickle. The President will open the section with an address on the brain. A discussion has been arranged to take place on each day, the subjects being: On the treatment of melancholia; on insanity, in relation to criminal responsibility; on epilepsy, and its relation to insanity. The President of the Physiology Section is Dr. David Ferrier, F.R.S. In this Section a discussion on the mechanics of the cardiac cycle will be introduced by Prof. Haycraft and Dr. D. Paterson; the following will take part—Dr. Noel Paton, Dr. Lauder Brunton, F.R.S., and Dr. Gibson. The Anatomy and Histology Section has for its President Mr. Henry Morris. The following subjects have been selected for discussion: Art in its relation to anatomy; the development and structure of the placenta; the topographical anatomy of the abdomen. The President of the Section of Pathology and Bacteriology is Dr. Samuel Wilks, F.R.S. The work of the Section includes the demonstration of the malaria parasite by Dr. P. Manson, with some facts as to its life-history. There will be a discussion upon this, and upon neuritis; vaccinia and variola; pernicious anæmia; and lymphadenoma. The President of the Section of Ophthalmology is Mr. H. Power. The following discussions have been arranged in this Section: On certain rare cases of recurrent ophthalmia; on the diagnosis of orbital growths; on the question of operating in chronic glaucoma. The Section of Diseases of Children has for its President Mr. John H. Morgan; and the President of the Section of Otology is Sir W. Dalby. The Section of Pharmacology and Therapeutics has for its President Sir William Roberts, F.R.S. In this Section there will be a discussion upon serum-therapeutics, and upon the requirements of the profession with reference to the revision of the *British Pharmacopœia*. Dr. Felix Semon is the President of the Section of Laryngology; and Dr. H. Radcliffe Crocker, of the Dermatology Section. Finally, the ethics of the medical profession has a Section to itself, presided over by Dr. W. F. Cleveland. Only members of the British Medical Association, invited guests, and accredited strangers, will be allowed to attend the general meetings or the meetings of Sections. The reception-rooms will be opened on Monday, July 29, at 12 o'clock noon. The members' reception-room is in the large hall of King's College. A separate reception-room has been provided for invited foreign guests next to the members' reception-room, and another for ladies at the Royal Society's Rooms, Burlington House. The arrangements for the conduct of the work of the Sections, and for the comfort of the members, have been admirably arranged, so there is every promise that the meeting will be a very successful one.

HELIUM, A CONSTITUENT OF CERTAIN MINERALS.[1]

I.

THE gas obtained from the mineral clèveite, of which a preliminary account has been communicated to the Royal Society (*Proceedings*, May 2, 1895), has been the subject of our investigation since the middle of April. Although much still remains to be done, enough information has been gained to make us believe that an account of our experiments, so far as they have gone, will be received with interest.

We have attempted to ascertain, in the first place, from what minerals this gas, showing a yellow line almost, if not quite, identical in wave-length with the line D_3 of the chromospheric spectrum, and to which one of us has provisionally given the name "helium"—a name applied by Profs. Lockyer and Frankland some thirty years ago to a hypothetical solar element, characterised by the yellow line D_3 of wave-length 5875·982 (Rowland). We may state at once that it is not our purpose to attempt to prove this coincidence, but willingly to leave the subject to those who are more practised in such measurements.

We propose therefore, first, to discuss the terrestial sources of this gas; second, to describe experiments on products from several sources; and last, to propound some general views on the nature of this curious substance.

I. *The Sources of Helium.*

It is usual in a memoir of this kind to cite previous work on the subject. It would be foreign to our purpose to discuss observations on the solar spectrum; our memoir deals with terrestrial helium. And we have been able to find only one short note of a few lines on the subject; it is a statement by Signor Palmieri (*Rend. Acc. di Napoli*, xx. 233), that on examining a lava-like product ejected by Vesuvius, he found a soft substance which gave a yellow spectral line of wave-length 587·5; he promised further researches, but, so far as we know, he did not fulfil his promise. He does not give any details as to how he examined the mineral.

An account has already been given in Part I. of Dr. Hillebrand's investigations on the gases occluded by various uraninites which he was so unfortunate as to mistake for nitrogen. Dr. Hillebrand was so kind as to supply us with a fair quantity of the uraninite he employed; and it is satisfactory to be able to confirm his results so far; for it is beyond doubt that the gas evolved from his uraninite by heating it in a vacuum or by boiling with sulphuric acid contains about 10 per cent. of its volume of nitrogen. It is therefore not to be wondered at, that he formed the conclusion that the gas he had was nitrogen; for he obtained some evidence of the formation of nitrous fumes on passing sparks through a mixture of this gas with oxygen; he succeeded in obtaining a weighable amount of ammonium platinichloride from the product of sparking it with hydrogen in presence of hydrochloric acid; and, in addition, he observed a strong nitrogen spectrum in a sample of the gas transferred to a vacuum-tube. Had he operated with clèveite, as will be shown later, he would have in all probability discovered helium (*Bull. U.S. Geological Survey*, lxxviii. 43).

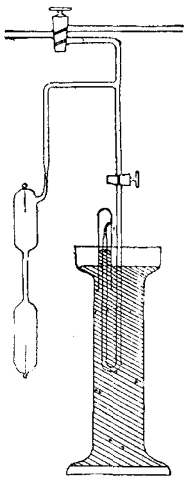
To extract the gas from small quantities of minerals, from 2 to 5 grams of the coarsely powdered substance was heated in a small bulb of combustion-tubing, previously exhausted by a Töppler's pump. As it was found that water and carbon dioxide were often evolved, a soda-lime tube and a tube filled with phosphoric anhydride were often interposed between the bulb

[1] A paper by Prof. William Ramsay, F.R.S., Dr. J. Norman Collie, and Mr. Morris Travers, read before the Chemical Society on June 20.

and the pump. After most of the gas had been evolved, the temperature was raised until the hard-glass bulb began to collapse.

Many of the minerals evolved hydrogen; hence, after the gas had entered the pump, the bulb was completely exhausted, and the gas was sparked with oxygen, no alkali being present. The oxygen was then absorbed with caustic soda and pyrogallic acid, and the gas was transferred to a vacuum-tube. As this process of transference proved very convenient, it is worth while to describe it in full.

The apparatus is shown in the annexed figure. It consists of a tube provided with a perfectly-fitting stop-cock; this tube is connected with a Töppler's pump. The vacuum-tube or tubes to be fitted are sealed to a lateral branch above the stop-cock. The lower part is bent into a sharp **U**, and the end drawn out to a point and sealed. The stop-cock is then turned full on, and the whole tube is completely exhausted, until the vacuum-tube shows brilliant phosphorescence, or, indeed, as often happens, ceases to conduct the discharge; the stop-cock is then closed. A mercury trough is placed below the bend of the tube, and the latter is sunk until the closed end disappears below the mercury. A small tube, which need not contain more than 1 c.c. of the gas to be introduced into the vacuum-tube, is then placed over the closed end of the bent tube, and the mercury trough is lowered. The sealed end is then broken by pressing it against the interior of the gas-tube, when gas enters up to the stop-cock. On carefully opening the stop-cock a trace of gas is passed into the vacuum-tube; this gas is then



pumped out and collected below the delivery tube of the Töppler's pump. One such washing with gas is usually sufficient. The stop-cock is again opened, and a sufficient amount of gas introduced into the vacuum-tube to show the spectrum. The vacuum-tube is then removed by sealing, and the gas still remaining in the bent tube may be transferred to the pump and collected. It is seen that this method permits of the filling of a vacuum-tube absolutely without loss, and it may be added with great expedition.

The results obtained with the minerals examined are given in the following table.

The spectrum of helium is characterised by five very brilliant lines; these occur in the red, the yellow, the blue-green, the blue, and the violet. In every case, except with hjelmite, fergusonite, and xenotime, in which cases the lines were merely seen, all these lines were identified by simultaneous comparison in the same spectroscope with the spectrum of helium from clèveite. With the gas from samarskite and in some other cases a still more careful comparison was made, and the absolute coincidence of every visible line was ascertained.

From many of these minerals, a hydrocarbon was extracted; this was manifested by the non-absorption of the gas by caustic potash until after explosion with oxygen. It would be interesting to ascertain whether the hydrocarbon is present as such in the mineral, or is formed during the heating, for in all cases where a hydrocarbon was evolved, a large quantity of hydrogen was also obtained. If a vacuum-tube be charged with the crude gas, merely deprived of carbon dioxide by caustic alkali, the spectrum consists almost wholly of the fluted bands of carbon.

Name of mineral.	Source.	Result.
Yttrotantalite ...	Rachwane, Ceylon	Hydrogen and helium.
Samarskite	Unknown	A little hydrogen and nitrogen. After sparking with oxygen over caustic soda, 15 grams yielded approximately 4 c.c. of helium. At high pressure (4 mm.) the unsparked gas shows fluted carbon spectrum. At low pressures this is invisible.
Hjelmite	Fahlun, Sweden...	No hydrogen; trace of helium.
Fergusonite ...	Ytterby, Sweden..	Do. do.
Tantalite	Fahlun, Sweden...	Trace of helium.
Pitchblende ...	Cornwall	50 grams yielded about 0·5 c.c. of helium. After fusion with hydrogen potassium sulphate a further very small quantity was obtained.
Pitchblende ...	Unknown	Small quantity of helium.
Polycrase	Hitterö, Norway..	Do. do.
All these minerals contain uranium.		
Monazite.....	N. Carolina.....	Contains hydrogen and helium in fair quantity.
,, ...	Fahlun, Sweden...	Do. do.
,, ...	Bahia	Do. do.
,, ...	Skrotorp, near Moss, Norway...	Do. do.
Xenotime	Brazil	Hydrogen, and, after explosion with oxygen, a trace of helium.
Orangeite	Near Arendal.....	Easily gave a good spectrum of pure helium.
Columbite	N. America	Much hydrogen; no helium.
Perofskite	Magnet Cove, Arkansas	Very little gas; partly hydrogen.
Wazite.....	Sweden	Hardly any gas; trace of hydrogen.
Thorite	Norway	Fair quantity of hydrogen.
Fluocerite	Unknown	Carbon dioxide; glass etched.
Orthite	Hitterö, Norway..	Carbon dioxide and small quantity of hydrogen.
Gadolinite	,, ,,	Carbon dioxide and small quantity of hydrogen.
Euxenite	,, ,,	Do. do.
Cerite	Unknown	90 grams gave 50 c.c. of gas, leaving 1·3 c.c. after explosion with oxygen. After sparking and absorbing oxygen, 0·1 c.c. remained.
Blende.....	Unknown	Not examined.
Rutile	,,	No gas.
Gummite.....	Flat Rock Mine, Mitchell Co., N. Carolina	,,
		No gas, except a trace of carbon dioxide.
Pyrolusite	Unknown	Only oxygen.
Native platinum	Brazil	Trace of oxygen.
,, ,,	Siberia	Trace of oxygen in larger quantity, and trace of nitrogen.

It is here of interest to inquire which constituent of these minerals is effective in retaining helium. For this purpose, it is necessary to know their composition; but it has not been possible to make accurate analyses of all the samples of minerals treated. Hillebrand supposed that the gas was retained by the uranium, and states that its volume varies roughly with the amount of uranium oxides present. To decide the question, it is necessary to consider the composition of these minerals in some detail.

Yttrotantalite is essentially a tantalate of yttrium and calcium, containing a little tungstic acid, and small amounts of iron and uranium. The yield of helium was here small.

Samarskite is a niobate of uranium, iron, and yttria, containing smaller amounts of tungsten, zirconium, and thorium. The amount of uranium oxide is about 11 or 12 per cent.; of thorium oxide about 6, of yttrium 13, and of cerium 3. It yields a moderate amount of helium.

Hjelmite closely resembles tantalite in composition, but contains stannic oxide. The yield of helium was minute.

Fergusonite is a niobate of yttrium and cerium, containing only a small amount of uranium, zirconium, tin, tungsten, &c. The yield of helium was here minute.

Tantalite consists of tantalate of iron and manganese; the helium obtained was a mere trace.

Pitchblende consists mainly of the oxide, U_3O_8. The rare metals are present in English pitchblende in very minute amount. The helium obtained was very minute in quantity, and had a large amount of the mineral not been used it would doubtless have escaped detection.

Polycrase is a niobate of uranium, containing titanium, iron, yttrium, and cerium. The amount of helium obtained from it was small.

These minerals, it will be seen, all contain uranium. To them must be added clèveite and bröggerite, from which by far the best yield was obtained.

Monazite, which gave a good yield of helium, is a phosphate of cerium, lanthanum, and thorium, but does not contain uranium. It might serve, if necessary, as a source of helium, for it is comparatively cheap; it would form a more economical source than either clèveite or bröggerite.

Xenotime is a phosphate of yttrium, and yields a trace of helium.

Orangeite and *Thorite* are silicates of thorium containing small quantities of uranium and lead. The former of these yielded a fair amount of helium, but none could be obtained from a larger quantity of the latter.

From these details, it may be concluded that the helium is retained by minerals consisting of salts of uranium, yttrium, and thorium. Whether its presence is conditioned by the uranium, the yttrium, or the thorium, we are hardly yet in a position to decide. To judge by the Cornish ore, oxide of uranium alone is sufficient to retain it; but that its presence is not absolutely necessary is shown by its existence in monazite and xenotime. The high atomic weights of uranium and thorium, and the low atomic weight of helium suggest some connection; and yet yttrium, which possesses a medium atomic weight, sometimes appears to favour the presence of the gas; for yttrium is present in yttrotantalite, which, however, contains uranium, and in clèveite, in which uranium is present in relatively large amount.

None of the oxides of uranium, when heated in helium and allowed to cool, retains the gas; but similar experiments have not yet been made with oxides of thorium and yttrium, or with a mixture of these with uranium oxide.

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

M. LIARD, Director of higher education in France, has been raised to the rank of Commander in the Legion of Honour.

BY the will of the late Mrs. Fraser, widow of the late Bishop of Manchester, a sum of £3000 is bequeathed to Oriel College, Oxford, for the foundation of a Scholarship.

MR. HENRY HILLS, who was an evening student in the Chemical Department of the Finsbury Technical College, has been elected by the Technical Instruction Committee of Accrington Town Council to the post of Principal and Head Master of the Accrington Municipal Technical Schools, just erected at a cost of £12,000.

AFTER ten years of quiet and unostentatious work in temporary buildings, the authorities of the Cambridge Training College for Women Teachers have been able to erect large and handsome college buildings by means of a grant from the Pfeiffer Bequest and voluntary subscriptions. The new buildings will be formally opened on Saturday, October 19, by the Marquess of Ripon, and other well-known persons interested in education have promised to take part in the proceedings. Practical demonstrations will be arranged to illustrate some of the latest developments of educational method, both in teaching and training, so as to make the occasion one of special interest to those who are taking a share in the development of secondary education in England. The experiment of training teachers under new conditions, and to some extent on new lines, under the shadow of an old University, is of special interest, and the opening ceremony will afford a unique opportunity to those interested in secondary education to learn something of the nature and results of this experiment.

HER MAJESTY'S Commissioners for the Exhibition of 1851 have made the following appointments to science research scholarships for the year 1895, on the recommendation of the authorities of the respective universities and colleges. The scholarships are of the value of £150 a year, and are tenable for two years (subject to a satisfactory report at the end of the first year) in any university at home or abroad, or in some other institution approved of by the Commissioners. The scholars are to devote themselves exclusively to study and research in some branch of science, the extension of which is important to the industries of the country: University of Edinburgh, John D. F. Gilchrist; University of Glasgow, Walter Stewart; University of St. Andrews, Henry C. Williamson; University College, Dundee, James Henderson; Mason College, Birmingham, Robert H. Pickard; University College, Bristol, Samuel R. Milner; University College, Liverpool, John T. Farmer; University College, London, Emily Aston; Owens College, Manchester, William H. Moorby; Durham College of Science, Newcastle-on-Tyne, Alexander L. Mellanby; University College, Nottingham, Martin E. Feilmann; Queen's College, Belfast, William Hanna; M'Gill University, Montreal, Robert O. King; Queen's University, Kingston, Canada, Thomas L. Walker; University of Sydney, John A. Watt; University of New Zealand, Ernest Rutherford.

SCIENTIFIC SERIALS.

American Meteorological Journal, June.—The principal articles are:—The Thermophone, by H. E. Warren and G. C. Whipple. This is an instrument for measuring temperature, particularly of distant or inaccessible places. It was devised by the authors for the purpose of obtaining the temperature of the water at the bottom of a pond, but is also suitable for obtaining the temperature of the soil at various depths. The apparatus resembles Siemen's resistance thermometer, advantage being taken of the fact that different metals have different electrical temperature coefficients. The instrument is not yet self-recording.—California electrical storms, by J. D. Parker. The object of the paper is to inquire into the causes of the infrequency of electrical storms in California. At San Diego, for instance, the Weather Bureau has only reported two electrical storms in the last sixteen years. Among the principal causes, the author mentions the humidity of the atmosphere, the absence of excessive heat during the rainy season (September to May), and the absence of cyclones during the dry season (May to September).

Wiedemann's Annalen der Physik und Chemie, No. 6.—Survey of the present position of energetics, by Georg Helm. The two directions in which the conversion of physics into a science of energy has been most successfully carried out are those of mechanics and of thermodynamics. Two views of energy are at present struggling for supremacy, that which regards energy as a mathematical abstraction, non-existent except in equations, and that which regards energy as a concrete reality, filling space, and migrating continuously from one place to another. One of the chief generalisations of the science of energetics is this: In order that something may happen it is