THURSDAY, NOVEMBER 15, 1917.

ELECTRICAL ENGINEERING.

(1) *The Theory of the Submarine Telegraph and Telephone Cable.* By Dr. H. W. Malcolm. Pp. xi+565. (London: The *Electrician* Printing and Publishing Co., Ltd., n.d.) Price 18*s.* net.

(2) *Alternating-current Electricity and its Applications to Industry. Second Course.* By W. H. Timbie and Prof. H. H. Higbie. Pp. ix+729. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 13*s.* 6*d.* net.

(1) IN the summer of 1850 a small party of engineers arrived at Dover in order to lay a cable across the Channel. One of them—Willoughby Smith, who was afterwards president of the Institution of Electrical Engineers—has left an interesting record of their adventures. At that period it was considered absolutely unnecessary to test copper wire. All copper wires were supposed to have the same conductivity. The cable was twenty-five miles long, made up of short lengths of wire which purported to be No. 14 Birmingham Wire Gauge, but which varied in diameter. It was covered with gutta-percha, so that the outside diameter was about half an inch. No armouring of any kind was used. The cable was coiled on board the tug *Goliath*, and the party had to wait some weeks for a calm day. The project excited much good-natured ridicule amongst the town folk. A man was found cutting the cable with his knife to show his friends that there was a wire inside. A spectator was heard explaining to interested listeners that it was impossible to pull a cable of this kind 25 yds. long resting at the bottom of the sea. It was, therefore, absolutely impossible to pull one twenty-five miles long. He evidently thought that the function of a cable was similar to that of a bell-pull. On an ideal calm day the pioneers laid the cable from Dover to Grisnez, but they were destined to bitter disappointment. The letters printed by the typewriting instrument at Grisnez were so mixed that the few messages received were quite undecipherable. To make their discomfiture complete, the anchor or the trawl of a fishing-smack cut the cable in two not many hours after it was laid. They were thus prevented from carrying out experiments which would probably have enlightened them considerably on the laws governing the transmission of submarine signals. As it was, they had no conception that their failure was mainly due to ignorance of the laws of electrical capacity and induction.

In 1866, when world-wide interest and enthusiasm were aroused by the laying of the Atlantic cable, one would have anticipated that a book on the theory of the subject would be published, at least in a few years' time. The development of the theory, however, was difficult, and needed laborious investigations by mathematical physicists. Most of the cable companies train their own engineers, giving them an insight into both their technical and commercial activities. Few cable experts, therefore, have sufficient mathematical knowledge to understand the writings of Kelvin, Heaviside, and Pupin, and so there was little demand for a text-book on the subject.

When, however, submarine telephony began to be studied the importance of the labours of Heaviside and Pupin were appreciated. The engineers of the Post Office and of the late National Telephone Company studied the theory enthusiastically and carried out most painstaking work in their research laboratories. They were helped in no small measure by the papers of Kennelly. Fleming, also, by numerous papers and lectures, rendered invaluable help to our telephone engineers. The recent great advances in submarine telephony are due to the recognition by engineers of the importance of the work done by the mathematical physicists. The application of these results to practice, however, was a triumph for which all the engineers concerned deserve the greatest credit.

Let us compare, for instance, the simple order for twenty-five miles of cable given to the Gutta-Percha Company in 1850 with the specification for the sixty-four-mile Howth and Aber Geirch (Ireland and Wales) submarine telephone cable laid in 1913. The specification says that the attenuation constant of the cable must not exceed 0·016 per naut (nautical mile) for sine-shaped waves of frequency 800. Considering that the value of the attenuation constant depends on many factors, this clause proves the confidence of the practical engineer in his ability to gauge the properties of the materials he uses and his faith in theory. Experiment later proved that the actual value of the attenuation constant was 0·015 at the specified frequency. The engineers had few, if any, misgivings that the cable might prove a failure. Once they had determined the physical constants of the cable, they knew from their laboratory experiments that they could calculate the quality of the speech transmitted. The only evidence of lack of faith, perhaps, is that they connected Aber Geirch with Manchester, and Howth with Dublin, by aërial lines of copper having the abnormal weight of 600 lb. per mile. We know that, if the position of the "loading" coils and their sizes had not been calculated by elaborate and lengthy mathematical formulæ, speech between Manchester and Dublin would have been impossible.

At first sight it is not obvious why the theory of the submarine telephone cable should be simpler than that of the submarine telegraph cable. The reason is that speech-sounds can be treated as periodic waves. The microphone transmitter also is admirably adapted for producing these waves, and the telephone receiver is a marvellously sensitive instrument. The working of the receiving apparatus of a submarine cable, however, depends on what electricians call transient phenomena. The mathematical solution is given in a

Fourier series, each term of which has an exponential factor. It is, therefore, much more unmanageable.

If we except Dr. Fleming's introductory textbook, this treatise is the first to give a complete account of the electrical theory of the transmission of signals along a submarine cable. The industrious student, provided he has a good mathematical foundation on which to build, can readily acquire the whole practical theory from this work. He will also find suggestions for improved methods of submarine telegraphy and for improving cables, both of which are very promising subjects for further mathematical and physical research. Hitherto radio-telegraphy has acted largely as a "feeder" for the submarine cable companies. After the war it is unlikely that the radio-telegraphists will be content to play this subsidiary *rôle*. Cable engineers, therefore, are alive to the necessity of making continual improvements in their methods, and a book like Dr. Malcolm's should prove a great help to them.

In the earlier portions of the book a *résumé* is given of the necessary mathematical theorems. The complete solutions are also given of the fundamental equations of transmission, particular stress being laid on the transient phenomena. Perhaps the treatment in this portion of the book is a little too modern. It is very tempting to define the sine and cosine functions by means of series, but to prove that they are periodic functions of 2π is extremely difficult. The author's proof, although ingenious, is not rigorous. The values of the ordinates of the sine and cosine curves are obviously not calculated from the series. The ordinary clumsy geometrical definitions of the hyperbolic sine and cosine might have been omitted with advantage. The negative sign in Formula 44 is inadmissible, but this does not follow from the proof given. The statement that the root with the negative sign is either *less than zero* or negative is rather quaint. On p. 299 we come across a divergent series due to Heaviside, and we are told that it is to be taken as far as its smallest term. As this needs explaining, we turn up Heaviside and find that the only comment he makes on it is that it is lucky that it is divergent. A reference to a book on modern analysis such as Whittaker and Watson's would, in this connection, be a help to the student.

As to the author's nomenclature, definitions, and mathematical methods we have only minor criticisms to offer. The numerous and excellent diagrams illustrating the formulæ are worthy of the highest commendation. The calculation of all the curves shown must have required a great deal of labour. We can heartily recommend the book to cable and telephone engineers and to physical mathematicians desiring subjects for research. The Committee of the Privy Council for Industrial and Scientific Research would, in the reviewer's opinion, be well advised to give grants to encourage mathematical research on some of the problems discussed by Dr. Malcolm.

(2) This book is not written for the designer. It is written, we are told, for the engineer who is responsible for the working of the machinery, and for the purchaser who pays the bills and seeks the profit. The special features of the book are the numerous questions and problems scattered throughout the text and the summaries in large type of the contents of the various chapters. The results given are trustworthy and can be easily understood by readers with very limited mathematical knowledge. Occasionally the authors seem to get a little weary. The appendix, for instance, refers us to p. 54 for a mention of the Tirrill voltage regulator. We are there told that it "is rather a complicated device involving the interaction of solenoids, differential magnets, levers, and contacts which it is not in the province of this book to describe, as no new principles are to be learned thereby." If we insist, however, on knowing about it, we are told to secure the "bulletins and instruction sheets" of the General Electric Company. After saying all this, the principle is described quite satisfactorily.

We wonder what the old-fashioned Cambridge don would have said to this question (p. 150): "How many dollars less per year does it cost to operate a 50 kv.-a., type S transformer (Table A) than a 50 kv.-a., type SA transformer? How many dollars more can we afford to pay for the 'S' than for the 'SA'?" Apart from the wording, it is really a very admirable question, teaching the student how to study a maker's catalogue intelligently. An excellent feature of the book is the stress laid on the distinction between "economy" and "efficiency." The most efficient apparatus is by no means the most economical, as the first cost and maintenance expenses have to be taken into account. This very obvious consideration is often neglected by beginners.

It may be more logical to talk about capacitance than about capacity, but when the word is repeated twenty-two times on one page (p. 376) it gets very monotonous. The authors should have stated that the model to represent the capacity of a transmission line (p. 376) is applicable only when the load is balanced. A. RUSSELL.

THE THYROID GLAND.

The Thyroid Gland in Health and Disease. By Major R. McCarrison, I.M.S. Pp. xvii+286. (London: Baillière, Tindall, and Cox, 1917.) Price 12*s.* 6*d.* net.

IN this well-appointed volume, with excellent illustrations, Major McCarrison has collected much useful information about the thyroid and parathyroid glands in health and disease. The work is of peculiar value in that the author has an intimate experimental and clinical acquaintance with the subject, and this first-hand knowledge has guided him in discriminating between the many and conflicting theories that have been advanced as to the physiological *rôle* of these glands. He is at the same time in a position to advance views of his own of far-reaching importance.

The volume is divided into three parts. About a third of its bulk deals, first, with anatomy and physiology, and, secondly, with the factors which determine the departure of the thyroid and parathyroid glands from the normal. The remaining two-thirds of the volume are devoted to a consideration of the diseases of the thyro-parathyroid glands.

The anatomy and histology of the glands are admirably described, and in no other work can one find so concise and accurate an account of the histological alterations presented by the thyroid in its various degrees of physiological activity. The physiology of the glands, despite the large amount of recent work upon them, is still obscure, and some of the functions ascribed to them by the author do not carry conviction. His statement that "the thyroid gland is to the human body what the draught is to the fire" is a particularly happy one. Further than that it is, perhaps, unsafe to go. The thyroid stimulates metabolism in general, and the growth of certain organs in particular. Hence it follows that secondary results occur in the body from the increased activity of the stimulated organs. There is evidence, indeed, that the thyroid is closely co-ordinated with other ductless glands, and that pathological alterations in its activity upset the normal balance between them. There are also sex differences as yet imperfectly understood. Excess of thyroid, for example, checks the development of the pituitary body in the female, but accelerates it in the male. Further differences in the sexes result from this peculiarity.

Major McCarrison insists upon the great importance of the thyroid in maintaining the health and efficiency of the body at different stages of the life-history of the individual, and shows how its activities are normally influenced. Some of his statements cannot escape criticism. That "married men under forty years of age are, on the whole, of better physique than the unmarried" may be true enough, but that this is "a fact which is probably dependent in considerable measure on the maintenance of thyroidal activity which marriage ensures" is an assumption that it would take much evidence to prove.

The factors which bring about pathological changes in the thyroid Major McCarrison discusses in detail, and this is one of the most valuable sections in the book. The author divides them into three categories—nutritional, infectious, and psychic. Major McCarrison has established beyond doubt that endemic goitre is frequently the result of infection of the alimentary canal by the fæcal contamination of drinking water. The exact organism or organisms responsible have not been isolated, and, indeed, Major McCarrison's observations leave one somewhat confused as to whether the virus is the product of a special organism or of the normal bacteriological flora of the colon. Predisposing factors are of some importance, and their nature is fully considered. In spite of the strong evidence brought forward, one is not quite convinced that Major McCarrison has altogether solved the problem of the causation of endemic goitre. Does the condition occur in all districts where the drinking water is thus contaminated? These must be fairly numerous. On the other hand, goitre may be very prevalent, as it is in a district in New Zealand, where the water supply is entirely derived from deep artesian wells, the water from which is stated to be bacteriologically pure. In that district radium emanations in the water are generally blamed.

The major portion of the volume is an excellent work on the diseases of the thyroids and parathyroids, and as such is a valuable addition to medical literature. Of its many admirable features, that of the treatment of these conditions deserves especial mention. As is to be expected from the views of the author, the promotion of a healthy intestinal condition is of paramount importance in treatment. The author lays stress on the frequency with which Graves's disease is associated with, and presumably caused by, intestinal disorders. He regards the increased activity of the thyroid as a result of toxæmia, and until this is remedied treatment based on diminishing the secretion by medical or surgical means is obviously misapplied.

The volume is full of interesting information, and will be welcomed by physiologists and medical men generally. P. T. HERRING.

OUR BOOKSHELF.

The Use of the Voice. By the Rev. T. Grigg-Smith. Pp. 118. (London: S.P.C.K., 1917.) Price 2*s.* 6*d.* net.

THIS is an admirable little book written by a teacher of experience who realises the importance of careful training in the use of the voice both in singing and in reading. The mechanism of the larynx is described in simple and, so far as possible, in untechnical language, and there is a succinct account of the mechanism of breathing. The author favours the view that the kind of breathing best adapted for the development of a good voice is neither wholly diaphragmatic nor wholly higher costal, but what may be termed general breathing; in other words, all parts of the mechanism of the chest should be brought into play. Very sensible instructions are given as to the use of the resonance cavities on which the quality of the voice largely depends. Graduated exercises on vowel and consonant sounds are highly recommended, and there can be no doubt that, following the good advice given, the best use can be made of the pupil's structures for voice production. We accept the author's view that far too little attention is paid to the education of the voice both in ordinary conversation and in public speaking, and that we have, therefore, often to suffer from mumbling, indistinct utterance, lack of modulation, and incorrect accentuation. Not only should one be trained to express his thoughts when "on his feet," but he should also be able to express them in sounds that give pleasure to those who listen. How very often is

this not the case and we are glad when the speaker sits down. There is an excellent chapter on "stuttering," with many wise suggestions.

J. G. M.

Practical Cheesemaking: A General Guide to the Manufacture of Cheese. By C. W. Walker-Tisdale and Walter E. Woodnutt. Pp. 182. (London: Headley Bros., Ltd., 1917.) Price 4*s.* 6*d.* net.

THIS book deals with the technical side of cheesemaking, and is intended to serve both as a text-book for dairy students and as a reference-book for practical cheesemakers. The subject-matter is well chosen, and whilst the explanations which are given at each stage are clear and simple, there is a great deal of practical information which it has previously been difficult to obtain in print.

Very properly, a considerable amount of space is devoted to the composition of milk and the methods which must be adopted if a milk suitable for cheesemaking is to be obtained. This side of the subject cannot be put forward too strongly, for, unless the cheesemaker can start with a reasonably pure product, no skill on her part can turn it into really first-class cheese.

Full working details of the methods used in analysing milk by the Gerber test and by the lactometer are given, also the usual tests for obtaining information as to the purity of the milk in respect of cleanliness. The nature and preparation of rennet are dealt with, and instructions given for the making of home-made rennet. The chapter treating of starter is a particularly good one, from both the theoretical and the practical points of view.

About half the book is devoted to the practice of cheesemaking, and the preparation and properties of all the best-known British varieties are dealt with in detail. This portion of the book is to be strongly recommended, for the authors' wide practical experience is drawn upon with the best results. The chapter on faults or defects of cheese should also be specially noticed.

LETTERS TO THE EDITOR.

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On an Appearance of Colour Spectra to the Aged.

MAY I suggest that the appearances described by Mr. R. Brudenell Carter in NATURE of November 1 all harmonise with the assumption that their cause is in some way due to diffraction?

The fact of the blue internal band and the red external band, and that the diameter of the colour circle increases in size in approximate ratio to the distance of the light viewed, seems clearly to point to this, no less than the fact that when the pupil is contracted, or when the light is viewed through a pinhole, the appearances vanish, because the actual number of diffracting elements upon which the light impinges would then be too small to give rise to the appearance. The spacing and the number per unit area of the diffracting elements could readily be estimated from the data so clearly given. Whether they take the form of particles or of lacunæ in the humours of the eye, or whether due to some alternating structure of the lens, is a matter on which I am not competent to express any opinion.

It is interesting that Tyndall had a somewhat similar case brought to his notice, to which reference is made in his "Notes on Light" delivered at the Royal Institution in 1869 (Longmans, Green and Co., 1890, p. 54) in the following words:—

"One of the most interesting cases of diffraction by small particles that ever came before me was that of an artist whose vision was disturbed by vividly coloured circles. When he came to me he was in great dread of losing his sight, assigning as a cause of his increased fear that the circles were becoming larger and the colours more vivid. I ascribed the colours to minute particles in the humours of the eye, and encouraged him by the assurance that the increase of size and vividness indicated that the diffracting particles were becoming *smaller*, and that they might finally be altogether absorbed. The prediction was verified."

JULIUS RHEINBERG.

23 The Avenue, Brondesbury Park,
London, N.W.6, November 5.

I AM much obliged to you for permitting me to see Mr. Rheinberg's interesting letter, and am humiliated by the proof of my forgetfulness of the passage from Tyndall, which I must often have read in past years. But, as a pathologist, I incline to my supposition of lenticular inefficiency, perhaps only an excess of that which is universal as life advances, for I do not see how the occurrence of a cloud of particles in the ocular media, in otherwise healthy and perfectly effective organs, is to be explained. Nor is it probable that the cloud, if it existed, would be of similar density in the two eyes, or that it could exist at all without some impairment of sight. In my own case, at least, the colour circles of the two eyes are of equal size and brightness.

R. BRUDENELL CARTER.

76 South Side, Clapham Comman, S.W.4,
November 10.

Paraffin a Scottish Product.

IN Lt.-Commdr. Wimperis's interesting article on "Coal-gas for Motor Traction," which appears in NATURE of November 1, he says:—"Paraffin can be used quite well on slow-moving vehicles . . . but this, again, is not home-produced."

I should like to point out that paraffin is, and always has been, a Scottish product; and it is fortunate indeed for the country that it is so. No doubt Lt.-Commdr. Wimperis is thinking of the similar petroleum products which are imported, but paraffin oil distilled from shale is exclusively a home product. So satisfactory is paraffin oil as an engine fuel that it has been adopted by the Board of Agriculture for Scotland for use by their agricultural tractors on its merits in preference to the foreign product.

H. R. J. CONACHER.

High Holm, Horsewood Road, Bridge of Weir,
November 3.

MR. CONACHER is quite right. I should have said that before the war Scotland was able to produce a very useful, though small, percentage of our home demand for paraffin. What the proportion may be now I do not know.

H. E. WIMPERIS.

November 8.

FERRO-CONCRETE SHIPS.

THE heavy demand for steel and iron for munitions has enforced economy in the use of these materials for other purposes, and led to the substitution of other materials wherever possible. The shortage of shipping and the necessity of making good war losses have produced recently a considerable development in the building of ferro-concrete vessels of a sea-going type, especially in the Scandinavian countries, where the losses have been great and the scarcity of metals has been much felt. Reference has already been made in our Notes columns to articles in *Engineering* giving interesting information as to what has been done in Norway in the building of such vessels, and most of the experience available at present has been obtained in Norwegian yards.

The production of concrete and ferro-concrete vessels such as barges, intended for quiet waters, is by no means novel, but the problem becomes complicated when the vessel is to undertake sea voyages under her own propulsive power. This is principally owing to the uncertainty of the loads imposed on the vessel, especially when in turbulent waters. Of course, the same difficulty occurs in the design of steel vessels, but the strength of these is determined almost entirely by experience, and there is plenty of experience available and embodied in the rules of the various registration societies. Until experience has accumulated of the actual behaviour of ferro-concrete sea-going vessels no rules will be formulated. The leading societies, however, are taking an active interest in the development, and Lloyd's Register has approved of plans up to 500 tons. The maximum weight of vessel projected so far appears to be 1000 tons.

FIG. 1.—Vessel being launched, bottom uppermost.

Concrete is weak under tension, and the reinforcement in ferro-concrete structures is always placed so as to take the tension, leaving the concrete to take the compressive stresses. There is difficulty in doing this throughout the structure of a ship, and lack of effectiveness in this matter may produce cracks, which, in the presence of salt water, may lead to trouble. Strict inspection and overlooking during construction are of much greater importance in all ferro-concrete structures than in buildings of other types. This is owing to the nature of the materials used and to the possibility of the reinforcing bars becoming displaced during the casting and ramming process. The life of the ship will depend probably upon the chemical composition and water-tightness of the concrete, on the proper placing of the reinforcement, and on the effect of salt water upon the concrete and upon the reinforcement if there are cracks.

Ferro-concrete vessels weigh considerably more than steel vessels of corresponding dimensions; hence their cargo-carrying capacity is less. This will probably make it impossible for them to compete against steel vessels in normal times. Owing, however, to the ease with which repetition orders for vessels of the same size can be executed, and to the reduced quantity of steel required in their construction, their production will certainly be useful during the war.

Particulars are given in *Engineering* of several of the vessels already built in Norway. The *Namsenfjords* is 84 ft. long, 24 ft. broad, and 11·6 ft. deep. The hull is monolithic with the deck and frames round the hatches. There are two large wooden fenders outside the hull, and the ship has a Bolinder motor and appliances for prompt loading and discharging. She is well suited for carrying timber, and will be put on a Norwegian coasting route. She passed her trial trip on August 1. Another vessel, ordered by the South Varanger Iron Ore Company, will have double sides and bulkheads, since ore does not take up much space.

The Porsgrund Cement Casting Company took up the question of ferro-concrete vessels in 1913, and built a bridge pontoon in 1915 which is claimed to be the first vessel of this type built in Norway. This vessel was cast with double boarding, or shuttering, in the walls. Experience of this method showed considerable difficulties; the arrangement of the reinforcement gave trouble, and there was no guarantee that the iron would be in proper position. Casting the concrete also was troublesome, and one or two places were found where faults had to be remedied. It was considered that these difficulties with pontoons having fairly rectangular section would become very pronounced in building vessels of ordinary section, and Mr. Harald Alfsen has overcome them by building the vessels' bottom uppermost, and using an inner shutter, or outer boarding only, so far as the vertical sides are concerned. This plan was adopted with the lighter *Beton I.*, interior shuttering only being used. This vessel is a 200-ton deadweight-carrying motor vessel; the calculations and design were prepared by Messrs. Bonde and Norman. As the vessel is intended to be sea-going, the reinforcement was made 50 per cent. heavier than in lighters intended for inland waters, rib and girder dimensions were increased, and a fat concrete mixture of 1 to 2 without cobbles was used. The wall thickness is 1·97 in.

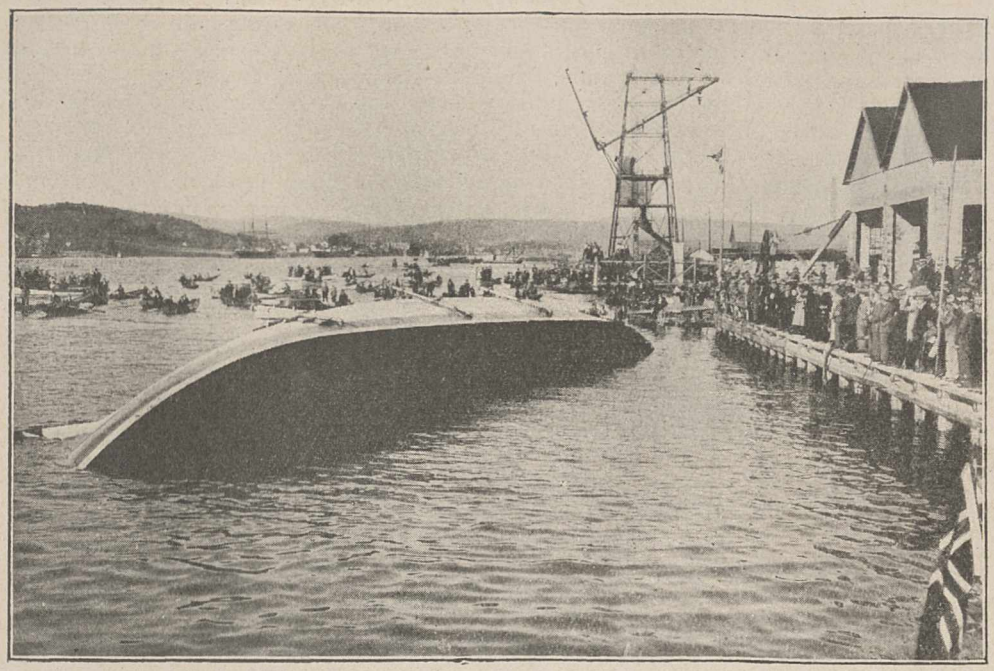

FIG. 2.—Vessel turning over.

The shuttering was built on a sledge, which followed the vessel into the water at the launch. Fig. 1 shows the vessel travelling down the ways, bottom uppermost, as built. On becoming

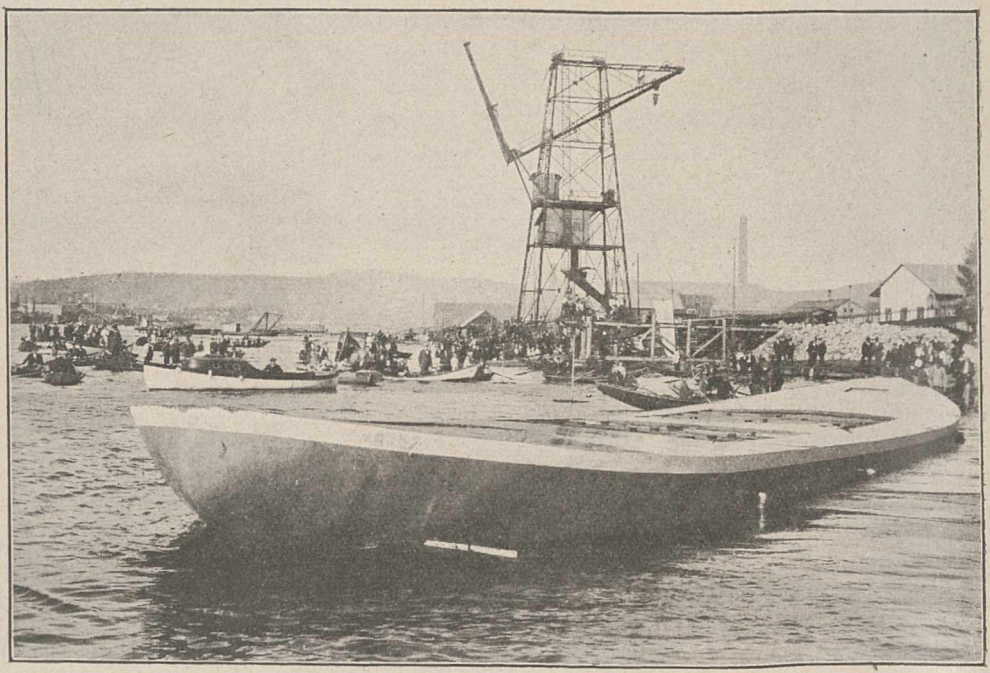

FIG. 3.—Final stage of launching.

fully water-borne the vessel is in stable equilibrium, and the turning right side uppermost is accomplished by permitting the air to escape from the interior; the vessel sinks in the water until a draught is reached for which the equilibrium becomes unstable, and the vessel then turns over without further aid until the deck is uppermost. Fig. 2 shows the vessel with the turning operation about half accomplished, and in Fig. 3 the vessel is seen floating in its ordinary position.

The first vessel took about six weeks to arrange the boarding and reinforcement, and two days to cast; three weeks were allowed for the concrete to set. It is estimated that the next vessel can be done in half the time, since the same shuttering can be used again.

W. DU BOIS DUDDELL, C.B.E., F.R.S.

THE death of William Du Bois Duddell on November 4, at forty-five years of age, leaves a gap in the ranks of our men of science which it will be difficult to fill. His was a rare and precious gift, for he had, in the highest degree, extraordinary patience and scientific instinct. When a problem was set him, however difficult, however insoluble it might appear to be at first, he was never satisfied until he had obtained a solution. It was an inspiration for anyone to have the privilege of helping him in a piece of scientific work. I shall always remember the development of his oscillograph. We were working together on the study of the alternate current arc and were using a laborious "point by point" method for obtaining the curves of current and potential difference. He had set his mind on the production of an instrument that would record the curves instantaneously, and at this problem he worked continuously. He made the first instrument in his workshop at home and brought it along to test; the damping was unsatisfactory, and we set to work to find a method of damping that was efficient. In the end he made a separate channel, with incredibly thin walls, for each strip, and succeeded. It was remarkable that, although the first instrument was designed by eye, the final form of the oscillograph, so far as the vibrator was concerned, did not differ very much in its principal dimensions from the original instrument. Theory enabled the best conditions to be determined, but a full understanding of theory did not lead to a very great improvement. Duddell's instinct as a designer gave the right dimensions from the start. No one who saw it will forget the demonstration that was given by Duddell before the Institution of Electrical Engineers of his instrument, perfect in every detail. There is no doubt that its production marked an epoch in the experimental investigation of alternating current phenomena. If genius is an infinite capacity for taking pains, then Duddell had genius of the very highest kind, for his patience was boundless. His gift as an instrument-maker was hereditary, for he was connected with the great Du Bois family, famous in that home of watchmaking, Switzerland, for its products.

Duddell's rise to the front rank of scientific men was meteoric. Soon after his paper on oscillographs (the first edition of which had been given before the British Association in Toronto) he read a classical paper on the resistance of the electric arc before the Royal Society. It was in the course of this work that he discovered the "singing arc," which formed the starting point in the development of the Poulsen arc, now so largely used in wireless telegraphy, and built the first really high frequency alternator. It was necessary, in order to prove his theory, that a current should be sent through the arc of such a frequency that sensible variations in the temperature of the arc could not be produced by it, so he designed and built an alternator giving 120,000 cycles per second, a frequency which at that time no one had attempted to produce by a mechanical alternator.

Not only was Duddell's gift as an inventor of the highest order; he had also rare skill as an experimenter; his experiments always worked. I can never remember having seen a lecture experiment of his that failed, while his power of talking clearly was a gift possessed by few; he reached, I think, almost the highest point in his career as a lecturer in the demonstration on "Pressure Rises" that he gave when he was elected president of the Institution of Electrical Engineers for the second time. The experiments were nearly all difficult, and liable to go wrong, but they all succeeded, and his model of the oscillating arc was a triumph of demonstration.

Duddell was made a fellow of the Royal Society in 1907, and his was one of the few cases in which election took place at the first time of asking, for he was elected on the first occasion on which his name appeared on the list of prospective new fellows. In 1912 he was awarded the Hughes medal. He was president of the Commission Internationale de Télégraphie sans Fil. In 1907 he was president of the Röntgen Society, and had been hon. treasurer of the Physical Society since 1910. He was a member of the Advisory Council to the Department of Scientific and Industrial Research and of the Board of Inventions and Research of the Admiralty. Last August the honour of Commander of the Order of the British Empire was conferred upon him.

As a chairman of committees Duddell was always excellent, being businesslike and to the point; no time was ever wasted when he was in charge. He was no mean linguist, and those who have seen him conduct an international conference will remember his gifts, and the infinite tact with which he was always able to reconcile the differing points of view and characteristics of men of different nationalities. It is an unspeakable grief to his friends that he has died so young, though few men have ever achieved so much in so short a time; but he worked himself to death. He was always in his laboratory or his office; he scarcely

ever took a holiday. He was at school at Cannes, and at that time the French took less interest in sports and games than they do now, so that he had none of that love for outdoor pursuits which is so characteristic of the average Englishman. He had no enemies, for everyone who knew him liked him for his kindliness and his extraordinary modesty, though, when the occasion arose, he could show great firmness and decision. He will long be remembered as a great man of science and a great gentleman. E. W. MARCHANT.

NOTES.

IN its column entitled "Through German Eyes," the *Times* of November 13 gives prominence to notices appearing in German newspapers of further important steps now being taken to strengthen and consolidate the great dye syndicate, of which the seven largest firms control a capital of nearly 12,000,000*l*. The three largest undertakings in this group, namely, the Höchst colour works, the Badische Anilin- und Soda-Fabrik, and the Bäyer colour factories, are each to increase their capital from 2,700,000*l*. to 4,500,000*l*. These increases of capital, raised by the Rhenish firms themselves, will be supplemented by additional sums to be provided by the German Government, so that the total capital will be more than 20,000,000*l*. The German Press appreciates fully the prominent part played by chemical industry in the war, and attributes largely to this group of factories the extraordinary striking force displayed by Germany on the fields of battle. The intimate relationship between synthetic dyes and high explosives has slowly dawned on the British public, but it is deplorable that even after three years of war the English colour industry is in a position even more disorganised and chaotic than it was at the outbreak of hostilities. A beginning of co-ordination and co-operation in dye production has developed among the Lancashire firms, but the State-aided company which was to have united the colour trade and to have administered the research grant of 120,000*l*. for the benefit of all the manufacturers concerned, so far from effecting these vital improvements, has actually been the direct exciting cause of additional friction and needless internal competition. Now that public appeals are being made for more Government support for this company it is surely time that a non-political, impartial Parliamentary inquiry should be set on foot to ascertain how the earlier grants have been expended, and whether the existing organisation is adequate to meet the competition of a powerful enemy syndicate operating under expert and scientific management.

IN a speech delivered on November 8 the President of the Board of Agriculture again directed public attention to the gravity of the food outlook, and outlined clearly the concatenation of circumstances which render it inevitable that even the establishment of peace cannot bring automatically the proverbially associated plenty. Of special interest was Mr. Prothero's warning that the productive power of the soil of Europe is falling. Not only have large cultivated areas become desolate wastes through the direct ravages of warfare, but even regions remote from the firing line are losing their fertility for want of labour and fertilisers. That is true of Germany; it is also true of areas in this country. Mr. Prothero pointed out that the yield per acre fell in 1916; it has fallen still further in 1917, and, so far as existing areas go, will almost certainly undergo a further decrease. On broad general grounds this prediction is doubtless reasonably probable, but statisticians will scarcely regard the results of the last two seasons as a sufficient basis for such a broad generalisation, especially as these have been years in which natural conditions alone have notoriously been unfavourable to a heavy grain crop. The average yield of wheat per acre in England and Wales this year is estimated at 29·88 bushels, of barley at 30·36 bush., and of oats at 38·49 bush., as compared with 28·60 bush., 31·11 bush., and 39·95 bush. respectively in 1916, and averages of 31·40 bush., 32·44 bush., and 40·03 bush. respectively for the ten years 1907–16. These differences are well within the range of natural variations, and can scarcely be adduced as evidence of specific decline in fertility. It is certain, however, that the increasing foulness of the arable land owing to lack of adequate labour for the necessary cleaning operations must tend towards a reduction of crop. On the other hand, it is equally certain that an extended and more skilful use of fertilisers for corn crops would lead to an appreciable increase of the average yields. An instance in point is furnished by a report on oat manuring experiments recently issued by the West of Scotland Agricultural College, in which it is recorded that on the average of seventeen experiments in three years the oat yield of 41¼ bush. on the unmanured plot was increased fully 30 per cent. by the combined use of superphosphate, kainit, and sulphate of ammonia. The wheat crop offers probably less scope for intensive manuring, but undoubtedly is capable of very substantial improvement on many farms.

IT was remarked in these columns, at the time of the establishment of the Air Board, that more co-ordination was needed between the various branches of the Air Services, and that the Air Board should do much to secure this end. The introduction of the Air Force Bill shows that the Government now intends to make such co-ordination complete by the establishment of an Air Council, which is to enjoy a status similar to that of the Admiralty and the Army Council. The *Times* remarks that this is a landmark in the history not only of aviation in this country, but also of the armed forces of the Crown; for it formally recognises the air as a distinctive fighting element, and provides for the establishment of a third service, to be called the Air Force. Those whose labours lie in the field of scientific aeronautical research will welcome the new *régime* as a step of great importance. A closer connection is very desirable between scientific work and practical aircraft design, and there seems little doubt that this end will be achieved much more rapidly if the present air services are organised as a single force and controlled by one central council. It is, indeed, a triumph for aviation that in only a few years of development it should rise to such importance as to cause the creation of a third Service, and it is pleasing to reflect that scientific research has played a very important part in this rapid development of the new industry.

A RECENT lecture delivered by Major Astor, M.P., on "Health Problems and a State Ministry of Health," at the Royal Institute of Public Health, was the third of a series of lectures and discussions on public health problems under war and after-war conditions. Not unnaturally, on this occasion, the bulk of what the speaker, and those who took part in the discussion, had to say related to the Ministry of Health, and Major Astor, having declared that the Local Government Board, and not the Insurance Commission, would form the best nucleus for a Health Ministry, there was a tendency on the part of other speakers to take sides. Amongst those who showed no inclination to declare in favour of any particular body was Mr. H. A. L. Fisher, President of the Board of Education, who presided over the meeting, and remarked, in the course of his speech, that though, as matters now stood, there was considerable possibility of overlapping, it did not

of necessity follow that the system was bad. Before condemning it he desired first of all to learn whether or not it worked well or ill; whether or not it was economical, and if there was friction. With reference to this question, it may be pointed out that Lord Rhondda has stated that the Board of Education and the Local Government Board have had differences of opinion as to their respective shares in the work of child welfare, but that before he left the latter Board an agreement had been arrived at. Possibly it was because there had been an agreement that Mr. Fisher desired to be non-committal.

THE organisers of the meeting held to take steps to form a representative association of British chemists, held at the Manchester School of Technology on November 10, are to be congratulated on the result of their efforts. Seldom have chemists been brought together in such numbers, at least 500 being present. Much criticism was levelled at the Institute of Chemistry, which has hitherto been held to be too exclusive and not sufficiently representative of the rank and file. In justice to the institute, however, it was recognised by the speakers that it has done a great deal for chemists and has within recent times evinced a disposition, as a war measure, to open its doors to properly trained and qualified chemists on a more liberal basis within the limitations of its constitution. The Provisional Committee of the new association obtained the support of the meeting to the main objects, but it agreed to submit its scheme to the council of the Institute of Chemistry before proceeding to definite incorporation, on the understanding that the institute, which has been established for forty years, should be asked in the first place to adopt its aims. The chairman of the meeting, Dr. Rée, intimated that the Provisional Committees for Manchester and Birmingham have already had an informal conference with the representatives of the institute, and that the latter has expressed its sympathy with the general aims of the proposed association. A great deal depends on what constitutes a chemist, and much will yet depend on the extent of the training and qualifications regarded by the organisers as necessary to justify registration of a candidate under the scheme. The meeting showed no disposition to claim that pharmaceutical chemists, many of whom are held to be sound chemists in the technical and technological sense, should be deprived of their right to the title. The meeting showed a healthy sign of activity among chemists, and it should produce far-reaching results. We trust that the Institute of Chemistry will welcome the opportunity of developing its sphere of usefulness. There is much to be considered and much to be done yet to secure for British chemists the position and recognition to which by their work they are clearly entitled.

THE death is announced, while leading his platoon during one of the recent advances in France, of 2nd Lieut. F. Entwistle, second assistant at the Observatory, Cambridge, aged twenty-one years. Mr. Entwistle was a computer at the Royal Observatory, Greenwich, and he went to Cambridge as second assistant in December, 1914. He was there a few months only before he was given a commission in the Norfolk Regiment as 2nd Lieutenant. Mr. Hartley, first assistant at the Cambridge Observatory, was killed on the *Vanguard* on July 9. The double tragedy exhausts the staff of the observatory, as distinct from the Solar Physics Observatory, except for the director.

MR. F. N. HAWARD, writing from 95 Uxbridge Road, Ealing, W.5, points out that the late Mr. Worthington G. Smith, whose work was referred to in NATURE of November 8, p. 191, was not only a botanist, but had also a world-wide reputation as an antiquarian. "W. G. S. was one of the most practical authorities in matters relating to prehistoric man, of whose implements of flint he made many discoveries of great importance. Besides being the author and illustrator of such a classic as 'Man, the Primeval Savage' (1894), he contributed largely and wisely to the current literature of the subject, and, being an expert engraver, he illustrated many of the works of his contemporaries on various scientific matters."

MR. J. A. HARDCASTLE, whose death on November 10 we much regret to record, was a grandson of Sir John Herschel, and himself a very capable astronomer in the fourth generation of that illustrious race of scientific men. Always a man of delicate health, and obliged in early manhood to winter abroad, he had been able by care and courage to carry through several important pieces of work in the intervals of illness, and the friends who had the privilege of knowing him recognised how considerable a share of the family talent was his. About fourteen years ago he undertook the measurement for the late Mr. S. A. Saunder of a series of lunar negatives from the Paris and Yerkes Observatories, which formed the observational basis of the now classic catalogue of precise positions on the moon's surface. Never, perhaps, in the history of observational astronomy has there been a more striking improvement on previous results than was shown in this work, and Mr. Saunder was always insistent on giving to Mr. Hardcastle a large part of the credit for his remarkable skill and judgment in a difficult task. A second large piece of work that he carried to a successful end was the examination and classification of the nebulæ on the 210 plates of the Franklin-Adams photographic chart of the whole sky, the results of which are published in the Monthly Notices of the Royal Astronomical Society for June, 1914. This has the unique merit that it is the only examination of the nebulæ of the whole sky made with the same instrument and of approximately uniform standard. For a number of years Mr. Hardcastle was a very successful University Extension lecturer in astronomy; he had served as secretary of the British Astronomical Association, and as member of council of the Royal Astronomical Society. A few months ago he was appointed to succeed Dr. Dreyer as director of the Armagh Observatory, and was looking forward with the keenest pleasure to the enjoyment of better health and the responsibilities of an official post, when a return of illness disappointed his hopes, and he died after much suffering at the early age of forty-nine.

THE Royal Geographical Society has sustained a deplorable loss in the death of one of its most active and most valued supporters, Brig.-Gen. Cecil Rawling, C.M.G., one of the gold medallists of the society this year. Many famous names are to be found in the list of soldier-geographers who have made exploration the one great objective of their lives, but there is not one which recalls a personality more inspired with high ideals or better endowed with all those qualities of mind and body which are the necessary outfit for the true explorer than Rawling. His best contributions to geographical science were gathered in Tibetan fields. He was there responsible for the results of an expedition in 1897–98 which added considerably to our knowledge of about 40,000 square miles of that inhospitable country. Such an experience fitted him well for the leadership of a subsequent expedition which was planned, after the Tibetan campaign under Sir F. Younghusband, for the determination of the sources of the Brahmaputra and Indus. Col. Ryder was attached to the expedition as surveyor, and brought back excellent mapping of the wild districts bordering the great Tibetan high road between Gartok and Lhassa, but the success of the expedition was doubtless due to the

remarkable capacity of its leader. Rawling's last expedition, to New Guinea, whilst it was not productive of all the geographical information which was anticipated, was nevertheless a most valuable pioneer exploration into an utterly unknown region, and proved to be of the highest interest to many collateral branches of science which depend on geographical discovery as their preliminary basis. It was fitting perhaps that a right good soldier and a famous explorer should meet his end in the field of a war waged in the interests of all humanity. Like Toppin (of the Peru-Bolivian boundary), who died at Mons, he never lived to reach his highest ideal. That ideal with Rawling was nothing less than the ascent of Everest, and who shall say that a man of his stout heart and magnificent physique would not have accomplished what many men have pronounced to be an impossibility?

THE Royal Society announces that the King has approved of the award by the president and council of the society of a Royal medal to Dr. John Aitken, for his researches on cloudy condensations, and a Royal medal to Dr. Arthur Smith Woodward, for his researches in vertebrate palæontology. The following awards have also been made by the president and council:—The Copley medal to M. Emile Roux, for his services to bacteriology and as a pioneer in serum therapy; the Davy medal to M. Albin Haller, for his researches in the domain of organic chemistry; the Buchanan medal to Sir Almroth Wright, for his contributions to preventive medicine; and the Hughes medal to Prof. C. G. Barkla, for his researches in connection with X-ray radiation.

IT has been decided to dissolve the Société Internationale de Chirurgie, and to form, after the war, a new society on the lines of the former one, but to be called the Société Interalliée de Chirurgie, the membership of which will be open not only to surgeons of the Allied countries, but also to those of neutral countries who shall be nominated for election by the general committee.

AT the annual general meeting of the Cambridge Philosophical Society held on October 29 the following were elected officers of the society for the ensuing session:—*President*, Prof. Marr; *Vice-Presidents*, Prof. Newall, Dr. Doncaster, and Mr. W. H. Mills; *Treasurer*, Prof. Hobson; *Secretaries*, Mr. A. Wood, Mr. G. H. Hardy, and Mr. H. H. Brindley; *New Members of Council*, Sir J. Larmor, Prof. Eddington, and Dr. Marshall.

THE council of the Institution of Civil Engineers has made the following awards for papers published in the Proceedings without discussion during the session 1916–17; A Watt gold medal to Major H. S. B. Whitley (Neath); Telford premiums to W. C. Popplewell (Manchester), H. Carrington (Woodley, Stockport), Dr. A. A. Stoddard (Bournemouth), A. E. L. Chorlton (Lincoln), and B. M. Samuelson (Rangoon); the Manby premium to R. Bleazby (Perth, W.A.); the Webb prize to J. B. Ball (London); and the Howard Quinquennial prize to Dr. W. C. Unwin.

AT the anniversary meeting of the Mineralogical Society, held on November 6, the following were elected officers and ordinary members of council:—*President*, Mr. W. Barlow; *Vice-Presidents*, Prof. H. L. Bowman and Mr. A. Hutchinson; *Treasurer*, Sir William P. Beale, Bart.; *General Secretary*, Dr. G. T. Prior; *Foreign Secretary*, Prof. W. W. Watts; *Editor of the Journal*, Mr. L. J. Spencer; *Ordinary Members of Council*, Mr. T. V. Barker, Mr. G. Barrow, Prof. C. G. Cullis, Mr. F. P. Mennell, Mr. H. Collingridge, Mr. T. Crook, Dr. G. F. Herbert Smith, Dr. H. H. Thomas, Mr. H. F. Collins, Mr. J. P. De Castro, Prof. H. Hilton, and Lieut. Arthur Russell.

THE programme of the one hundred and sixty-fourth session of the Royal Society of Arts, to be opened on Wednesday, November 21, shows that the society is continuing its valuable work for "the advancement, development, and practical application of every department of science in connection with the arts, manufactures, and commerce of this country." At the opening meeting an address will be delivered by Mr. Alan A. Campbell Swinton, chairman of the council, upon "Science and its Functions." At a later meeting the general aspects of the application of science to industry will form the subject of a lecture by Sir Dugald Clerk, and during the session leading authorities will deal with particular industries, such as those of sugar, rubber planting, cotton, timber, and the manufacture of margarine in Great Britain. Some of the papers to be read after Christmas are:—The relations between labour and capital, Lord Leverhulme; The war and its effects on the mind, Sir Robert Armstrong-Jones; Water-power in the British Isles, A. Newlands; Agricultural machinery, F. S. Courtney; and Organic chemistry in relation to industry, Dr. M. O. Forster. The Cantor lectures will include courses on progress in the metallurgy of copper; high-temperature processes and products; and military explosives of to-day.

THE Postmaster-General, speaking at the Mansion House on November 12, said:—"It is intended, as soon as the military position will admit, to institute international aerial posts between London and the various principal capitals of Europe."

MR. A. ADAMS, writing from Looe, Cornwall, records the occurrence in that county of the little owl (*Carine noctua*). A specimen was sent to him recently for identification by a rabbit-trapper in the neighbourhood, who had found it in a trap. In the *Zoologist*, in 1914, the little owl was recorded as breeding in Somerset; Mr. Adams's communication shows that it has extended its range westwards and southwards, as one would expect.

MR. T. MCKENNA, chairman of the Executive Committee of the Decimal Association, informs us that at a recent joint meeting of the association with the Institute of Bankers and the Association of Chambers of Commerce unanimous agreement was secured as to the retention of the £ sterling as the monetary unit and its division into 1000 parts, or mils. This enables all the existing gold and silver coins down to and including the sixpenny-piece to be retained without any alteration in their respective values. For example, the sixpence is represented exactly by 25 mils. In regard to the coins of lower denomination, it was unanimously agreed that they should consist of 1, 2, 3, 4, 5, and 10 mil pieces, of which the two latter would be of nickel. This enlarged range of the coins of lower value, in addition to providing coins substantially equal in value to the existing halfpenny and penny, would provide coins of intermediate value between the present halfpenny and penny, and thus overcome a defect in our present coinage which has resulted in prices in millions of small transactions in daily life being unduly increased because of the absence of suitable intermediate coins.

OWING to ill-health Dr. R. Hamlyn-Harris, director of the Queensland Museum, resigned his appointment on September 30. Referring to his retirement, the *Brisbane Courier* remarks that it will be a serious loss to the institution and to the cause of science in Queensland. It is about seven years since Dr. Hamlyn-Harris was appointed director, and in the interven-

ing period he has laboured with enthusiasm and ability to make the museum an educational force in the community. He succeeded in making the museum both attractive to non-scientific visitors and a centre of student and scientific activity. He raised the scientific status of the institution, and reorganised the whole of the valuable collections, and the fine ethnological department of the museum owes a great deal to his knowledge, study, and enterprise.

THE Admiralty has issued the following particulars of the unmanned, controlled high-speed craft to which we referred last week (p. 190):—The electrically controlled motor-boats used on the Belgian coast are twin petrol-engined vessels partially closed in, and travel at a high speed. They carry a drum with between thirty and fifty miles of insulated single-core cable, through which the boat is controlled electrically. The fore part carries a considerable charge of high explosive, probably from 300 lb. to 500 lb. in weight. The method of operating is to start the engine, after which the crew leave the boat. A seaplane, protected by a strong fighting patrol, then accompanies the vessel at a distance of three to five miles, and signals to the shore operator the helm to give the vessel. These signals need only be "starboard," "port," or "steady." The boat is zigzagged while running; this may be either intentional or unintentional. On being steered into a ship the charge is exploded automatically. The device is a very old one. A boat similarly controlled was used in H.M.S. *Vernon* (the torpedo experimental ship) so far back as 1885. The only new features in the German boats are petrol engines and wireless telegraphy signals, neither of which existed then.

THE first report of the Conjoint Board of Scientific Societies shows that many subjects of national importance have engaged the attention of the board since it was constituted in June of last year. Forty-eight leading scientific and technical societies are represented upon the board, and the expenses are met by contributions from them. The receipts at the end of September last amounted to 652*l.* 6*s.* 8*d.*, the expenses to 270*l.* 12*s.* 3*d.*, and the balance at that date was 381*l.* 14*s.* 5*d.* There are ten sub-committees concerned respectively with the International Catalogue of Scientific Literature, the application of science to agriculture, technical optics, education, the prevention of overlapping among scientific societies, the metric system, anthropological survey, iron-ore, the water-power of the Empire, and timber for aeroplane construction. The Sub-committee on Agriculture emphatically believes that a great future awaits the development of electrical applications to agriculture in the United Kingdom. The board recommends, therefore, that the Board of Agriculture be asked to grant the necessary funds for designing, constructing, and testing practically an electrical tractor and certain other agricultural machines. The Sub-committee on Education, in conference with representatives of the Council of Humanistic Studies, has arrived at a reasonable statement as to the essential place of science in education. It has also communicated to Sir Joseph Thomson, for the use of the Government Committee on Science in the Educational System of Great Britain, two resolutions referring to the importance of training teachers to give inspiring and attractive courses in science, and the need for adequate salaries to be paid to such teachers. Dr. G. W. Walker having stated that in working on the magnetic survey of the country he had found evidence of disturbance in certain areas which he considered might be explained by the presence of iron ores, the board, upon the recommendation of the Iron-ore Sub-committee, has arranged for a detailed magnetic survey of (1) the neighbourhood of Melton Mowbray, and (2) that of Strachur and Lochgoilhead. The survey will be accompanied by (1) a detailed geological and petrological investigation of the rocks in each area, and (2) a determination of the magnetic permeability of the rocks and minerals occurring in each area. The report refers, among other matters, to the establishment of the Department of Scientific and Industrial Research, of the Department of Technical Optics at the Imperial College, and proposals by the British Association for the formation of a Geodetic Institute, with which the board has expressed itself entirely in sympathy.

UNDER the title of "Links between North and South," Prof. Flinders Petrie, in the October issue of *Man*, traces a connection between the Teutonic goddess Brynhild and Ishtar of Babylon. "The position seems to be that a warrior goddess, with lovers, but never married, who forced her way into hell, was an idea of a Central Asian people; that this was transformed into Ishtar by the peoples who pressed down in prehistoric days into Babylonia; that it was carried in some form westward by the Huns, and transformed into Brynhild by the Norse ethics and customs; and it was finally treated by the Germans much as Malory treated the Arthurian legends. Such are a few of the dim links between North and South which may some day serve to join up the two great streams of ancient history."

THE second number of "Recalled to Life" was issued in October. It is a journal devoted to the care, re-education, and return to civil life of disabled sailors and soldiers, and contains valuable matter dealing with treatment and training and with administrative matters such as pensions. In the present number Col. Sir John Collie discusses neurasthenia and allied disorders, Major Horton-Smith Hartley deals with tuberculosis in its relation to the war, and Sir William Osler offers some remarks on the problem of the crippled.

THE method of determining the surface tension of a liquid in air by allowing drops of the liquid to form slowly at the lower end of a thick-walled capillary tube and counting the number which fall off is so simple that it is very unfortunate that a satisfactory theory of the process has never been given. Lord Rayleigh showed that the mass m of the drop of a liquid of surface tension T which falls from a tube of outer radius r is given by $mg=CTr$, where C is a constant which varies from 3·7 to 4·2, according to the properties of the liquid and the radius of the tube. The problem is a dynamical one, and its ultimate solution will be facilitated by the recent kinematograph pictures of the formation of falling drops which have been taken for M. F. L. Perrot, and are reproduced in his article on the subject in the *Revue générale des Sciences* for October 15. They show that the drop before it breaks away is connected to the liquid above it by a thin filament of considerable length, which breaks simultaneously in two places. We hope M. Perrot will succeed in placing the method on a sound basis.

THE following works are in preparation for appearance in Messrs. Longmans and Co.'s *Monographs on Physiology*:—"The Physiology of Reflex Action," Prof. C. S. Sherrington; "The Physiological Basis of the Action of Drugs," Dr. H. H. Dale; "The Nature of Muscular Movement," Dr. W. M. Fletcher; "The Cerebral Mechanisms of Speech," Dr. F. W. Mott; "Tissue Respiration," Dr. C. Lovatt Evans; "The Physiology of Muscular Exercise," Prof. F. A. Bainbridge; and "The Vaso-Motor System," Prof. W. M. Bayliss.

OUR ASTRONOMICAL COLUMN.

NOVEMBER METEORS.—The moon being absent this year at the epoch of the Leonids, a favourable opportunity will occur, should the atmosphere be clear, for re-observing the shower. The parent comet (Tempel 1866 I.) is, however, now near aphelion, and there is little prospect of witnessing an abundant display. But some of the swift, streaking meteors directed from the "Sickle of Leo" are visible every year, and may well repay observation on the morning of November 16.

There is another shower, possibly more irregular and uncertain in its returns, connected with Biela's comet. These meteors, radiating from near γ Andromedæ, travel very slowly, as they are moving in the same direction as the earth and have to overtake us. They are due on the nights from November 19 to November 22, and may be observed at any hour. These Andromedids were seen in 1872, 1885, 1892, 1899, and 1904, but have not reappeared in plentiful numbers since the last-named year. The parent comet has not been seen since 1852, though it must have made nine returns to perihelion, the periodic time being about 6·6 years.

ENCKE'S COMET.—It is curious that although this comet was photographed a year ago, when close to its aphelion, yet repeated search in the present autumn has failed to reveal it. The object observed for it in mid-September by Wolf proves not to be a comet, but a minor planet. It has been designated CP, and the following orbit published :—

Epoch 1917 October 3·5 G.M.T.

M	29° 5·6′	ϕ	11° 30·4′
ω	39° 44·2′	μ	1057·9″
Ω	285° 43·7′ (1917·0)	log a	0·35038
i	4° 43·7′	Period	3·354 y.

It will be recalled that in January, 1908, Prof. Wolf announced an object as Encke's comet that proved to be an independent comet. The very large value 3·84 was found for its perihelion distance, but the observations were too few to give trustworthy elements.

EFFECTIVE WAVE-LENGTHS OF CLUSTERS AND SPIRAL NEBULÆ.—A new series of determinations of the effective wave-lengths of certain spiral nebulæ and globular clusters has been made at Upsala by K. Lundmark and B. Lindblad (*Astronomische Nachrichten*, 4907). The method employed was that in which a coarse grating, with spacing in this case of 1·3422 mm., is fixed in front of the object-glass of a photographic telescope. Some of the results are as follows :—

Object	Mag.	Effective wave-length	Spectrum inferred
Cluster M5	6·7	4191	F
,, M3	6·6	4251	F5
Spiral M94	7·7	4267	G
,, M51	8·4	4307	G5
,, M64	8·6	4338	K

A FAINT STAR AS NEAR AS α CENTAURI.—In Circular No. 30 of the Johannesburg Observatory attention was directed by Mr. Innes to a faint star in Centaurus which had been found to have the large proper motion of about 5″ per annum. Mr. J. Voûte, of the Cape Observatory, now announces (Monthly Notices, R.A.S., vol. lxxvii., p. 650) that the parallax and proper motion of this star are nearly identical with those of α Centauri, which is still the nearest star known. Mr. Voûte finds the parallax to be 0·755″, and the proper motion 3·76″ in the direction 282·7°, while the corresponding figures for α Centauri are 0·759″, and 3·68″ in the direction 281·4°. It will be seen that the agreement is extraordinarily close, although the distance between the two stars is 2° 12′. The question is raised as to whether the stars are physically connected, or are members of the same drift.

The visual and photographic magnitudes of the faint star are respectively 11·0 and 13·5, so that the spectrum is probably of type M. The magnitude reduced to a distance of 10 parsecs is 15·4, or 17·9 photographically, and the star would thus appear to be the faintest at present known.

The position of the star for 1916·11 is R.A. 14h. 23m. 54·28s., declination −62° 19′ 10·1″.

PYROMETERS AND PYROMETRY.

THE meeting of the Faraday Society on November 7, at the Royal Society of Arts, Sir Richard Glazebrook occupying the chair, was devoted to a general discussion on "Pyrometers and Pyrometry." From the character of the papers read and the remarks of the various speakers, it may be inferred that present-day activities in this direction are mainly devoted to applying existing instruments to industrial uses, rather than to the development of new methods of measuring high temperatures. The extent to which pyrometers are now employed may be gauged from the fact that one armament firm alone has six hundred instruments in daily use, and in all branches of industry where accurate temperature control is necessary pyrometers now form an indispensable part of the equipment.

In this country the standardisation is undertaken by the National Physical Laboratory. At the outbreak of the war negotiations were in progress with a view to the production of an international scale of temperatures, in the absence of which a provisional scale has been adopted for present purposes. Dr. Ezer Griffiths and Mr. F. H. Schofield, on behalf of the N.P.L., gave an account of this scale, and also of the methods adopted in standardising pyrometers of various types. A striking confirmation of the value of central standardisation was furnished later in a paper read by Prof. J. O. Arnold, who, in experiments on the quenching of high-speed steels, used four different types of pyrometers to control the temperature of a barium chloride bath. The agreement of the instruments near to 1300° C. was remarkably good, and proved that any of the four could have been relied upon to regulate the temperature independently.

The types of pyrometers now used industrially are chiefly the thermo-electric, for temperatures up to 1200° C., and total radiation and optical pyrometers for higher temperatures. The chief drawback to the thermo-electric instrument is the error caused by fluctuations in the temperature of the cold junction, to obviate which various devices have been introduced from time to time. Mr. R. S. Whipple suggested that this trouble might be overcome by burying the cold junction in the ground to such a depth that any temperature variations would be negligible. From experiments conducted at Cambridge, and extending over three years, it was found that at a depth of 10 ft. the variation in temperature was only 1·6°. It was pointed out, however, that in the vicinity of a group of steel furnaces it would be necessary to locate the cold junction at a much greater depth than 10 ft. to secure anything approaching constancy, and that in consequence the method would have a limited application in practice. With regard to optical pyrometers, it was rather disquieting to learn that the monochromatic glass used in some of these instruments could not yet be produced in England. Pre-war supplies were of German origin, and at present this indispensable material is obtained from the United States. It is to be hoped that one of our own glass firms will take this matter in hand, particularly in view of the rapid extension of the use of optical pyrometers.

Several of the papers read bore on the temperature of molten steel, and the discussion made it clear that steel-makers now attach great importance to the tem-

perature at which steel is poured, as the properties of the ingot produced are influenced by this factor. The correct measurement of this temperature is difficult; thus, if an optical pyrometer be sighted on the molten stream as it issues from the furnace, black-body conditions are not realised, and the apparent temperature indicated may vary according to the quantity of slag accompanying the metal. Similarly, the layer of cooled slag on the surface of the metal in the ladle prevents the true temperature from being ascertained by optical means. Although an occasional reading may be taken with a sheathed junction of platinum and platinum-iridium alloy, the method could not be used regularly owing to the rapid destruction of the sheath. One proposal made was to encase the wires in a large mass of fireclay, leaving the ends uncovered, so that both touched the molten steel; but it was pointed out that this method would cause a rapid destruction of the wires. In spite of these difficulties much progress has been made by following out definite lines of procedure, such as sighting on a certain part of the molten stream at definite intervals of time during the pouring. Mr. Cosmo Johns and others found it possible, under uniform conditions, to obtain readings varying only by 5° to 10°, which, as the chairman remarked, was a surprising result considering the temperature measured. All the speakers who had attacked this problem agreed that the temperature of open-hearth steel when being poured was about 1600° C., careful determinations by Dr. Hatfield with a thermal junction indicating 1600° to 1625°. Further work in this direction is very desirable, as a trustworthy method would be of the greatest value to the steel-maker.

It is still customary in the pottery industry to gauge the firing temperature by using a set of clays of progressive fusibility, and noting the effects on the separate pieces. The latest developments of this method were described in the paper read by Mr. H. Watkin, one of which consisted in placing the test-pieces across two sloping uprights, ladder fashion, so that the droop or complete fusion of any could be readily observed.

Two new suggestions for measuring temperatures of the nature of 1600° C. were put forward, both of which entailed the use of a fused metal. Dr. Northrup, of Trenton, U.S.A., described an instrument based on the expansion of molten tin, constructed on the same lines as an ordinary thermometer. The bulb and stem were of graphite, and a nickel wire passing through a gland in the top of the stem could be pushed down so as to touch the top of the molten tin, when an electric circuit was completed. The position of the top of the column of tin in the stem could thus be ascertained and the stem divided up in the same manner as a thermometer. Dufour many years ago suggested a thermometer of tin in a silica envelope, but the instrument never came into practical use, and the graphite enclosure is an undoubted improvement. Dr. Northrup has found that molten tin does not give off vapour at 1700° C., and proposes to use his instrument up to this or even higher temperatures. Mr. C. R. Darling suggested a thermo-electric pyrometer in which one or both of the members of the couple might melt without breaking the circuit. As shown by Mr. A. W. Grace and Mr. Darling, the thermo-electric properties of metals in general are unchanged by fusion, and hence cheap metals, such as tin or copper, might be used to measure temperatures of 1500° C. or more, as their boiling points usually exceed 2000° C.

An excellent feature of the meeting was an exhibition in the room of pyrometric apparatus of all kinds. Included in these was the original tapered gauge used by Josiah Wedgwood for measuring the contraction of his clay cylinders, by means of which the science of high-temperature measurement was founded. The modern productions of British makers are highly satisfactory, and this young but flourishing industry has undoubtedly a great future in front of it. Special mention may be made of an automatically controlled furnace, on the principle devised by Mr. R. P. Brown, of Philadelphia. The control is effected by means of a thermo-electric pyrometer inserted in the furnace, the indicator of which is provided with two stops, which may be set in any position, one on either side of the pointer. To control a furnace to within 5° above or below a given temperature, the stops are set at 5° on either side of the number on the indicator. The pointer of the indicator is depressed periodically by means of clockwork, and when touching either stop an electric circuit is completed which actuates a relay. If touching the lower stop, the effect is to cut out an external resistance from an electric furnace, or to open wider the tap of a gas supply in a gas furnace, whilst when in contact with the higher stop resistance is added or the gas supply checked. There appears to be no good reason why large furnaces should not be similarly controlled, and the saving in fuel and labour effected should soon cover the cost of the apparatus.

The success of the discussion, in which makers of pyrometers, representatives of various industries, and scientific men were able to compare notes, suggests that meetings of this kind are desirable in connection with the application of science to manufacturing processes, and cannot fail to act as a stimulus to all concerned.

HEREDITARY CHARACTERS IN RELATION TO EVOLUTION.[1]

II.

(1) FIRST, then, what are the facts as to numerous finely graded variations in a single unit factor? Here we have certain remarkable data as to the eye-colour of Drosophila—data that are of great interest with relation to the nature of evolutionary change. This fruit fly has normally a red eye. Some years ago a variation occurred by which the eye lost its colour, becoming white, a typical mutation. Somewhat later, another variation came, by which the eye colour became eosin. By those wonderfully ingenious methods which the advanced state of knowledge of the genetics of Drosophila have made possible, it was determined that the mutations white and eosin are due to changes in a particular part of a particular chromosome, namely, of the so-called X-chromosome, or chromosome I. And further, it was discovered that the two colours are due to different conditions of the same *locus* of the chromosome; in other words, they represent two different variations of the same unit. Moreover, the normal red colour represents a third condition of that same unit. And now, with the minute attention paid to the distinction of these grades of eye colour, new grades begin to come fast. Up to date we know from the mutationists' own studies of Drosophila that a single unit factor presents seven gradations of colour between white and red, each gradation heritable in the usual Mendelian manner. These grades are the following:—(1) red; (2) blood; (3) cherry; (4) eosin; (5) buff; (6) tinged; (7) white. Considering that the work on Drosophila has been going on only about seven or eight years, this is remarkable progress toward a demonstration that a single unit factor can present as many grades as can be distinguished; that the grades may give a pragmatically continuous series. The extreme selectionist asks only a little more than this.

Besides showing that a unit factor may thus exist in numerous minutely differing grades, this case shows

[1] Abridged from an address by Prof. H. S. Jennings. Continued from p. 198.

that a heritable variation may occur so small as to be barely detectible. Although the variations do not usually occur in this way, the case presents the conditions which would allow of a gradual transition from one extreme to the other, by means of numerous intermediate conditions. In a population in which were occurring such minute changes as are here shown to be possible, we could get by selection such a continuous series of gradations as Castle describes in his rats.

(2) But, as we have seen, the mutationists reject the view that the changes in the coat colour of the rat are due to alterations in a singe unit factor; they explain this and other cases of the effectiveness of selection on a single character by *multiple modifying factors*. Accepting again their contention, the question is shifted to the nature of such factors.

Our direct experimental knowledge of these "modifying factors" is scanty. We find data as to certain known modifying factors by one of the workers on Drosophila, Bridges (1916), in his recent important paper on non-disjunction of the chromosomes.[7] Bridges found a factor the only effect of which was to lighten the eosin colour in a fly with eosin eyes; this factor, indeed, nearly, or quite, turns the eosin eye white. Another factor has the effect of lightening the eosin colour a little less, giving a sort of cream colour. A third factor dilutes the eosin colour not so much. In addition to these, Bridges has discovered *three other* diluters of the eosin colour, and another factor the only effect of which is to modify eosin in the direction of a darker colour. None of these factors has any effect save on eosin-eyed flies. These things add tremendously to our gradations in eye colour. We had already been furnished seven grades, from white to red; now we have seven secondary grades within a single one of these seven primary grades. These seven new grades are not located in the same unit factor as are the seven primary ones; their loci are in other chromosomes (or possibly in other parts of the same chromosome).

Here again, then, we have minutely differing conditions of a single shade of colour, brought about by seven modifying factors. Bridges makes the following remark concerning them:—

"A remarkably close imitation of such a multiple case as that of Castle's hooded rats could be concocted with the chief gene eosin for reduced colour, and these six diluters which by themselves produce no effect, but which carry the colour of eosin through every dilution stage from the dark yellowish pink of the eosin female to a pure white." [8]

Now this is an extremely interesting statement, one that must arouse the keen interest of the student of the method of evolution. In Drosophila we could get the same sort of graded results that Castle does with his rats, only in Drosophila this is by means of multiple modifying factors, whereas Castle believes that in the rat it is by actual alterations of the hereditary constitution!

But what are these modifying factors? And here we come to the astonishing point. *These modifying factors are themselves alterations in the hereditary constitution.* Bridges leaves no doubt upon this point. He lists and describes them specifically as mutations; as actual changes in the hereditary material.

Where, then, is the difference in principle between the condition in Drosophila and that in the rat? In Drosophila there occur minute changes in the germinal material, such as to give, so far as our present imperfect knowledge goes, seven diverse grades of a colour which is itself only one grade of another series of seven known grades. By means of these graded changes one could obtain, by the mutationist's own statement, the continuously graded results which selection actually gives. What more can the selectionist ask?

The mutationist thinks of all these numerous grades as, after all, essentially discontinuous, as a series of steps so minute that the difference between one and the next one is not detectible. His opponent, on the other hand, perhaps thinks of the series as actually continuous. But when steps become so minute as to be beyond detection, the question whether they exist becomes metaphysical.

To put the case in brief, if the mutationists are to show that the existence of multiple modifying factors has any bearing on the general question of the effectiveness of selection, they must show that such factors are not themselves minute changes in the hereditary constitution. Not only have they made no attempt to do this, but in the only well-examined cases they state squarely that such factors are indeed alterations in the hereditary constitution.

For the inheritance of such factors as Mendelian units, of course absolutely nothing is required save that the location of the change is in a chromosome. No particular degree of magnitude, no unity of any other kind is required.

But there remains one point brought out by the mutationists which is of great importance to the student of the method of evolution. While they must admit, by their own account, that all these grades occur, they, of course, point out that the changes do not occur in a continuous series. In the eye of Drosophila variation may occur from red to white directly, without any transitional stages; or from any grade to any other; the continuous scale is obtained only by arranging the steps in order. Therefore, it is maintained, evolution may have occurred by such large steps, not by continuous gradations.[9] This is, of course, a matter deserving of serious consideration. But certain other points must be considered also. First, the very facts known for Drosophila show that there is nothing to prevent a passage from one extreme to the other by minute changes, just as is held to occur by the palæontologists and selectionists, although change by large steps occurs also. Secondly, in such cases as the eye colour of Drosophila we are dealing with characters that are already highly developed. We know, for example, that this particular character is formed by the co-operation of many separate parts of diverse chromosomes; it is a highly complex product of evolution. Now, we find that one or another of these parts may suddenly cease to perform its function, so that the red colour is not completely formed; there is a sudden change in it; or it may disappear entirely. But is this, after all, strong evidence that in the original production of this complex character with its numerous underlying functional parts, there was the same change by sudden large steps? Indeed, is it not rather true that such destructive changes in a fully formed character could not be expected to throw light on how that character was built up?

To sum up, it appears to me that the work on Drosophila is supplying a complete foundation for evolution through selection of minute gradations. The so-called "multiple allelomorphs" show that a single unit factor may thus exist in a great number of grades; the "multiple modifying factors" show that a visible character may be modified in the finest gradations by alterations in diverse parts of the germinal apparatus. The objections raised by the mutationists to gradual change through selection are breaking down as a result of the thoroughness of the mutationists' own studies. The only outstanding difficulty is the

7 Bridges, 1916, p. 148. (See Bibliography.)
8 *Ibid.*, p. 149. (See Bibliography.)
9 See particularly the discussion of this point in Morgan, 1916, pp. 7–27. (See Bibliography.)

fact that large changes occur as well as small ones; this seems perhaps due to the fact that we are witnessing the disintegration of highly developed apparatus in place of its building up.

In all this, except the last point, the work on Drosophila is in agreement with my own observation of gradual variation in Difflugia, with Castle's similar results on the rat, and with the conclusions of palæontologists as to the gradual development of the characteristics of organisms in past ages.

But there is one point in the palæontological conclusions which is not in agreement with the experimental and observational results on existing organisms; this I wish to notice briefly. Osborn sets forth that in following given stocks from earlier to later ages, characters arise from minutest beginnings, and pass by continuous gradations to the highly developed condition; these developing characters do not show random variations in all directions, but follow a definite course, which might seem to have been in some way predetermined. And this is emphasised by the fact that the same sorts of characters (horns, for example) may arise independently, at different ages, in diverse branches of the same stock, and each follow in later ages the same definite course of development. Evolution is characterised by Orthogenesis, as this phenomenon has sometimes been called.

Now it appears to me that we do not observe this in the present-day experimental work; by selection we can move in more than one direction. There is no indication, so far as I can see, that the variations push in one determinate direction only. Examining the palæontological summaries further as regards this, we find that diverse courses are followed by given characters, in diverse branches of a given group.

A second point which Osborn sets forth is deserving of particular attention. He states, in agreement with Waagen, that in any given geologic stratum, we do find, in addition to characteristics that are in the line of determinate descent, other variations from this line, which are of the sort that constitute what we call at the present time varieties; things that are like the diverse races of Difflugia in my own work. But, say Osborn and Waagen, there is a great difference in principle between these and the others, for those which are in the determinate line of progress persist into the next geologic stratum, while the mere varieties do not. The persistent changes were called by Waagen mutations (in a sense somewhat diverse from that in which the word is used by de Vries).

Osborn expresses the opinion that these "varieties" may be merely non-heritable modifications.[10] But in our present geologic period we find just such diverging forms, in great number, and we find that their peculiarities *are* heritable. There is, then, no reason for supposing that these variations were not heritable in earlier geological periods; there must have been many races heritably diverse, just as there are now; and these are what Waagen called varieties.

Now, since this is so, the only difference between Waagen's mutations and his varieties is that the former persisted and the latter did not. But this tells us nothing whatever about why the latter did not. It is perfectly possible, so far as these facts go, that it was a matter of selection by external conditions; many diverse stocks were present, on an equal footing; some were destroyed, others were not. The conditions described by the palæontologists support strongly the theory of evolution by gradual change, but I cannot see that they tend to establish the view that variations show a tendency to follow a definite course, as if predetermined. The palæontologists appear rather to report precisely the conditions which we are bound to find if evolution occurs through the guidance of natural selection operating on a great number of diverse variations, the typical Darwinian scheme.

[10] Osborn, 1915, p. 225. (See Bibliography.)

There is one other point, made by Bateson (1914), in his presidential address before the British Association, and further developed by Davenport (1916) in a recent paper: the proposition, namely, that since practically all observed variations are cases of loss and disintegration, we are driven to suppose that evolution has occurred by loss and disintegration. Davenport combines this idea with the theory that these disintegrating variations follow a definite course, predetermined in large measure by the constitution of the disintegrating material.

There are two points worth consideration in dealing with this theory. The first is one of fact; although it is true that many of the so-called mutations appear to be cases of loss and disintegration, yet there is no indication that this is the case in such effects of selection as have been described by Castle and myself; variations are not limited to any particular direction. Secondly, it appears to me that this conclusion—that because the variations we see are cases of loss and disintegration, therefore evolution must have occurred by loss and disintegration, involves an error in logic, which makes it unworthy of serious consideration.

To summarise, then, what I have obtained from experimental work combined with a survey of the work of others, the impression left is as follows:—

(1) Experimental and observational study reveals that organisms are composed of great numbers of diverse stocks differing heritably by minute degrees.

(2) Sufficiently thorough study shows that minute heritable variations—so minute as to represent practically continuous gradations—occur in many organisms, some reproducing from a single parent others by biparental reproduction.

(3) The same thing is reported from palæontological studies.

(4) On careful examination we find even that the same thing is revealed by such mutationist work as that on Drosophila; single characters exist in so many grades due to minute alterations in the hereditary constitution as to form a practically continuous series.

(5) It is *not* established that heritable changes must be sudden large steps; while these may occur, minute heritable changes are more frequent.

(6) It is *not* established that heritable variations follow a definite course as if predetermined; they occur in many directions.

(7) It is not established that all heritable changes are by disintegration; although many such do occur, they cannot be considered steps in progressive evolution from the visibly less complex to the visibly more complex.

Evolution according to the typical Darwinian scheme, through the occurrence of many small variations and their guidance by natural selection, is perfectly consistent with what experimental and palæontological studies show us; to me it appears more consistent with the data than does any other theory.

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UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

IT is proposed by the governors of the West Ham Municipal Central Secondary School to call the institution "The Lister School," to perpetuate the association of Lord Lister with the borough of West Ham.

THE annual meeting of the Association of Public-School Science Masters will be held on Tuesday and Wednesday, January 8 and 9, at the City of London School, under the presidency of Sir Ronald Ross, who will give an address on "Observations on the Results of our Present System of Education." The subjects to be discussed during the meeting are:—Examination or inspection as a test of science teaching, G. F. Daniell; Compulsory science in university entrance examinations, O. H. Latter; Subsidiary subjects in university scholarships examinations, H. de Havillard; Descriptive astronomy in the "science for all" course, Rev. A. L. Cortie; and Map reading as a school subject, V. S. Bryant.

A SCHOLARSHIP designated the "Institution of Naval Architects Scholarship in Naval Architecture" will be offered for competition among students of the institution in 1918. All students (being British subjects) who have been elected at or before the annual general meeting of the institution (March 20, 1918) will be eligible for this scholarship, subject to the conditions named below. The scholarship is of the annual value of 100*l.*, and is tenable for three years, provided that they are not less than eighteen or more than twenty-one years of age on March 1, 1918, and at that date have been continuously employed for at least two years upon naval architecture or marine engineering. Candidates for the scholarship must forward a written application to the secretary of the Institution of Naval Architects, 5 Adelphi Terrace, London, W.C.2, to reach him not later than January 15, 1918.

MR. FISHER is still hopeful that the passage of his Education Bill into law will not be postponed indefinitely. Speaking at Swindon on November 10, he said that, though the pressure of Parliamentary business may render it impossible for the Government to proceed with the Bill this session, it must not be supposed that the Bill will therefore be discarded. The Government intends to proceed with the measure at the earliest possible opportunity, always, of course, assuming that the complexion of European events permits Parliamentary attention to be bestowed on domestic legislation. So important is it to the nation that the education of those on whom its industrial efficiency depends shall be extended and improved that we are confident, if the Government is really in earnest, there will be no insuperable difficulty about finding the time at least to pass the educational clauses of the Bill. The meeting at which the President of the Board of Education spoke passed a resolution approving the Bill and protesting against any delay in securing its passage through Parliament.

THE subject of University Representation in Parliament was before Committee of the House of Commons on November 8, in connection with the Representation Bill. Sir Philip Magnus's amendment, giving separate representation with one seat to the University of London and two seats to the group composed of Durham, Manchester, Wales, Liverpool, Leeds, Sheffield, Birmingham, and Bristol, was adopted on a division by a majority of 128 (162 for, 34 against). The amendment was supported by speeches also from Sir William Collins, Mr. Burdett-Coutts, Mr. Macmaster, Mr. Boyton, and Col. Greig, and accepted by the Home Secretary (Sir George Cave). Sir Philip Magnus laid stress on the peculiar constitution, character, and work of the University, and pointed out the practical objections to the large group, including London, proposed by the Bill. This point was emphasised also by Sir William Collins, who said that the three representatives of the proposed group would speak with no sense of individuality, and would represent nothing but a fortuitous and heterogeneous concourse of academic atoms. Sir George Cave said he did not think the Speaker's Conference intended to put a slight upon the University of London, but had in mind the

transferable vote; and if London preferred one representative to itself rather than the half of three to which it was entitled under the Bill and by the number of its graduates, he had no desire to oppose its wishes.

ONE of the great captains of industry of Scotland has specially organised and equipped an engineering factory for the employment exclusively of educated women of good social standing instead of the usual woman factory worker, and with the fixed determination to carry on operations permanently under those conditions, the work to be taken up being that associated with the manufacture of internal-combustion motors. There is a fully illustrated account of the new factory in *Engineering* for November 9, from which we learn that it has some of the salient features of a technical college combined with practical work in the factory, which gives that stimulus to study not realisable in the laboratory of a college. The factory is situated in the south of Scotland amidst beautiful scenery, so that students of botany and of wild-life generally can have full opportunity of pursuing their hobby. All the accessories which are now placed under the wide term "welfare" have been adopted to the fullest extent. Highly trained lecturers conduct classes at the works; these are compulsory. Entrants receive 20*s*. per week during the probationary period of six weeks; they then decide whether or not they intend to pursue the engineering career. If such be the case, and they are considered suitable, an apprenticeship agreement is entered into, and the wages become 25*s*. per week. Examinations are held at six months' intervals, and each "pass" means an increase of 5*s*. per week. It is evident that the whole scheme provides for women the opportunity of prosecuting an engineering career under the most favourable and stimulating conditions, and that the conditions are those best calculated for women of good education and social standing to attain a broad experience of engineering science and practice.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 8.—Sir J. J. Thomson, president, in the chair.—Prof. A. D. **Waller**: The galvanometric measurement of "emotional" physiological changes. The principal object of this communication is to prove that emotional response of the human subject is characterised (and can be measured) by alterations of the electrical resistance of the skin, independent of the well-known muscular and vasomotor and secretory manifestations of emotion.—Lieut. D. M. S. **Watson**: The structure, evolution, and origin of the Amphibia. Part I.—The "orders" Rachitomi and Stereospondyli. In this paper all known genera of Rachitomous and Stereospondylous Stegocephalia are reviewed, the brain-case and basi-cranial region, hitherto practically unknown, being described more or less completely, and much new information about other regions set down.—E. C. **Grey**: The enzymes concerned in the decomposition of glucose and mannitol by *Bacillus coli communis*. Part II.—Experiments of short duration with an emulsion of the organisms. Part III.—Various phases in the decomposition of glucose by an emulsion of the organisms. By selection, Harden and Penfold obtained evidence that the proportion in which the enzymes of bacteria occurred could be artificially modified, which result might suggest that the enzymes, although intracellular, are able to act independently of one another. The present researches demonstrate that this is a fact.

Physical Society, October 26.—Mr. W. R. Cooper, vice-president, in the chair.—T. **Smith**: A class of multiple thin objectives. The objectives dealt with are cemented combinations of several thin lenses. Two kinds of glass only are employed, the odd elements being of one kind, say crown, and the even elements of the other kind, flint. Such lenses may be regarded as combinations of achromatic cemented doublets, and formulæ are found for the aberration coefficients of such lenses in terms of those of a standard doublet when the geometrical conditions for the absence of air-gaps between the components are satisfied. Generally speaking, the results reached are that the outer surfaces are concerned with coma, and the inner surfaces with spherical aberration. In all cases the determination of a system to satisfy given conditions involves only the solution of a quadratic equation, and an algebraic method thus effects a solution in a fraction of the time involved in a trigonometrical investigation. Chromatic differences of first-order aberrations are easily determined. The application of the method is illustrated by a series of quadruple objectives which satisfy the ordinary conditions for telescope objectives. Diagrams show the variation of the curvatures with the different forms, the magnitude of the second order spherical aberration, and the chromatic differences of first-order aberrations.—Prof. J. W. **Nicholson**: The radius of the electron and the nuclear structure of atoms. The electron is usually regarded as a globule of electricity with a definite radius. This conception has proved valuable, but involves difficulties in connection with the nuclear structure of complex atoms. On the view that the electron consists of a region of strain in the æther such line constants should have some significance throughout the whole æther, which may, in fact, be in some manner cellular with these linear magnitudes involved in the specification of the cells, and therefore in any strained structure composed of them. The electron would be regarded as a state of strain which for practical purposes is concentrated at its centre, rapidly diminishing outwards according to some very convergent law involving some line constant in its specification. By way of illustration the idea is worked out mathematically on the assumption that the strain varies as $e^{-\lambda r}$, on which hypothesis λ^{-1} is the "radius." It can be shown that the Lorentz formula for mass as a function of velocity can be obtained for this type of electron. The charge on the electron is regarded as a fundamental property of the æther, and is related to Planck's constant h.

Linnean Society, November 1.—Sir David Prain, president, in the chair.—Prof. W. A. **Herdman**: Spolia Runiana. III., The distribution of certain Copepoda and Diatoms in the Irish Sea throughout the year. The author explained the prevalence of certain genera at definite periods of the year, such as the abundance of seven genera of Diatoms in the maximum attained about April in the many (more than 5000) standard hauls of the plankton-nets on the yacht *Runa*, in some cases reaching hundreds of millions of Diatoms per haul. The Copepoda, which were of much greater size, did not reach such numbers, but attained as many as tens to hundreds of thousands per haul, in the autumn maximum at a period when the Diatoms had practically disappeared. These two periods, spring and autumn, showed monotonic plankton in each case of phytoplankton and zooplankton respectively. The connection between the prevalent plankton and the movement of migratory food-fishes was traced in several cases, and the fact was emphasised that the bulk of the plankton of our seas is made up of a very few organisms present in enormous numbers.—Lt.-Col. J. H. Tull **Walsh**: The germination of *Iris pseudacorus*, Linn., in normal and abnormal conditions.

Aristotelian Society, November 5.—Dr. H. Wildon Carr, president, in the chair.—Dr. H. Wildon **Carr**: Inaugural address: The interaction of mind and body. After a brief allusion to the progress made during

the last two or three decades in the clinical knowledge of mind and body, and particularly to the amount of material for study furnished daily by the injuries of war, the president passed to the consideration whether anything in our new knowledge throws light on the old philosophical problem. He rejected as inconceivable the notion that psychical and physical action can be comprised within one energetical system, or that there can be direct equivalence of exchange between the two orders. The alternative of parallelism, apart from its incredibility on the ground of extravagance, is in direct conflict with the facts of individual experience. The important fact in regard to the nature of mind and body is that each is the unity and continuity of an organic individuality, and that every modification of either is a modification of the whole. Interaction must therefore, it was argued, be interaction between the whole mind as an individual unity of personal experience and the whole body as a living unity of co-ordinated mechanisms. Such interaction is not causal in the sense the term is used in physical science. It is the mutual adaptation of two individual systems distinct in their order, diverse in their function, and divergent in their principle, both of which are necessary and complementary to the common end for which they co-operate, living action. The term which best expresses their interaction is solidarity in its old legal meaning, which denoted the unity of common purpose, the diverse obligations, and the corresponding claims on the members, of a partnership. The philosophical theory sought further to deduce the principle of a dichotomy of living experience into two divergent but complementary systems, mind and body, from the nature of living action.

Mineralogical Society, November 6.—Anniversary meeting.—Dr. J. W. Evans in the chair.—Miss E. **Smith**: Etched crystals of gypsum. Baumhauer conducted experiments on colemanite and calcite to determine whether the phenomenon of etched figures is due to lack of homogeneity or irregularity in the incidence of the dissolving liquid, or to lack of homogeneity in the crystal itself. Further experiments now made on cleavage surfaces of gypsum tend, on the whole, to confirm Baumhauer's conclusion that the second hypothesis is the correct one.—Dr. G. T. **Prior**: The mesosiderite-grahamite group of meteorites. Analyses of the mesosiderite Hainholz and the grahamite Vaca Muerta show that these meteorites do not differ materially as regards the amount of felspar, and microscopical examination of other mesosiderites supports the idea that there is no real distinction between them; the name mesosiderite is therefore proposed for the whole group. The ground-mass of these meteorites consists mainly of anorthite and a pyroxene, poor in lime and having a ratio of MgO to FeO of about 2. The iron and olivine are very unevenly distributed, and have chemical compositions such as they have in the pallasites, the iron being poor in nickel (ratio of Fe to Ni generally greater than 10) and the olivine poor in ferrous oxide (ratio of MgO to FeO from 6 to 9). In accordance with the author's conception of a genetic relationship of meteorites, it is suggested that a eucrite-like magma, *i.e.* one of higher oxidation, was invaded by a pallasite-like magma of lower oxidation. The curiously unequal distribution of the nickel-iron and the shattered (cataclastic) structure, which is generally confined to the parts rich in iron, support this view.—Prof. H. **Hilton**: Changing the plane of a gnomonic or stereographic projection. A method was described by means of which the gnomonic or stereographic projection of a crystal on any plane may be obtained when the projection on one plane is given. The application to the drawing or orthographic projection of the crystal was also discussed.—Prof. H. **Hilton**: Cleavage angle in a random section of a crystal. A graphical method was given by means of which it is possible to calculate the chance that the angle between the cleavage-cracks on a random section of a crystal with two good cleavages may lie between specified limits. The method was worked out in detail for the cases in which the angle between the cleavage-planes was 90° or 60°.

Optical Society, November 8.—Prof. F. J. Cheshire, president, in the chair.—Lt.-Col. A. C. **Williams**: Description of certain optical stores which have been captured from the enemy. The paper dealt with certain optical military instruments which are representative of those employed by the Central Empires. Most of them are used in connection with artillery. The first part of the paper had reference to the general requirements of such instruments and the methods of their employment. The second part contained a detailed description of the instruments, including the optical data, mechanical construction, weight, dimensions, etc. The concluding part contained some observations as to the general design of the instruments as regards serviceability, portability, finish, internal cleanliness, the employment of complicated prisms, and adjustments. Finally, the principal needs as to the designing of military optical instruments in this country were considered, and suggestions given as to the most satisfactory solution of the question.

MANCHESTER.

Literary and Philosophical Society, October 16.—Mr. W. Thomson, president, in the chair.—D. Ward **Cutler**: Natural and artificial parthenogenesis in animals. Parthenogenesis, or the production of an organism from an egg which has not been previously fertilised by the male element, was shown to be of wide occurrence in the animal kingdom, though confined to only a few of its great divisions. The life-cycles of many of the animals which exhibit this method of reproduction were described, and it was pointed out that though fertilisation, among these animals, almost always resulted in the production of females, the sex of the animals developing from parthenogenetic eggs was male in some species, female in others. Experiments were then described which tended to show that the cause of the change from sexual to parthenogenetic reproduction was due to the interaction of the external factors (environment) and internal factors resident in the egg. The cytological aspect of the subject was developed in detail in the paper. Some of the most important theories regarding the cause of sex-production were then discussed, and it was shown that the one put forward by Wilson and Castle seemed at present to fit the facts more nearly than any other. This theory regards male and female formation as a quantitative phenomenon and not a qualitative one; thus "femaleness is maleness *plus* something else." The second part of the paper dealt with the experiments which had been performed on the eggs of various animals that are not normally parthenogenetic, causing them to develop without the action of the male element. This phenomenon has been termed artificial parthenogenesis. Boursier in 1847 stated that a virgin silkworm placed in sunlight and then shade produced eggs from which caterpillars developed, and Tichomoroff was able to get larvæ from unfertilised eggs by placing them for a short time in strong sulphuric acid. Since 1899, however, observations have accumulated enormously, and the substances capable of producing development are many and various. The following are a few of the substances used:—Hypertonic solutions, acids, thermal changes, cytolytic agents, blood sera, shocks from induction coils. Although most observers have worked

with invertebrate eggs, Bataillon has largely confined his attention to the lower vertebrates. He was able by pricking the frog's eggs to cause development, which proceeded in three cases up to the tadpole stage. The various theories which have proceeded from the experiments were then discussed. Finally, it was pointed out that although various substances were capable of inducing development, no factor or factors common to all these substances had been isolated, and that until this was done the problem of fertilisation could not be said to have been solved. Further, it was significant that up to the present no animal had been raised to sexual maturity by artificial means.

October 30.—Mr. W. Thomson, president, in the chair.—Prof. W. Boyd **Dawkins**: The organisation of museums and galleries of art and technology in Manchester. The author gave an outline of the organisation of the Manchester Museum. The scheme of classification is based upon the two great principles of time and evolution. It begins with the ancient history of the earth, dealing first with minerals built of elemental bodies, secondly with the rocks built up of minerals, and thirdly with the history of life as revealed in the rocks. The history of life is represented in its three great stages of evolution—primary, secondary, and tertiary, the series ending with the groups illustrating existing Nature, plants, animals, and man. An account was then given of art in Manchester at the present time, and a scheme outlined for the organisation of a collection of new art in Manchester. The needs of manufacturers and workers generally who look for the best examples of mechanical processes and handicrafts can only be met by the establishment of a great industrial museum.

PARIS.

Academy of Sciences, October 22.—M. Camille Jordan in the chair.—E. **Branly**: Electro-metallic influences exercised through insulating leaves of very small thickness. An experimental study of the conditions under which a very thin sheet of mica exhibits unipolar or bipolar conductivity.—H. **Douvillé**: The Tertiary of the Aquitanian gulf and its differences of facies.—M. **de Sparre**: The influence of the variation of wall thickness on strokes of the ram in a constrained pipe.—G. **Charpy** and S. **Bonnerot**: The heterogeneity of steel. The specimens discussed were etched by a copper reagent, the metallic copper being afterwards removed by solution in ammonia. The advantages of the method are shown by six illustrations reproduced from photomicrographs, four showing the progressive effects of rolling on the structure of the metal.—E. **Goursat**: The integration of certain systems of differential equations.—S. **Bays**: The triple cyclic systems of Steiner.—H. **Larose**: The uniform movement of a wire in a resisting medium.—C. **Camichel**, D. **Eydoux**, and M. **Gariel**: The strokes of an hydraulic ram.—M. **Mesnager**: The thick rectangular plate, loaded at the centre, and the corresponding thin plate.—J. C. **Solá**: The parallax of the star P Ophiuchi. An application of the stereoscopic method; the parallax found for this star is $0{\cdot}418'' \pm 0{\cdot}24''$.—M. **Brillouin**: The electromagnetic field of an element of constant current in a biaxial anisotropic medium.—A. **Mailhe** and F. **de Godon**: The transformation of secondary and tertiary fatty amines into nitriles. Di*iso*amylamine, passed over reduced nickel at 300°–320°, gives amylene, hydrogen, ammonia, tri*iso*amylamine, and *iso*amylnitrile. Tri*iso*amylamine, under similar conditions, also yields *iso*amylnitrile. The formation of a nitrile is unexpected, and further investigations will be made to see if the reaction is a general one.—M. **Guerbet**: Condensation, under the action of potash, of *cyclo*hexanol with secondary butyl alcohol. The synthesis of 4-*cyclo*hexyl-3-butanol.—L. F. **Navarro**: The structure and petrographic composition of the Pic du Teyde (Teneriffe).—J. **Deprat**: The presence of the Lower Cambrian to the west of Yunnanfou.—H. **Coupin**: The acid excretion of roots. The acid excretion is due, not to the root-hairs, but to the superficial cells of the outer layers, especially when the latter have suffered lesions.—Em. **Bourquelot**: The influence of glycerol on the activity of invertine. Unsuccessful attempts to synthesise sugar by the action of invertine on solution of glucose and levulose led the author to make a study of the hydrolysis of sugar by invertine in presence of glycerol. Without glycerol the inversion is practically complete in seven days; increasing proportions of glycerol cause a progressive weakening in the activity of the invertine, so that in 50 per cent. glycerol solutions only 21·6 per cent. of the sugar was hydrolysed.—M. **Cazin** and Mlle. S. **Krongold**: The use of commercial sodium hypochlorite solutions (eau de Javel) in the treatment of infected wounds. Of 510 patients treated by this solution only three died. The question of the supposed irritating properties of this solution is discussed, and the results of comparative experiments made with Dakin's solution and 0·5 per cent. sodium hypochlorite solution are given.—C. **Benoit** and A. **Helbronner**: The treatment of war wounds by the combined action of visible and ultra-violet radiations.

October 29.—M. Ed. Perrier in the chair.—V. **Cremieu**: Experimental researches on gravitation.—P. **Pascal**: The distillation of mixtures of sulphuric and nitric acids. The boiling points of mixtures of water, sulphuric acid, and nitric acid have been studied and the results shown graphically. The diagrams give all the elements necessary for the theory of the concentration of weak nitric acid in retorts, and the denitration in towers of nitro-sulphuric acid mixtures.—J. **Bougault**: The preparation of acyl hydroxylamines, starting with the oximes of α-ketonic acids. By the action of iodine and sodium bicarbonate upon the oxime of an α-ketonic acid an acyl hydroxylamine is formed, CO_2 being eliminated, a nitrile being also formed by a secondary reaction. Thus the oxime of phenylpyruvic acid,

$$C_6H_5.CH_2.C(NOH).CO_2H,$$

gives phenylacetylhydroxylamine,

$$C_6H_5.CH_2.CO.NH(OH),$$

and phenylacetonitrile, $C_6H_5.CH_2.CN$. Other examples are given proving the generality of the reaction.—A. B. **Chauveau**: The diurnal variation of potential at a point in the atmosphere with clear sky. It is shown that part, at least, of the diurnal variation is due to dust particles.—F. **Morvillez**: The leaf trace of the Rosaceæ.—W. **Kopaczewski**: Researches on the serum of *Muraena helena*: the toxic power and physical properties of the serum. The toxic action of the serum remains after thirty days' storage in the dark, but sunlight exerts a destructive effect. The toxic effect disappears after exposure to 75° C.—A. **Lécaillon**: The appearance of "bivoltins accidentels" in univoltine races of silkworm, and the rational explanation of this phenomenon.—J. **Amar**: Rational prothesis of the lower member: a practical model of the leg.

MELBOURNE.

Royal Society of Victoria, September 13.—Prof. W. A. Osborne, president, in the chair.—Dr. C. **Fenner**: The physiography of the Glenelg River. The Glenelg originated in a post-Pliocene uplift forming the low western end of the main divide of Victoria. The uplift having a westerly tilt, all the tributaries enter from the east. Part of the asymmetry results from vigorous tributaries crossing the divide and capturing head-

waters of north-flowing streams, while the flooding of western Victoria with basalt diverted south-flowing streams to the west, and augmented the importance of the Wannon, the principal tributary of the Glenelg River.—Kathleen **Haddon** (communicated by Sir Baldwin Spencer): Some Australian string figures. Making these figures, which form imitations of animals and other natural objects, is a favourite amusement of women in all aboriginal races, and in the form of the well-known cat's cradle they are supposed to have reached Europe from China, along with the tea-trade. Similar figures are found to be in use all the world over, and it is, in fact, possible that this is one of the earliest sedentary prehistoric games.—Dr. S. **Pern**: A method of estimating minute traces of calcium in the blood. To a faintly acid solution containing calcium three-quarters its volume of alcohol is added, then three drops or more of a saturated solution of oxalic acid. It is then shaken up, and within a few minutes a white cloud appears, which under the ultra-microscope shows no crystalline shapes, but rounded bodies, 0·1 μ in diameter. This method is so sensitive that a four-thousandth part of a milligram of calcium can be detected in 5 c.c. volume. The main object of the method is for the estimation of calcium in the blood in different diseases.

BOOKS RECEIVED.

The Organism as a Whole from a Physicochemical Viewpoint. By Dr. J. Loeb. Pp. x+379. (New York and London: G. P. Putnam's Sons.) 2.50 dollars net.

An Ethical System based on the Laws of Nature. By M. Deshumbert. Translated by Dr. L. Giles. Pp. ix+231. (Chicago and London: Open Court Publishing Co.) 2*s*. 6*d*. net.

The Electron: Its Isolation and Measurement and the Determination of some of its Properties. By Prof. R. A. Millikan. Pp. xii+268. (Chicago: University of Chicago Press; London: Cambridge University Press.) 1.50 dollars net.

Radiography and Radio-Therapeutics. By Dr. R. Knox. Part i., Radiography. Second edition. Pp. xxv+382+xx+78 plates. (London: A. and C. Black, Ltd.) 30*s*. net.

British Grasses and their Employment in Agriculture. By S. F. Armstrong. Pp. vii+199. (Cambridge: At the University Press.) 6*s*. net.

Instinct in Man. By Dr. J. Drever. Pp. x+281. (Cambridge: At the University Press.) 9*s*. net.

Highways and Byways in Wiltshire. By E. Hutton. Pp. xvii+463. (London: Macmillan and Co., Ltd.) 6*s*. net.

The Psychology of War. By Dr. J. T. MacCurdy. Pp. xi+68. (London: W. Heinemann.) 2*s*. 6*d*. net.

Biologia Marina. By R. Issel. Pp. xx+607. (Milano: U. Hoepli.) 10.50 lire.

Piscicoltura Pratica. By Prof. F. Supino. Pp. viii+327. (Milano: U. Hoepli.), 5.50 lire.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 15.

ROYAL SOCIETY, at 4.30.—A New Gyroscopic Phenomenon: E. E. Tournay Hinde.—Investigation into the Imbibition Exhibited by some Shellac Derivatives: A. P. Laurie and C. Ranken.—Phenomena connected with Turbulence in the Lower Atmosphere: G. I. Taylor.—The Relation between Barometric Pressure and the Water Level in a Well at Kew Observatory: E. G. Bilham.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—Slime Treatment on Cornish Frames, with Particular Reference to the Effect of Surface: S. J. Truscott.—Comparative Concentration Tests on Wood and Fluted Glass Surfaces at Porco, Bolivia: H. A. Lewis.

LINNEAN SOCIETY, at 5.—Methods of Staining Embryonic Cartilage: E. S. Goodrich.—Notes on Calamopitys: Dr. D. H. Scott.

FRIDAY, NOVEMBER 16.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Some Notes on Air Lift Pumping: A. W. Purchas.

MONDAY, NOVEMBER 19.

ARISTOTELIAN SOCIETY, at 8.—Thought and Intuition: Mrs. Karin Stephen.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Sandbanks and Deltas: E. C. Barton.

SOCIETY OF ENGINEERS, at 5.—Sewage and its Precipitation; Further Experiments: R. Brown.

TUESDAY, NOVEMBER 20.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 5.—Witch Sacrifices: Miss M. A. Murray.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—The Hardinge Bridge over the Lower Ganges at Sara: Sir R. R. Gales.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 8.—The Oil Prospects of the British Isles; W. H. Dalton.

ZOOLOGICAL SOCIETY, at 5.30.—The New-born Marsupial and its Mode of Birth: Prof. J. P. Hill.—The Development of *Echinocardium cordatum*: Prof. E. W. MacBride.—(1) New South American Rhopalocera; (2) New South American Arctiidæ; (3) New Butterflies from Africa and the East; (4) Gynandromorph of *Papilio lycophron*, Hbn.; (5) Three Aberrations of Lepidoptera: J. J. Joicey and George Talbot.—Deformity of *os penis* in a *Phoca caspica*, Nilsson, Sergius Alpheraky.—Notes on a Collection of Heterocera made by Mr. W. Feather in British East Africa, 911-13: Lt.-Col. J. M. Fawcett.

ROYAL STATISTICAL SOCIETY, at 5.15.

WEDNESDAY, NOVEMBER 21.

ROYAL SOCIETY OF ARTS, at 4.30.—Inaugural Address: Science and its Functions: A. A. Campbell Swinton.

ROYAL METEOROLOGICAL SOCIETY, at 5.—The Twelve-hourly Barometer Oscillation: Dr. G. C. Simpson.—Abnormal Temperature, with Special Reference to the Daily Maximum Air Temperature at Greenwich: W. W. Bryant.

GEOLOGICAL SOCIETY, at 5.30.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Some Foraminifera from the North Sea, etc. V. *Thurammina papillata*, Brady: A Study in Variation: E. Heron-Allen and A. Earland.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, NOVEMBER 22.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Bactericidal Properties conferred on the Blood by Intravenous Injections of Diamino-acridine-sulphate: C. H. Browning and R. Sulbransen.—The Pelmatoporinæ, an Essay on the Evolution of a Group of Cretaceous Polyzoa: W. D. Lang.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Gas-firing Boilers: T. M. Hunter.

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