were originally determined from the other (yttrium tantalate). In fact, it was stated in my former communication that the Baddeleyite of Ceylon is itself associated with such a chemical compound; and I may add that this associated mineral was there designated without the mention of a species-name because it had been found to have a specific gravity (4·9) far below the inferior limit (5·5) hitherto observed in the case of undoubted Yttrotantalite: it was intended to determine later whether or not the lowness of the specific gravity was accompanied by a difference in the proportion of the chemical constituents; further, the similarity of aspect of the zirconia and yttrium tantalate of Ceylon is such that a confusion of the two would be easy. In this way the discrepancy of the chemical results and the complete accuracy of the observations of Dr. Hussak, whose reputation stands so high in the annals of mineralogical science, would be found consistent with each other.

There remains the inconvenience that two names have been suggested for the same mineral; but according to the rules of nomenclature formulated by Dana (rule 13*d*) the name of *Baddeleyite* has the prior claim. I may add that the name *Brazilite* was in use eight years ago, commercially at least, for the specification of an oil-bearing rock found in the neighbourhood of Bahia. L. FLETCHER.

GAS POWER FOR ELECTRIC LIGHTING.

AT the ordinary meeting of the Institution of Civil Engineers on Tuesday, January 10, an interesting paper on "Gas-Power for Electric Lighting" was read by Mr. J. Emerson Dowson. The author stated that in Great Britain alone gas-engines had been sold for electric lighting, exceeding in the aggregate 7000 horse-power, and that in Germany engines were used for about 1100 arc- and 90,000 glow-lamps. It was, however, only within the last few years that gas-engines of large size had been before the world in a practical form. The varying load-factor in central stations was a serious trouble, and the author hoped to show that much of the present loss, due to fuel, water, and wages, would be avoided if gas-power were used instead of steam-power.

Special reference was made to the central-station at Dessau, belonging to the German Continental Gas Company. That station was opened in 1886 with two 60 horse-power, one 30 horse-power, and one 8 horse-power (effective) engines, worked with town-gas, and all the dynamos were driven by belting and counter-shafts. In 1891 considerable alterations were made. One 60 horse-power engine, with its belting and counter-shaft, was retained, and one of 120 horse-power introduced, coupled direct to its dynamo. The speed of the engine and coupled dynamo was 145 revolutions per minute, and the consumption of town-gas was equal to 39 cubic feet per kilowatt. Formerly, without accumulators, it was thought necessary to adjust the size of the engines to the supply, so that they should always be worked to their full extent. It had, however, been found that a limited supply could more advantageously be furnished entirely from accumulators. In spite of the loss of about 21 per cent. in the accumulators, large engines worked more profitably in parallel than smaller ones supplying direct without accumulators. Since February, 1889, the Municipality of Schwabing, a suburb of Munich, had used an Otto engine worked with Dowson gas for 10 arc- and 300 glow-lamps. The load was variable, but with an average output of 22·5 kilowatts per hour the fuel-consumption was 3·3 lbs. per kilowatt. The town of Morecambe was lighted by nine arc-lamps and glow-lamps, equal to 1600 of eight candle-power each, the dynamos being driven by Stockport gas-engines worked with Dowson gas. With an output of only 1155 kilowatts per week the consumption of fuel was 2·58 lbs., and the cost of the gas, including wages and fuel, was ½d. per kilowatt delivered. At the château of Mr. Say, at Longpont, in the South of France, there were 650 glow-lamps and one arc-lamp, supplied by a dynamo driven by a Crossley engine worked with Dowson gas. The consumption of fuel was 1·2 lb. per indicated horse-power, and 2·7 lbs. per kilowatt per hour.

It was believed that the late Sir William Siemens first drew attention to the fact, that when illuminating-gas was burnt in a gas-engine to drive a dynamo, much more light was produced electrically than could be produced by burning the same quantity of gas in burners in the usual way. Latterly the consumption of gas per horse power in gas-engines had been reduced, and the ratio was at the present time about 20 to 1 in favour of converting the gas into an arc-light, by means of a gas-engine. The author had collected data from various sources, as to the consumption of ordinary town-gas by engines supplying electric light with and without accumulators. The average of all the returns, with engines under varying loads and without accumulators, was about 47 cubic feet per kilowatt-hour; when accumulators were used, the consumption of gas was less, because the engines then worked under a full load. With 47 cubic feet per kilowatt, and 55 watts per 16 candle-power, one light of that power required only 2·6 cubic feet per hour; whereas a standard Argand burner required 5 cubic feet per hour. In this comparison, it was assumed that the glow-lamps and gas-burners were in good order, but under ordinary working conditions they did not maintain so high a duty.

The question of load-factor was a serious one with any type of engine, but with gas-engines the loss was much less than with steam-engines. When a gas-engine was stopped, its consumption of fuel stopped also, and there was no furnace to maintain, nor was there any water to boil at starting. At the same time, it was desirable that the gas-engine should be worked as much as possible under a full load, and in this respect the experience at Dessau was generally confirmed. A central-station was worked under trying conditions, and in the London district there was only a full output of current during from three to five hours in every twenty-four; moreover, about 60 per cent. of the total output was required during that short period. In practice, this meant that in a station where the current was supplied without accumulators, the engines were run at a reduced speed during a portion of the time, and at other times some of them were stopped altogether; but all had to be ready to work in the evening, and occasionally in the day-time, when there was fog. Generally, it might be assumed that the average consumption was more than 6 pounds per kilowatt where accumulators were used, and about 9 to 12 pounds where they were not used. In any case, with the best possible arrangement of steam-power, there must be a large amount of fuel consumed which did no useful work; for, even if some of the fires were drawn, they had to be re-lighted, and the large quantity of water which had cooled during the time of standing must be re-heated.

The author believed that the solution of the difficulty was to be found in the use of gas-plant instead of steam-plant. With a large gas-engine, one brake horse-power per hour could be obtained with a consumption of about 1 lb. of anthracite, or 1⅓ lb. of coke; whereas the consumption of coal with the steam-engines used for central-stations, must be taken at about 2½ lbs. per brake horse-power, when working under a full load. A saving of not less than 50 per cent. could therefore be effected in stations where the engines were fully loaded; and where there were great fluctuations in the output, the loss of fuel with boilers not used, or only partly used, could be almost entirely avoided. For a maximum of 400 kilowatts, there would be three gas-generators, each capable of supplying one-third of the maximum required. The production of gas could be raised or lowered in several ways, and the working of each generator could be stopped immediately by shutting off its steam supply. Supposing, therefore, that all three generators were working at their maximum rate, and a gradual reduction was required, this could easily be effected; and when the production of one or two generators could be dispensed with their operation was at once stopped. The third generator could then be kept at work, and its production adjusted to suit the minimum consumption required. A gas-generator had a small grate-area compared with that of a boiler, and much less cooling-surface; it contained no water, and required no chimney-draught. A generator of the size referred to lost only 6 to 8 lbs. per hour whilst standing. If an average of only 40 per cent. of the maximum power were required for twenty-one hours, it was equivalent to letting two of the generators stand for that period; and at 8 lbs. each per hour that meant a total loss of only 3 cwts.; compared with the much greater waste when steam-power was used. As the use of large engines, driven with generator gas, was of recent date, the author proceeded to describe the gas-plant used, and gave the results of engines working regularly with Dowson gas, under the usual conditions obtaining in factories. He also gave the results of brake-tests made with several engines of large size, and reproduced indicator diagrams taken from engines of different makers. Although admirable results had undoubtedly been obtained from engines working with the Otto cycle, he was of opinion, that, with engines of large size, the results would be still better if the cycle were altered, especially when generator-gas was used. His reasons for this were fully stated in the paper.

The following was a summary of the points urged by the author:—

1.—When town-gas was used for driving the engines of an electrical station, the consumption was about 50 per cent. less than the volume of gas required to give the same amount of light by ordinary burners.

2.—When town-gas was used, neither boiler nor firemen were required, and there were no ashes to remove; less space was needed; no accumulators were required, except such as might be necessary to equalize the load of the engines and to provide for a small amount of storage. The engines could be worked in the most crowded districts, close to where the lights were required, and where boilers were not allowed.

3.—When generator-gas was used, the consumption of fuel under a full load would be at least 50 per cent. less than with steam-power, and the loss due to steam-boilers not being fully worked could be almost entirely avoided.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—We regret to hear that Professor Cayley has been suffering from serious illness, and that he is in consequence unable to give this term his advertised course of lectures in Pure Mathematics.

L. Cobbett, M.A., M.B., of Trinity College, has been appointed Demonstrator of Pathology in the place of Dr. E. Lloyd Jones, who has resigned the office.

Mr. F. Darwin, Deputy Professor of Botany, announces a special course of lectures in the Chemical Physiology of Plants, to be given by Mr. Acton, of St. John's College, on Tuesdays in the present Lent Term.

Mr. J. Y. Buchanan, F.R.S., announces a second course of lectures in Geography, to be given in the Easter Term.

Mr. A. E. Shipley has been appointed an additional member of the Special Board for Biology and Geology.

SCIENTIFIC SERIALS.

Journal of the Royal Agricultural Society of England, 3rd series, vol. iii. pt. 4.—Cottage sanitation (illustrated), by H. McLean Wilson, a paper prepared under the supervision of Dr. Spottiswoode Cameron and T. Pridgin Teale, F.R.S. It contains a discussion of the principal sanitary defects, which are most likely to be found in the houses of agricultural labourers, with valuable suggestions and remedies. The object aimed at is "to put the whole country, and every house in the country, into such a condition that if the epidemic (cholera) should break out it would have no chance of spreading."—Field experiments on the fixation of free nitrogen, by James Mason, gives an account of the enriching of some plots of poor land on the Oxford clay at Eynsham by the growth of two leguminous crops in succession. The two crops chosen were beans and mixed clovers. So far as they go the results are striking. Prior to 1888 the land had never been cultivated or received any manure. Brought into tillage in that year two plots produced 10½ cwts. and 9 cwts. per acre of barley and oats respectively, straw included,—an excessively low return. In the autumn of 1888 the plots were treated with 20 cwts. of basic slag per acre, and the subsoil with the same amount. Beans in the following year yielded an average of 46 bushels and 23 cwts. straw per acre. In 1890 mixed clovers gave a yield of 28 cwts. per acre as the average of the two plots, and in 1891 a crop of three tons clover-hay was obtained. Potatoes were grown upon the plots last year, and gave an average yield of eight tons per acre. Excepting the basic slag, no manure of any kind had ever been applied to the plots. The experiments are being continued and extended.—Wild birds, useful and injurious (illustrated), by C. F. Archibald.—Utilization of straw as food for stock, by Joseph Darby. Showing methods of using chaffed straw as a remedy for the deficient hay crop of last summer, with records of previous experiences under similar circumstances.—Yew poisoning, by Mr. E. P. Squarey, Mr. Charles Whitehead, Mr. W. Carruthers, F.R.S., and Dr. Munro. But few definite conclusions can be arrived at, owing to the conflicting nature of the information available. It appears, however, (1) that both the male and female yews are poisonous; (2) the poisonous alkaloid (or alkaloids) exists chiefly in the leaves and in the seeds; (3) the fleshy part of the fruit is harmless, or nearly so; (4) the amount of poisonous alkaloid in the leaves varies considerably with individual trees, and perhaps with the season of the year. Dr. Munro contributes a review of the chemical work done upon taxine, the only alkaloid in yew which has been investigated; very little is known with certainty about it, either as to its chemical nature or its physiological action. As Dr. Munro suggests, "yew leaves merit *exhaustive* chemical examination."—Besides the official reports, there are several short articles, including one upon the ferments of milk, abridged by Dr. Munro from Prof. H. W. Conn's pamphlet on the subject, issued last summer; also a paper upon the decline of wheat-growing in England, by the editor.

American Journal of Science, January.—The age of the earth, by Clarence King. This paper contains an application of Lord Kelvin's reasoning from probable rates of refrigeration to the determination of the earth's age, aided by Dr. Carl Barus's recent work in geological physics, especially his determination of the latent heat of fusion, specific heats melted and solid, and the volume expansion between the melted and solid state, of the rock diabase. Thermal considerations have shown that with a given initial excess of temperature of the earth over surrounding space, and an assigned value for rock conductivity, it is possible to determine the curve of temperature from the earth's centre to its surface. It appears that for an initial temperature of 2000° C., the initial maximum temperature must still extend uniformly from the centre to within a few hundred miles of the surface for any admissible value of the age. But since the pressures increase steadily as we proceed towards the centre, there must be a point at which their effect outweighs that of the temperature, and the material, though very hot, remains in the solid state. Now on the data supplied by Barus's researches it is possible to state what temperatures are necessary to keep a certain representative species of rock in the fluid state at successive points within the earth. The amount of possible liquid layer is limited by the facts of tidal rigidity, which fix the maximum admissible temperature at 1950° and the age at 24×10^6 years. Lower values are excluded by the gradient of temperature observed on proceeding downwards from the surface. This value, twenty-four million years, agrees fairly well with the age assigned by Helmholtz and Kelvin to the sun. It is also concluded that the earth never was all liquid, that the original liquid layer did not exceed 53 miles, and that the spheroidal shape is due to the plasticity of the lithosphere as manifested under the action of very slowly applied forces.—Tertiary geology of Calvert Cliffs, Maryland, by Gilbert D. Harris.—"Anglesite" associated with boleite, by F. A. Genth.—Preliminary account of the iced-bar base apparatus of the United States Coast and Geodetic Survey, by R. S. Woodward.—Some experiments with an artificial geyser, by J. C. Graham.—Observations of the Andromed meteors of November 23 and 27, 1892, by H. A. Newton.—Preliminary notice of a meteoric stone seen to fall at Bath, South Dakota, by A. E. Foote.—New Cretaceous bird allied to Hesperornis, by O. C. Marsh.—Skull and brain of Claosaurus, by O. C. Marsh.

THE *Botanical Gazette* for October contains an interesting article by Mr. H. L. Russell on the bacterial investigation of the sea and its floor. The author has had the opportunity of carrying on bacteriological observations in sea-water, both from the Bay of Naples and from the coast of Massachusetts. He finds micro-organisms invariably present in sea water, though not in such large numbers as in fresh water, even at a great distance from the shore, and to a depth of 3200 feet; and a larger number in the slime at the bottom than in the water itself. Some marine forms are cosmopolitan, and the bacteria that are so universally present in sea-water and mud seem to be quite peculiar to this habitat.—Mr. E. L. Berthoud describes the mode in which the geographical distribution of some plants has been greatly extended by the agency of the buffalo.—In the number for November Prof. Underwood gives a report of the proceedings of the International Botanical Congress lately held at Genoa.—Mr. G. W. Martin contributes an account of the development of the flower and embryo-sac in *Solidago* and *Aster*.