1906, and Mr. Johnstone's results agree with his previous ones in so far as they show an off-shore migration in the summer and an along-shore movement in the winter. A number of other movements were observed, just as in the North Sea, where individual fish moved long distances, *e.g.* to the east and south coasts of Ireland, but such movements appear to be irregular according to present knowledge.

The same author also gives a valuable contribution on sewage pollution of shell-fish, and in this connection we regret that Prof. Herdman has not been able to give us a report upon the action of copper in connection with the purification of infected shell-fish, of which a preliminary statement appeared last year.

As usual, there is no lack of charts, tables, and illustrations, and the volume certainly shows very well Prof. Herdman's idea as to the association of scientific research and fishery problems.

FRANK BALFOUR BROWNE.

INCANDESCENT ILLUMINANTS.[1]

A LITTLE more than twenty years ago Auer von Welsbach, who was engaged on researches on the rare earths, invented the modern incandescent mantle. His first mantles were made of zirconia and yttrite earth in the proportion to make a normal zirconate. Shortly afterwards he found that the best material has a basis of thoria. Pure thoria, which requires care in its preparation, gives very little light, but if a small percentage of a coloured and permanent oxide, such as ceria, is added, it gives good illumination.

There has been much discussion about the theory of the incandescent mantle. It has been generally assumed that the temperature of a Bunsen burner is too low for a mantle to give the light it does by simple radiation unless it is much hotter than the flame. Unfortunately, the temperature of the flame is generally taken with a thermocouple, and this gives far too low a reading, as the thermocouple never reaches the real temperature of the flame; but, admitting that the temperature of the flame is high, it is still urged that the light given by the thoria with a small percentage of ceria is so great that there is something more than mere thermal radiation. It is said that the ceria acts as a catalytic agent, and that it oscillates between two states of oxidation. Ceria does act somewhat in the same way as platinum; for instance, if a ceria mantle is put on a lighted burner, the burner turned out, and the gas turned on again, the ceria mantle will glow and finally light the gas. It is odd that this is not brought forward by the advocates of the catalysis theory; but the opponents might urge that zirconia will do the same thing, and the zirconia mantle gives very little light. This does not prove that ceria does not increase the rate of combustion, however.

According to the simple radiation theory, the light depends only on the emissivity, or blackness of the mantle, and its temperature. Its temperature must be lower than that of the flame, as it must be robbing the flame of the heat it radiates. In order to give the flame every chance of supplying the heat, the threads of the mantle have to be made very fine, so that the flame can rush through the meshes, and the hot gas should be in brisk movement through the interstices of the mantle. By using a special draught arrangement, known as the intensive system, about twice the light per cubic foot of gas can be obtained. In order to get the highest temperature the emissivity should be low, that is to say, the mantle should be very white; but then, though it would get to a high temperature, it would give very little light. On increasing the emissivity the light will first increase, but this means a lower temperature, so that as the emissivity is increased from white to black the total radiation increases, but as that means a greater abstraction of heat from the flame, the mantle is cooler, and therefore radiates a larger proportion of the energy as heat and a smaller proportion as light, so the mantle gets redder and gives less light. This is just what happens in practice, whether ceria or any other coloured oxide is used.

It has been urged that, as pure ceria is white, adding it cannot make the mantle blacker; but ceria is white only when cold. A mantle may look quite white cold, and be darker in colour when hot. Rubens has devised an experiment to show this. The mantle is strongly illuminated by an arc and condenser, and its image is thrown on the screen. It looks quite white, of course. On lighting the gas, the mantle, instead of becoming still brighter, at once becomes dull. Again, alumina, which is white, gives little light. Chromium oxide is so dark that it gives only a dull red glow. But on adding a little chromium oxide to the alumina, a dark red light is first given, because the chromium oxide is too dark, but as soon as it combines with the alumina to make a light pink mantle a good light is obtained.

The incandescent mantle is now applied, not only to the ordinary Bunsen burner, but to an inverted form, which lends itself to decoration, and to the petroleum lamp. It is now also applied to air carrying a little hydrocarbon gas, and this application is said to provide an extraordinarily cheap light, which is especially useful for country houses.

One of the drawbacks to gas, compared with electric lighting, is that merely turning on does not light gas. This difficulty has been largely overcome by the use of the bye-pass, but further advances have been made. Welsbach has discovered that an alloy of cerium and iron gives off sparks on being scraped or filed, and a burner has been designed in which the act of turning on the gas scrapes a little wheel of this alloy, causing a spark which lights the gas. This overcomes the drawback of having a little jet always burning. Another invention allows the gas to be lighted from a main tap. Each burner has an attachment which lets the gas straight through to the burner when the pressure is on, but on turning the main supply off, and allowing a little gas to pass at the controlling tap, the attachment to each burner turns off the burner and lights a little pilot jet, which keeps alight until light is wanted again. On turning on the main tap the pilot jets light the various burners and go out themselves. By this means burners can be fully lighted up by turning one tap at the door of the room.

The electric incandescent light is undergoing a great change. Carbon is being replaced by metal wires. It has been found possible to make wires of high enough resistance of tungsten, osmium, tantalum, and a few other metals and compounds. The osmium lamp was the first of these, but there was difficulty in making it of high enough resistance. The tantalum lamp is now in great demand. It is made for 100 volts to 130 volts, and is much more efficient than the carbon lamp. It will not last long on alternating currents, however. The wires of a lamp that have been run for some time on a direct current show a curious notched or crinkled appearance under the microscope; but a wire that has been run on an alternating circuit looks as if the metal had been melted into short cylinders with round ends, and these cylinders had stuck together end to end without their centres being in a line. Sometimes the little cylinders are nearly separated, merely touching at a corner. This action is very extraordinary, and has never been explained. In addition to this, when a lamp breaks down on an alternating circuit, the wire sometimes goes at one point and sometimes it breaks in several places, and tangles itself up in an extraordinary way; at other times it breaks up into numerous little pieces, which will be found lying on the inside of the globe. Some of the other lamps show a change under the action of the current, but it is not so marked as in the case of tantalum.

One of the most interesting of the new lamps is the zircon. It is said to be made of zirconium and tungsten, and lamps of this material have been made for 200 volts, a matter of the greatest importance from a distribution point of view. It is possible that the conductor is really a zirconide of tungsten, and this opens up a new series of compounds. A zircon lamp for 100 volts has really six separate loops of wire mounted in series inside a bulb. A recent improvement is to provide an extremely

[1] Abstract of a Discourse delivered at the Royal Institution on Friday, April 26, by Mr. J. Swinburne, F.R.S.

light spring for each loop, so as to keep it taut. The lamp can then be used in any position.

Tungsten seems to be the favourite metal, as it gives a very high efficiency. It is probable the lamp of the future will have an efficiency of nearly a candle per watt, and this is promised by the use of tungsten. At the same time, it must be admitted that to make a wire with a resistance of 500 ohms small enough to give twenty candles with 20 watts is a triumph of inventive skill.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The board of anthropological studies recommends in a report to the Senate (1) that a diploma in anthropology be established; (2) that an advanced student who has studied some branch of anthropology under the direction of the board, and has presented a thesis, which thesis has been approved for a certificate of research, shall, on the payment of such fees as the Senate may from time to time determine, be entitled to a diploma testifying to his competent knowledge of anthropology; (3) that any member of the University having graduated before the date of the establishment of the diploma, who has presented a thesis on some branch of anthropology, which thesis has been approved by the board, shall, on the payment of such fees as the Senate may from time to time determine, be entitled to a diploma testifying to his competent knowledge of anthropology.

The John Winbolt prize for engineering for 1907 has been awarded to J. E. Sears, St. John's College, for his essay "On the Longitudinal Impact of Metal Rods with Rounded Ends."

The special board for biology and geology has nominated Mr. A. E. Shipley the representative of the University on the council of the Marine Biological Association from the annual meeting of the association in 1907 to the annual meeting in 1908.

MANCHESTER.—The provision for study and research in metallurgy has been recently very materially increased. The equipment for metallurgy, as also for the heat treatment and mechanical testing of metals, has been brought up to date. Dr. H. C. H. Carpenter, late of the National Physical Laboratory, was elected professor of metallurgy a short time ago, and Mr. C. A. Edwards (Carnegie scholar of the Iron and Steel Institute) has just been appointed demonstrator and research assistant.

SHEFFIELD.—The University council has appointed Mr. Arthur Holden to the post of assistant lecturer and tutor in mathematics. Mr. Holden, who was a scholar of Queens' College, Cambridge, is at present lecturer in mathematics at St. Mark's College, Chelsea. He will enter upon his new duties next session.

THE plans for the restoration of the main building of the Merchant Venturers' Technical College, Bristol, have now been approved by the Society of Merchant Venturers; they involve very considerable changes in the arrangements of the original building. From the description of the provision to be made in the new building, it appears that the governors are concentrating the work of their college so as to provide a much more extensive equipment for those departments which train civil, mechanical, electrical, and mining engineers, and prepare for the B.Sc. degrees of the University of London in science and engineering. With this end in view, they will discontinue certain portions of the work formerly undertaken by the college.

REPRESENTATIVES of the University of London to the number of nearly a hundred are this week paying a visit to the University of Paris. The party includes Sir Edward Busk (Vice-Chancellor of the University), Sir Philip Magnus (the Parliamentary representative of the University), Sir Arthur Rücker (the Principal), Dr. Pye-Smith (ex-Vice-Chancellor), members of the Senate, Deans of the several faculties, Mr. P. J. Hartog (Academic Registrar), and other guests. On May 21 the visitors assembled in the grand amphitheatre of the Sorbonne under the presidency of M. Briand, Minister of Public Instruction, who with M. Liard, Vice-Rector of the University of Paris, delivered addresses of welcome, and Sir Edward Busk replied. Prof. Alfred Croiset and Prof. Gardner, Dean of the Faculty of Arts of the University of London, also spoke. Afterwards the English visitors were entertained at lunch by the municipality of Paris, and in the afternoon paid a visit to Versailles. A reception in honour of the visitors was given by the British Ambassador in the evening. On May 22 there was an excursion to Chantilly. To-day is to be devoted to an inspection of the various departments and laboratories of the Paris University; in the afternoon a reception will be given in honour of the visitors at the Elysée by the President of the Republic and Mme. Fallières. In the evening the English visitors will be the guests of the University of Paris at dinner at the Sorbonne, when the French Ministers of Public Worship and of Foreign Affairs are expected to be present. The dinner will be followed by a concert in the great hall, and a conversazione in the reception rooms of the Sorbonne. The party will return to London to-morrow.

THE urgent needs of the University of Oxford led to an important meeting being held on May 16 to consider a scheme for raising a fund to meet them. Lord Curzon, Chancellor of the University, presided over a large and distinguished assembly, and in the unavoidable absence of the Lord Chancellor proposed a resolution:—"That a fund be raised entitled the Oxford University Appeal Fund, to meet the needs of the University as set forth in the letter signed by the Chancellor and Vice-Chancellor, which was published in the newspapers on May 2, 1907." Speaking in support of the resolution, Lord Curzon announced that the fund was being started with promises and gifts amounting to 57,000*l.*, which includes 10,000*l.* from Mr. Brassey, 10,000*l.* from Mr. W. W. Astor, 2500*l.* from Mr. W. F. D. Smith, 2000*l.* from Lord Curzon, and five donations of 1000*l.* Following the Chancellor's eloquent appeal, the Chancellor of the Exchequer seconded the resolution (which was eventually carried unanimously), and took the opportunity to point out several directions in which the work of Oxford University needed development to keep the University abreast of modern needs. The Archbishop of Canterbury moved:—"That a body of trustees of not less than nine, nor more than twelve, be appointed for the administration of the fund, composed of one-third resident and two-thirds non-resident members of the University, and that the hebdomadal council be requested by the Chancellor to nominate the University representatives, and that the Chancellor and Vice-Chancellor be authorised to consult with the leading supporters of the movement as to the appointment of non-resident trustees." Lord Milner seconded the resolution, and it was carried. A further resolution was adopted appointing a committee to consider the best means of raising subscriptions to the fund. Though we are of opinion that the provision of adequate funds for our universities is a State duty, we hope that until that duty is recognised by the Government our men of wealth will see to it that the work at Oxford is not hampered by the want of what is really a modest amount when compared with the greatness of the needs of the University.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 14.—"The Purification and Testing of Selenion." By R. **Threlfall**, F.R.S.

The paper deals with the purification and testing of considerable quantities of selenion with the object of investigating the electrical constants of the element in the pure state. It was found that Ekman's and Petterson's method is suitable and satisfactory as a means of purification of selenion from other known elements, with the possible exceptions of mercury, tellurium, and arsenic. The analytical separation of selenion from tellurium was investigated, and it was found that the most satisfactory method is by fractional sublimation of the dioxides. It is shown that a sharp separation can be made by subliming a mixture of the oxides containing one part