THURSDAY, JULY 17, 1919.

THE FIGURE OF THE EARTH.

The Earth's Axes and Triangulation. By J. de Graaff Hunter. (Survey of India Professional Paper, No. 16.) Pp. viii+219+vi charts. (Published by order of the Government of India. Dehra Dun: Printed at the Office of the Trigonometrical Survey, 1918.) Price 4 rupees or 5*s.* 4*d.*

THE Survey Department of India has long been labouring under a disadvantage which attaches to pioneers in that the fundamental constants employed as the bases of its computations, and upon the accuracy of which its final results depend, are now, and have been for a long time past, known to be in substantial error. The axes of the earth hitherto used are those derived from Everest's early work, and in view of the enormous amount of geodetic data accumulated since they were formulated, their values naturally require considerable correction in order to fit in with more recent knowledge. Furthermore, owing to the magnitude of the local attraction at Kalianpur, the point taken as the origin of the co-ordinates of the survey, the absolute position of this origin, and hence of every other point deduced from it, requires a further correction on this account. This correction in the case of longitudes is a constant quantity of the same magnitude at every point, and in the case of latitudes a varying quantity, depending, first, upon the absolute change in the assumed latitude of the origin, and, secondly, upon the changed distance between origin and point due to the changed spheroid.

To recompute the whole triangulation with the new origin and new axes would have been a piece of numerical work of altogether prohibitive magnitude, and the primary object of Mr. Hunter's research was to derive a formula for ascertaining the necessary corrections without repeating the whole calculation. This is not quite such an elementary problem as it appears. It might possibly be thought that it would be easy to compute the correction at a number of symmetrically situated points, say the intersections of each degree of latitude and longitude, and thence to derive the correction at any other point by interpolation. This, however, cannot be done in any simple and direct way. To derive the proper value of the correction, the "route" along which the position of the point was determined has to be considered, and if, for example, assuming the position of the origin as 0°, 0°, we thence determine the correction at the point 1°, 1°, the value will be different according as we proceed along the parallel from 0°, 0°, to 0°, 1°, and thence along the meridian to 1°, 1°, or conversely along the meridian to 1°, 0°, and thence along the parallel to 1°, 1°. This discrepancy arises from the fact that the original observations were "adjusted"—*i.e.* constrained to fit a particular spheroid—and will consequently not fit a different spheroid without distortion. There must therefore always remain a degree of uncertainty in the computed corrections, and in the final results it is claimed by Mr. Hunter, apparently with full justification, that these residual errors are of magnitudes such as to be negligible in the most precise geodetic survey.

The whole question of the adjustment of the errors of a triangulation is fully discussed, and a new method of considerable practical importance set forth. The volume embodies the results of a most laborious research, and reflects great credit upon the author and upon the Survey of India. A perusal of it brings home, however, with great force a question much to the fore lately upon which a definite solution appears at length to be in sight, viz. the imperative necessity of establishing a geodetic institute in this country. Many of the problems opened up in this volume are applicable to geodetic surveys wherever they may be undertaken, and it is scarcely an ideal state of affairs that the great responsibility for laying down new methods, and for all practical purposes deciding upon their validity, should rest on the shoulders of one survey department, often, moreover, on those of one man. These general questions should be fully investigated by all concerned who are in a position to help, and an institute which will co-ordinate the higher survey work of the whole British Empire will be in a position to assist individual survey departments in all questions of general and fundamental importance to the science of geodesy.

E. H. H.

PLANT PHYSIOLOGY.

Life Movements in Plants. By Sir J. C. Bose. (Transactions of the Bose Research Institute, Calcutta. Vol. i., parts 1 and 2, 1918.) Pp. xxiv+251+xv. (Calcutta: Bengal Government Press, 1918. Published by the Bose Research Institute, Calcutta.)

IN addition to a series of scientific papers, the volume before us contains administrative details of the Research Institute and an inaugural address delivered by Sir J. C. Bose on November 30, 1917, when the institute was opened.

India is to be congratulated upon the foundation and generous endowment of an institute of this character, which is intended to include departments for physics, plant physiology, animal physiology, and psycho-physics, as well as their applications to agriculture and medicine.

The address outlines the events leading up to the organisation of the institute. It is pointed out that the two ideals before the country are complementary and not antagonistic. "There is first the individualistic ideal of winning success in all affairs, of securing material efficiency and of satisfaction of personal ambition. These are necessary, but by themselves cannot secure the life of a nation. . . . The weakling who has refused the conflict, having acquired nothing, has nothing

to renounce. He alone who has striven and won can enrich the world by giving away the fruits of his victorious experience. . . . The ideal of giving, of enriching—in fine, of self-renunciation in response to the highest call of humanity, is the other and complementary ideal."

The scientific papers are divided into two groups: part i., "Response in Plant Organs," and part ii., "Growth and its Responsive Variations." In many of the papers Sir J. C. Bose was assisted by his research students.

Ever since the days of his clumsy efforts to induce preparations of frogs' nerves and muscles to perform their movements with military precision, the present writer must confess to a dislike to all dealings with smoked glass plates and tracings thereupon. The records upon which the conclusions of the Calcutta laboratory are based are, however, on an entirely different level. In these, skill in manipulation and the most ingenious clockwork and electrical devices have been combined to evolve methods whereby the minute movements of response to carefully regulated stimuli have been recorded on the same chart as their time relations.

In order to cut out errors arising from the variation of factors other than the one under consideration, the observations are in most cases made only for a very short period of time. This is possible with the aid of the great magnification employed; the latter is obtained by a combination of levers coupled with the disturbance of equilibrium in a magnetic field due to the motion of the steel lever in it.

The massed attack of the workers in the Bose Institute has in a very short time cleared up much that was obscure in the phenomena of response. It may be noted, however, that the papers contain very few references to current literature, but this is perhaps owing to the novelty of the methods used. In particular, the recent work upon the transmission of a stimulus through a glass tube in the absence of all protoplasmic connection is of interest in relation to certain of the Calcutta experiments. W. R. G. A.

ABNORMAL PSYCHOLOGY AND EDUCATION.

Echo Personalities: A Short Study of the Contributions of Abnormal Psychology towards the Solution of some of the Problems of Normal Education. By Frank Watts. Pp. 111. (London: George Allen and Unwin, Ltd., 1918.) Price 4*s.* 6*d.* net.

MANY readers of the voluminous literature upon mental and nervous disorders published almost weekly in our own country must have been struck by the vast stores of information for the educationist which these writings contain. The significance for education of much of this information lies chiefly in the fact that it tells the teacher what to avoid, but an almost equal amount is grist of the finest quality for his own particular mill; for many of the painstaking and minute analyses of these states of mental twistedness are but the prelude to a subsequent process of re-education. Here, if anywhere, may the educator of the normal child help and find help.

While, as we said, many persons must have felt all this, few have ventured upon the task so courageously undertaken by Mr. Frank Watts, that of refracting the rays of light from the dense and clouded medium of psychopathology into the somewhat clearer atmosphere of normal education. And if one feels, here and there, that an important ray fails to get through, there is little justification for grumbling at the properties of our prism, for it is almost the only one we have.

Mr. Watts has read widely; he leads us from the early giants of rational mental treatment, Pinel and Esquirol in France, and Conolly in England, to our contemporaries—whose height we cannot yet measure, perhaps because they stand too close to us—Janet of Paris, Freud of Vienna, and Jung of Zürich. In his chapter on "Psychopathology and Personality," which seems to us the best in the book, he gives clear little sketches of the typical "nervous" disorders, never forgetting that the blessed word "abnormal" does not exempt him from the obligation of showing their near relationship to "normal" eccentricities and weaknesses.

In his chapter on "The Crowd at School" he boldly acknowledges the existence of a fact—often protectively coloured, but nevertheless angular and unyielding when one strikes against it—that suggestion is the means by which most of the child's beliefs are inculcated. He draws from this the obvious conclusion that the teacher's duty is to understand the mechanism of suggestion and thereby to utilise its advantages and avoid its pitfalls. It is good to see Mr. Watts making use of that salutarily disquieting book by Mr. Trotter, "The Herd Instinct in Peace and War." But we feel that a still more extensive use of Mr. Trotter's explanation of the present unfashionableness of rational opinion and of his suggestions for making it fashionable in the future might have strengthened this chapter still more. Perhaps, however, the trouble about Mr. Trotter's "Herd Instinct" is that the title would be improved if he avoided the term "instinct" and used another word instead of "herd." Which brings up the subject of Mr. Watts's own title. On buying the book, one may understand what the title means. But is not this a reversal of the usual process?

The final chapter, on "The Psychology of the Defective Mind: its Influence upon Teaching Methods," deals in a very up-to-date way with the subject. One paragraph may be offered to the reader here as food for thought:

"One may perhaps draw attention here, in passing, to the popular modern educational ideal of self-realisation as the ultimate good. Séguin occupied himself, like Froebel and Rousseau before him, wholly with the problem of the perfecting of human personality, but a sane study of abnormal psychology should prevent us adopting the unfortunate heresy that personality is the most

sacred of all the good things with which the universe teems."

In his book Mr. Watts has probably attempted too much. But ample justification for this is his readiness to share his knowledge with others.

T. H. P.

OUR BOOKSHELF.

The Human Skeleton: An Interpretation. By Prof. H. E. Walter. Pp. xv+214. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1918.) Price 10*s.* net.

THE human skeleton has been the favourite text of anatomists for many a day, but never before has an author couched his discourse in more racy and picturesque phraseology than that employed by Prof. Eugene Walter. Indeed, it is the author's method of treatment which justifies his book, for the theories and opinions which he sets forth are those with which medical students have been familiar for a past generation. The book is designed to appeal to the layman rather than to the professional student. "The ordinary layman seems, subconsciously at least, to regard a consideration of his 'insides' as something rather impertinent and indelicate, a subject, in truth, unavoidable whenever complications set in, but quite barren and forbidding to one simply in quest of pleasant stimulating intellectual adventures." Prof. Walter's aim is to represent the human skeleton as "a very wonderful and animated piece of architecture, full of beauty and inspiration for one who looks upon it with a seeing eye and considers its age-long evolution with a comprehending and sympathetic mind."

To elucidate the subject of his discourse the author culls facts from the whole realm of the animal kingdom, both present and past, and cites examples from standard works on embryology and anthropology. A living internal skeleton, such as vertebrate animals are provided with, represented "a brand-new idea of far-reaching evolutionary significance," whereby "*Thermomorphs* lifted tons of flesh into the air upon majestic bony scaffoldings." Hair and epidermal structures are described as "relics of a bygone age." The human skeleton illustrates the "thrift and resourcefulness of Nature," the "chequered career" of individual structures, and, in many of its parts, "a complicated series of makeshifts." Here and there, however, one observes that the author's statements are loose and scarcely accurate. His statement on p. 74 that "the odontoid process rocks back and forth and from side to side upon an articular surface within the ring of the atlas, thereby allowing lateral movements of the head," is one which would prove fatal to a candidate in an examination in elementary anatomy, and unfortunately there is a considerable number of similar misstatements of fact. One regrets that the author has not taken more trouble to become accurately acquainted with the human skeleton, for he possesses a very happy power of exposition.

Manual de Fabricantes de Azucar de Caña y Químicos Azucareros. By Dr. Guilford L. Spencer. Traducción Autorizada de la 6ª Edición Inglesa. By Dr. Gaston Alonso Cuadrado. Pp. xvii+617. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1918.) Price 23*s.* net.

DR. SPENCER'S "Handbook for Sugar Manufacturers and their Chemists" is well and favourably known to sugar technologists. In the sixth edition, of which the volume under notice is the authorised Spanish translation, the principal new feature is a chapter on evaporation, written by Prof. W. H. P. Creighton, of Tulane University, New Orleans. In this the scientific principles which govern the concentration of sugar juice by heat are elucidated at some length, and their practical applications to vacuum evaporation explained.

Speaking generally, the section devoted to manufacturing processes gives a good account of sugar production as carried out according to the best American practice in Louisiana and Cuba. In the earlier part, dealing with crude sugar, descriptions of various modern improvements are included, such as the "Norit" carbon process of decolorising, the use of Hind-Renton grooved rollers in the mill, and the Bach "sulphitation" process as employed in Java. Mr. G. P. Meade, superintendent of a Cuban sugar refinery, contributes an interesting chapter on refining. The analysis of sugars and the general chemical control of the manufacture are fully explained, a good collection of tabulated data being provided.

Like the original English work, the translation is in a handy, compact form, suitable for carrying in the pocket. Its six hundred pages will be found close-packed with sound and well-arranged information.

Prothèse Fonctionnelle des Blessés de Guerre. Troubles Physiologiques et Appareillage. By Dr. Ducroquet. Pp. xi+235. (Paris: Masson et Cie, 1919.) Price 5 francs.

THE equipment of soldiers who have been permanently lamed or maimed with appliances which will mask or make good their defects tasks to the utmost that department of surgical endeavour known as prosthesis. Dr. Ducroquet's "Functional Prosthesis" is entirely concerned with defects and injuries of the arm and leg, and hence the problems he has to solve are those relating to the kind and degree of movements which occur at the various joints of the limb. A very clear and accurate account is given of the mechanism of walking and of the manner in which defects can be made good by the use of appliances. Both surgeon and anatomist will find much that is new in Dr. Ducroquet's pages, particularly regarding the position and direction of the axes of the various joints of the limbs. This book has a value which extends beyond the immediate needs of the military surgeon.

A. K.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Electro-Atomic Phenomena in the Magnetic Field.

I HOPE you will grant me the opportunity of making some brief observations on an article which appeared in the issue of NATURE for April 3, in which the anonymous reviewer "N. R. C." delivers a judgment of exceptional severity on one of my publications, "Electro-atomic Phenomena under the Action of the Magnetic Field," and for that reason very different from the other judgments which have come to my notice.

I shall limit myself to a few points with the aim, not of inducing the reviewer to change his opinion, but of facilitating somewhat an equitable estimate by readers of NATURE, which is so widely diffused and read by so many cultivated persons who are not occupied in any particular way with physics.

The reviewer seems unwilling to take into consideration the fact that my book was written with the sole purpose of bringing together and co-ordinating my recent very numerous new experiments, of not one of which (and this seems to me something important) has he been able to place the perfect validity in doubt. Hence he has confined himself to attacking the hypotheses proposed by me to account for the new facts. He declares that he is occupied only with the theory put forward to explain the facilitated ionisation by shock which I have demonstrated to take place through the influence of the magnetic field. He says, in fact: "This matter has been discussed less thoroughly than the theory of magnetic rays." By this he evidently intends to convey to the reader the conviction that the latter theory has been destroyed by the courteous objections of some physicists, to whom I believe I opposed exhaustive, and not less courteous, rectifications.

The theory under examination at present consists in this: Under the action of the field a gaseous molecule tends to orient itself in such a manner that the force due to the field, and acting upon a satellite electron, acts towards the outside of the atom, and therefore facilitates the liberation by shock of the electron itself. If the atom has one single satellite electron, certainly it will act in this manner, because it will be paramagnetic according to the accepted theory. And the behaviour of the air, which was the gas experimented upon by me, is paramagnetic.

Hence no one can succeed in understanding what the question propounded by the reviewer means: "How Prof. Righi arrives at a result so directly contrary (?) to that on which Langevin's theory of diamagnetism is based? According to the new theory, all atoms must be paramagnetic." As if I had declared that I had obtained my results by experimenting, not only on air, but also on diamagnetic gases, it being granted that for the latter that objection would have a serious value. It is well to direct attention to the fact that the reviewer seems to believe that a diamagnetic substance orientates itself, and in a sense opposite to a paramagnetic, in a *uniform* field.

It is a method of polemic unhappily sometimes adopted (although rarely in scientific questions), this of combating assertions which were not made; unfortunately, such a method can leave an unfavourable, although unjust, impression on the great majority of readers.

Furthermore, if (and this is not at present the case) there should some day be presented any facts contravening the theory of Langevin, it need not be necessary to choose between this and another theory; so long the nature of the connections, in virtue of which the tendency of the trajectory of an electron to orient itself in a given manner influences the orientation of the entire atom, remain still indeterminate.

I refrain from noticing the final hint on the typographical quality of my book. It is not clear whether this constitutes an unjust estimate of the sacrifices undergone by my country during the recent war—in which case I should protest with all my soul—or whether it is nothing but a witticism in somewhat questionable taste, intended to raise a contrast between the external aspect of the book and its contents—in which case I would leave the judgment to readers of NATURE.

AUGUSTO RIGHI.

Bologna (Italy), April, 1919.

I AM certainly sorry that Prof. Righi should regard my review as of "exceptional severity." It is true, of course, that more space is occupied in it by criticism than by the expression of approval; but this is simply due to the fact, familiar to every reviewer, that while the good features of a work can often be described in a single sentence, many sentences are usually necessary to explain why a less favourable view is taken of other features. It was not my intention to imply that the book is without value, and I cannot help thinking that Prof. Righi has—unintentionally, of course—adopted the practice which he deprecates of "combating assertions which were not made."

I am not at all "unwilling to take into consideration the fact that the book was written with the purpose of co-ordinating very numerous new experiments." I stated, and I repeat, that Prof. Righi "has recorded a large number of interesting and suggestive facts, which deserve the close attention of all students of physics." What more could I say, unless I proceeded to give an account of these facts—a task which is entirely unnecessary and obviously impossible in any reasonable space? Again, when I said that "this matter has been discussed less thoroughly . . . " I "intended to convey" nothing but a bare statement of fact which provided a reason for the choice of one portion of the work rather than another for more detailed discussion. So far as I can ascertain by an examination of the literature, there are much fewer papers dealing with Prof. Righi's theory of magneto-ionisation than with his theory of magnetic rays. If I have overlooked some of the literature, I apologise; but if I have not, it is not my fault that one of the theories has received more attention than another.

No useful purpose would be served by a further elaboration of my criticism of Prof. Righi's theory. A reviewer is surely not only entitled, but in duty bound, to record his difference of opinion from the author on any matter which is essential to the work reviewed; in doing so he does not condemn the author, but merely invites those interested in the matter to read the work and to judge between the conflicting opinions. Prof. Righi has expressed his opinion in his book, and I have indicated mine very briefly in my review; if there is to be further discussion, it had better take place in the normal manner in technical journals.

But perhaps I may add a few words in further explanation of my reference to Prof. Langevin's theory. According to that theory, when a revolving electron is introduced into a magnetic field, the radius of the orbit is unchanged, but the angular velocity is

altered in such a manner that the change in magnetic field due to the electron is opposed in direction to the magnetic field in which it is placed. The orbit thus behaves like a diamagnetic body, and on this fact is based Prof. Langevin's theory of the fact that in weak fields most bodies are diamagnetic. On the other hand, if I understand rightly, according to Prof. Righi the effect of introducing the orbit into the magnetic field is to change the radius, but not the angular velocity, and in such a manner that the change in the field due to the orbit is in the same direction as that of the field in which it is placed. The orbit behaves like a paramagnetic body, and it would seem to follow that all bodies should be paramagnetic. The two views are irreconcilable, and—again unless I have misunderstood Prof. Righi—either he or Prof. Langevin must be wrong. I suggested that if he thinks Prof. Langevin is wrong, he should have explained why he thinks so; or if he thinks his view is not inconsistent with that of Prof. Langevin, he should have told us how he removes the apparent inconsistency.

In self-defence, perhaps I may add that I do not think that a diamagnetic body orientates itself in a uniform field, and that I never suggested in any way that I thought so.

I must refrain (in the same manner as Prof. Righi) from noticing his last paragraph. I cannot imagine why he should read into my words such implications. I meant nothing but that the style of the book was admirable, that it was very refreshing to see a well-produced book once more, but that, in my opinion, the excellence of the production did not compensate for the absence of an index.

And as for my anonymity, I venture to believe that most English physicists would identify me from my initials; at any rate, they would recognise that the writer was not one of the small and distinguished band who could claim scientific precedence of Prof. Righi. But in order that any doubts as to my competence or incompetence may be removed, I beg leave now to sign myself NORMAN R. CAMPBELL.

Kettlewell, May 1919.

The Collection and Presentation of Public Statistics.

IT is a matter of common knowledge to all who have had occasion to use official statistics, whether published or Departmental, that the national and Imperial equipment for obtaining and publishing statistical data is very imperfect in its scope and inadequate in its machinery.

Further, the efforts made are Departmental, are under no common controlling or directing authority, and suffer very gravely from lack of co-ordination.

There is no need to adduce proofs of these statements, or to enumerate the various efforts, fruitless in the main, which have hitherto been made to remedy these defects.

The council of the Royal Statistical Society has appointed a special committee to deal with the subject in the belief that the time is now ripe for a new movement in the direction of reform, and that the consciousness of the existing defects is present to the minds of his Majesty's Ministers, Members of Parliament, and Civil Servants, as well as to others interested in statistics.

It is proposed to petition his Majesty's Government to set up a Parliamentary Committee to examine the whole question of the collection and presentation of public statistics, and to report on means of improvement. It is believed that this method of procedure is more likely to be effective than the pressing of specific proposals on his Majesty's Ministers.

The officers of the local government and other public bodies, as well as of scientific societies, are being invited to bring the matter at once before their councils. Moreover, publicists and others who are known to be interested are being approached directly.

We ask the courtesy of your columns to lend support to this movement, and we invite your readers to help with their influence and signatures. The council will be glad if all who are disposed to sign such a petition would communicate with the Secretary, Official Statistics Committee, Royal Statistical Society, 9 Adelphi Terrace, W.C.2. A copy of the petition will then in due course be sent to them for signature. GEOFFREY DRAGE,

Chairman, Official Statistics Committee.

Royal Statistical Society, 9 Adelphi Terrace, Strand, London, W.C.2, July 10.

THE FISHERIES AND SCIENTIFIC RESEARCH.

THERE has been quite unexpected confusion of counsel with regard to post-war reorganisation of the fishing industry. The collapse of the German submarine campaign about the middle of last year left everyone grateful to the fishermen and wondering what ought to be done for them in the future. That feeling "created an atmosphere," and a number of inquiries began. First of all, the English trawler owners anticipated the end of hostilities, and had a scheme of reconstruction ready by the time the Armistice had been granted. This attracted the attention of Lord Ernle, but did not succeed in impressing the War Cabinet (who had by then "other fish to fry"). The Scottish Steam Drifters' Association was equally ready with its scheme, and about the same time appeared the report of the Haldane Committee on the Machinery of Government, with its proposals for the creation of a State Department of Research, which was to take account of fisheries. Next came an inquiry by a committee of the British Science Guild, and then the deliberations of the National Sea Fisheries Protection Association (which are still going on). The sub-committees of the association began to prepare proposals for scientific research, education, and codification of the law. Following that, the Development Commissioners appointed a committee to advise them as to the best way in which research could be promoted. As if all this were not enough, the International Research Council has now arranged to meet in Brussels on July 18, and it is expected that interesting matters with relation to the exploration and fisheries of northern seas will be discussed.

Meanwhile, the conditions are very much what were anticipated in the memorandum presented to Lord Ernle last year. Fish is scarce and dear in the retail shops, and abundant and cheap at the ports of landing, for the means of transport have largely broken down. Exporting has become difficult even with Government guarantees. There is no scientific research yet, and no simplification of the administrative procedure. Nothing has been done for the fishermen, the Admiralty scheme

of co-partnery in the vessels built as patrols during the war having been opposed by the trawler owners because of its financial unsoundness. The vessels themselves are now offered for public sale. The situation obsesses anyone who has anything to do with it, and has become intolerable—if not farcical.

It is to be hoped that the confusion is only the means towards some satisfactory solution of the difficulties, that the time will come when everybody will be thinking alike—a psychological moment, as the phrase goes—and that then the problem will resolve itself. Anything that is published at the present time is interesting in view of this consummation, and several utterances of late seem to help a little. The report of the Executive Committee of the British Science Guild presented to the general meeting on June 17 last, Prof. Herdman's report to the Lancashire Fisheries Committee, recently issued, and a lecture by Prof. McIntosh, published in the columns of NATURE of July 3 and 10, all have interest in this connection. The guild's report will be received with general approval by men of science, though it may offend the Philistines in Government offices and in the industry. It agrees with the recommendations of the Machinery of Government Committee, regards thought and investigation as desirable preliminaries to action, and urges that the organisation of scientific and industrial research should be the task of a State Department presided over by a Minister. Investigations controlled by administrative officials, the report suggests, are likely to be narrowed in scope and abandoned if they should not prove to be "practical." Probably this is true, but one seems to notice that fishery administration is becoming less important than it was, while scientific and industrial research is much more so, and is attracting a greater share of public attention. Development can be helped very much by investigation, but is only likely to be hampered by restrictions and regulations (which have been the motives of the "administration" of the past). Governmental and other fishery authorities are, therefore, unlikely to neglect scientific and industrial research in the future.

Probably both the administrative people and the researchers will approve of Prof. Herdman's summary of the situation. There are, he says, two categories of fishery research, one having practical administrative, and the other speculative, value. And yet there are not two categories, but only one, for the same mechanism of research can, and does, achieve both kinds of results. Practical results raise questions of strictly scientific interest, while speculative results may at any moment become of practical importance. So also there might be two ways of controlling and organising research, one by a Department of State, which might only think and suggest, and the other by the administrative authorities making the universities their instruments. To deprive the authorities of the privilege of doing research would tend to sterilise their activities, while to create a Government Department quite out of touch with the industry would tend to set up a kind of Olympic pedantry. So these two means of controlling research must also be one. In short, Prof. Herdman adopts the methods of Athanasius, and in seeking to reconcile the intransigents suggests a way out from the confusion.

Lastly, Prof. McIntosh, after a long life spent in marine biological research and a greater experience of fishery investigation than anyone else, seeks to summarise his views as to what has been achieved by the International Council for Fishery Investigations during the last dozen years or so. That research was instigated, on one hand, by the "melancholy anticipations of the pessimists," and, on the other, by the far sounder motive of seeking to discover the reasons for seasonal physical and metabolic changes in the ocean and in its inhabitants. Pessimism as to the future of the fisheries was well expressed by Prof. Garstang in his paper on "The Impoverishment of the Sea," and a vigorous optimism was proclaimed by the *doyen* of marine biologists in his book "The Resources of the Sea." There were thus two opposed theses, one that the exploitation of the fishing-grounds was exceeding their recuperative power, and the other that fishing operations were carried on on too small a scale to make any appreciable difference. Now nobody is *quite* sure which thesis is proved, and anybody who is asked to give an opinion will certainly be inclined to hedge.

This back-number controversy, of which Profs. McIntosh and Garstang were the protagonists, has not so much interest for us just now. Some time must elapse before fishery operations will attain, much less surpass, their pre-war intensity; it will be a long time before the transport systems of Europe will be able to take fish everywhere that it is required, and so long as the prices of inferior categories of fish remain high not so much complaint of impoverishment of the superior categories will be heard from the *entrepreneurs*. But it is certain again to arise, and as we ought to possess the means of closuring it we cannot afford to scrap the mechanism of international investigation or kill the germ of international regulation. Even if it should be proved that the cherished fear of progressive impoverishment is a real one, *that* would be a result of exceedingly practical importance, for we might then be enabled to scrap the machinery of regulations, restrictions, prohibitions, and policing, all of which is expensive to maintain, and intolerable if it is unnecessary. But even then there would arise questions as to means of rendering this superabundance of food available on a greater scale by developing methods of preservation and utilisation in ways not yet attempted. And since man does not live by food alone, an international organisation will have much to do in the promotion of purely oceanographical discovery, which may be regarded as quite properly a part of the activities of civilised communities. J. J.

AN UNDEVELOPED ASPECT OF ENGINEERING TRAINING.

A SURVEY of the careers of students who enter the engineering profession after a technical training at a university reveals the fact that in very many cases the student, within a comparatively short time of his leaving the university, finds himself in need of knowledge which his training has neither provided nor even suggested would in time be required. This fact was emphasised in a paper recently presented to the Institution of Electrical Engineers by Lt.-Col. W. A. J. O'Meara, who urged the inclusion in the training of engineers of courses of instruction relating to non-technical subjects, such as book-keeping, custodianship, administration, law, etc. Further emphasis is given to this point of view by the considerable amount of published matter relating to various aspects of management in connection with industrial affairs, with much of which the engineer is nowadays directly concerned.

In most of the British universities having faculties of engineering, technical studies represent the outstanding feature of instruction, and it must be admitted that such studies will always be the real backbone of an engineer's training. At the same time, with changing industrial conditions, technical instruction alone—presupposing that this will be followed by a period of practical training—is not an adequate preliminary equipment for an engineer. Consider, for instance, a student who enters a manufacturing branch of the engineering industry—a branch which offers the widest scope and attracts probably the greatest numbers of technically trained men. Such a student will, after his works training, find that his natural interests lie in the direction either of the commercial, technical, works administration, or research department of the organisation. In any one of these departments it is of fundamental importance that he should have a thoroughly sound grasp of the principles of industrial economics, since a cardinal feature of all manufacturing effort is to produce economically, and this is not possible if the basis on which costs are computed and compared is not fully understood. An engineer will be a better designer, for instance, if he can discuss intelligently with the works management details of manufacturing cost. Similar ability is of value to the commercial engineer, and will enable him to appraise correctly the strong and weak features of competitors' efforts. Such knowledge is not at present available in most of the courses of instruction for engineers, although many universities and colleges are paying attention to the matter. In some large works this instruction is given to members of the staff, including the technically trained apprentices, who can make best use of the knowledge, but it is important that works costing and accounting should occupy a much more definite position in the regular instruction of the engineer.

In view of the already overcrowded courses, the main principles underlying these studies could be taught to the student before he enters the university, and he might receive instruction in their practical application, either in post-graduate courses in the university, or by systematic instruction in the works into which he ultimately proceeds.

Another most important subject is that broadly covered by the term "industrial administration," comprising modern methods of management. Shortened hours and increased wages, together with the burdens of taxation imposed by war, emphasise the necessity for increased and more efficient production, and bring to the fore the importance of the prevention of waste, whether relating to time, effort, or materials; a study of the periods of working that will result in optimum effort; factory conditions as regards lighting, ventilation, the supply of food, and everything that conserves the health and vitality of the workers; the selection of workers so that the job is adapted to their characteristics rather than that they should be forced to adapt themselves to fixed conditions imposed by the character of their work; and means for improving the collective efficiency of workers and management by ensuring harmonious relations between them. Related to this subject is the all-important one of the education of both the juvenile and the adult worker, the former being particularly pressing in view of the new Education Act.

We should like to see the principles of industrial administration laid down in the university courses in so far as this can be done without jeopardising the value of the present curriculum. In this connection it is interesting to note that at the Municipal College of Technology, Manchester, a directorship in industrial administration has been set up, which not only provides public lectures to which managers and others interested in industry are invited, but also affords a full-time course of instruction to young men who desire to prepare themselves for managerial positions in industry.

RECONSTRUCTION PROBLEMS.

THE Ministry of Reconstruction is issuing a series of pamphlets which deserves to be very widely read by the public, as they bring briefly and yet clearly to notice a number of considerations of great importance, though probably not familiar to everyone. Two of these pamphlets bear the titles "The Classics in British Education" (No. 21) and "Natural Science in British Education" (No. 26).

It is remarkable, notwithstanding the discussions which have been going on during the last forty years or more on the conflict between literature and science in education, how much confusion still exists, even in the minds of fairly well informed people, as to the aims of the two parties in the controversy. It is a misfortune that the word "science" has become perverted from its original meaning to such an extent that it now

seems to connote something mysterious and apart from ordinary modes of thought or practice, whilst, as Huxley pointed out long ago, science is just common knowledge, but exact and purified from error whether in observation or inference. In the words of the pamphlet, science should be "treated as one of the humanities or a record of the progress of human thought applied to the solutions of the problems of Nature."

Sir Joseph Thomson's Committee, the report of which is largely the theme of this publication, states: "We are by no means sure that the popular interest in science is as great to-day as it was thirty years ago." This is a point which might well be regarded as debatable, in view of the constant talk about the marvels of modern scientific discovery and invention, but that ignorance still prevails in unexpected quarters is quite true. It seems necessary that the education of those especially who are likely to become members of the ruling class should be so far rectified that in the next generation it can no longer be said that the Ministry of the Crown is from top to bottom ignorant of the most rudimentary ideas in this direction.

As concerns the subject of the other pamphlet under notice, there is much here that deserves careful thought. We may agree that "the real enemy of education is want of faith in its value," and deplore the general tendency to look for purely utilitarian results. We may agree that "if there is one thing more certain than another it is that the Allies won the war because their moral ideals were higher than those of Germany," while we may demur to the assumption that these arise to any preponderant extent out of the study of the Greek and Latin classics.

The pamphlet is composed in a laudable spirit of liberality towards other studies, and it is well that each side should remember that "one mind responds best to one stimulus and one to another," but it remains clear that a mind nourished on purely literary material, while careless of the physical universe, is not only deprived of one great source of delight, but is also incapable of perceiving many of the influences which are at work in shaping human destinies.

THE RETURN OF R 34.

THE rigid airship R 34 has successfully accomplished the return flight from New York to Pulham, in Norfolk, where it landed safely on July 13, having left Long Island on July 10. As might have been expected from the direction of the prevailing winds, the return journey was made in considerably less time than the outward crossing, occupying only 75 hours, as against 108 for the previous flight. The highest speed recorded on the return crossing was 72 knots, or nearly 83 miles per hour. One of the engines broke down completely in mid-Atlantic, but this did not seriously hamper the airship, the full power of which was only used when severe head-winds were encountered. Major Scott's account of the voyage seems to indicate that thick fogs are the airship's worst enemy, preventing, as they do, the observations which are required to determine the course. A dead reckoning by compass and air-speed indicator is still possible in a fog, but this only gives the course relatively to the air, and takes no account of the motion of the air relatively to the earth.

The start homeward was hurriedly arranged to prevent the airship being caught in a gale at her moorings, and the strong westerly wind which was blowing at the time enabled R 34 to make rapid headway on her course eastwards. Weather conditions on the homeward passage were very similar to those prevailing over the Atlantic during the outward voyage, but the more southerly route followed on the western side of the ocean led to the avoidance of much bad weather. Anticyclonic conditions have prevailed over the open Atlantic for some time past, but a change may reasonably be expected soon. After the summer weather conditions have broken up, Atlantic flight by any class of machine will probably be in abeyance for several months. The *Times* of July 15 says:—

> Some remarkable wireless signals were exchanged during the voyage of the R 34. The Royal Air Force station at Dundee exchanged signals at 1000 miles. The R 34 sent messages at 1100 miles that were read by the Air Ministry and by Wormwood Scrubs at 1135 miles, and by Ballybunion at 1600 miles. In one case, when the R 34 was approaching America, a signal was sent to her from the Air Ministry through Clifden, and a reply received *via* St. John's, Glace Bay, Clifden, and Marconi House, and then to the Air Ministry, all in twenty minutes—a very fine example of wireless telegraphy work.

The double crossing of the R 34 must be regarded as a very great achievement in the history of aeronautics, a flight of 7600 miles in two stages being an enormous advance on previous records. The airship has also abundantly proved its capability to withstand fairly severe weather without mishap. The possibility of commercial trans-Atlantic airships seems to be mainly governed by the question of speed. The cost of transport is at present very much higher for aircraft than for even the most rapid means of land and sea communication, and it is only in virtue of high speed that aircraft will find their use in the commercial world—at any rate for the next few years. The question is further complicated by the fact that airships may meet adverse winds having velocities equal to, or even greater than, their own maximum speed, whereas the ocean liner has only to contend against currents of very low velocity compared with its own steaming speed. The airship, like the steamship, is most economical to run at low speeds, and analogy would lead one to expect that only by greatly increasing the size of airships can high speed and commercial success be attained, exactly as has been the case with the ocean liner. Whatever the future may hold in store, we cannot fail to admire the wonderful achievement of the R 34,

the first aircraft to journey from the Old World to the New and back again, and we extend our heartiest congratulations to Major Scott and his crew on the unqualified success of their remarkable flight.

NOTES.

ON July 11—the eve of his seventieth birthday—Sir William Osler, Regius professor of medicine in the University of Oxford, was presented with a collection of essays contributed by representative members of the profession on both sides of the Atlantic—physicians, surgeons, physiologists, anatomists, pathologists, and historians—to the number of one hundred and fifty. The presentation was made before a large audience at the house of the Royal Society of Medicine by Sir Clifford Allbutt, Regius professor of physic in the University of Cambridge, who said that though the last years had been a time of war and desolation, yet through the clamour and destruction Sir William Osler's voice among the voices in the serener air of faith and truth had not failed; nor had he grown weary in labouring for the sufferings of others. In Sir William Osler was to be seen the fruitfulness of the marriage of science and letters and the long inheritance of a culture which, amid the manifold forms of life, had survived to inspire and adorn a civilisation which so lately had narrowly escaped the fury of the barbarian. Sir William Osler, in reply, said that two circumstances deepened the pride he felt at this demonstration of affection by his colleagues on both sides of the Atlantic; one, that amid so much mental and physical tribulation his friends should have had the courage to undertake this heavy two-volume task, and the other that this honour was received at the hands of his brother Regius professor, a friend of more than forty years. He had deeply appreciated the loyal support of the large circle of men with whom his contact had been through the written word, the general practitioners of the English-speaking world. A vote of thanks to Sir Clifford Allbutt, moved by Sir D'Arcy Power and seconded by Sir Donald MacAlister, was carried by acclamation. The volumes have not yet been issued to the subscribers, and subscriptions may still be sent to the English publishers, H. K. Lewis and Co., 136 Gower Street, W.C.1.

BY the death of Sir John Brunner on July 1 the world has lost, not only a great industrial leader, but also a man famed for his wide sympathy with, and his practical support of, national schemes for the improvement of the conditions of labour, no less than for the development of scientific education and research. It is no small thing in this country that a man of wealth should endow the university of his native city with three professorial chairs in physical chemistry, in economic science, and in Egyptology. Born at Everton in 1842, Sir John Brunner was trained in the Unitarian school which his father, son of a Protestant minister at Zurich, had opened in Liverpool. At fifteen he began his business career in a shipping office, and at twenty entered the chemical works of Messrs. Hutchinson and Earle at Widnes. Here he began that association with Dr. Ludwig Mond which was destined to revolutionise the alkali industry. Convinced of the economic advantages of the Solvay system, the two joined forces and started making soda by the ammonia-soda process in 1873 at Winnington, Cheshire. How "Brunner, Mond's" overcame its first difficulties owing to the business capacity and the chemical genius of the partners, and how the firm absorbed neighbouring works at Lostock-Gralam, Middlewich, and Sandbach, which, adding their output to that of their ever-growing parent at Winnington, gradually made it the largest in the world, makes one of the romances of industrial science. If before the war Sir John Brunner preached reduction of armaments at home and a friendly understanding with Germany abroad—and his critics have not failed to remind the world of the fact—it is fair to record that *in the war* no firm was in a finer position to turn its magnificent resources to the supply of high explosives, and no firm made a more wonderful or more successful effort to do so than the firm founded by Sir John Brunner.

THE Civil List pensions granted during the year ended March 31 last, under the provisions of the Civil List Act, 1910, includes the following:—Mrs. Edith Harrison, in consideration of the services rendered by her late husband, Col. W. S. Harrison, in connection with inoculation against enteric and typhoid fevers, 50*l.*; Mrs. Cash, in view of the contributions of her late husband, George Cash, to the study of Scottish topography, 50*l.*; Mr. William Cole, in view of his contributions to the study of natural history and to scientific education, 50*l.*; Mrs. R. O. Cunningham, in view of the services of her late husband, Prof. Cunningham, as naturalist on board H.M.S. *Nassau* during the survey of the Straits of Magellan and the west coast of Patagonia, and as professor of natural history in Queen's College, Belfast, 50*l.*; Mr. Benjamin Harrison, in view of his devotion to scientific work (in addition to his pension of 26*l.* a year), 25*l.*; Mrs. E. A. Mettam, in view of the distinction of her late husband, Prof. A. E. Mettam, as professor of pathology and bacteriology, and of his contributions to veterinary science, 75*l.*; Miss Helen Tichborne, in view of the late Prof. Tichborne's scientific discoveries in chemistry and pharmacology, 60*l.*; Miss Eliza Standerwick Gregory, in view of her eminent services to botanical science, 60*l.*; and Lady Eleanor Charlotte Turner, in view of her late husband, Sir George Turner's services in the investigation and prevention of rinderpest, and in consideration of his death through contracting leprosy in the public service, 50*l.*

THE Ministry of Ways and Communications Bill was read a third time in the House of Commons on July 10. Sir Eric Geddes, the Minister-Designate, announced the names of the prospective heads of departments as follows:—*Civil Engineering:* Sir Alexander Gibb, Civil Engineer-in-Chief, Admiralty, 1918. *Mechanical Engineering:* Lt.-Col. L. Simpson, R.E., Chief Mechanical Engineer in Charge of Railway Equipment and Rolling-stock of the British Armies in France. *Consultant Mechanical Engineer:* Sir John Aspinall, president of the Institution of Civil Engineers. *Traffic Department:* Sir Philip Nash, K.C.M.G. *Finance and Statistics:* Sir J. George Beharrell. *Development Department:* Rear-Admiral Sir Charles Martin de Bartolome, K.C.M.G. *Public Safety and Labour:* Sir William Marwood, K.C.B., Joint Permanent Secretary of the Board of Trade. *Roads Department:* Brig.-Gen. Sir Henry P. Maybury, K.C.M.G. *Secretarial and Legal:* Sir R. Francis Dunnell, K.C.B.

CAPT. H. J. PAGE has taken up the appointment of research chemist and head of the chemical department of the Research Station and School of Horticulture of the Royal Horticultural Society at Wisley, Surrey, on his release from military service. Capt. Page is an 1851 Exhibition research scholar of University College, London, and was formerly on the staff there.

THE Joint Committee of the Board of Agriculture and Fisheries and the Road Board appointed to consider the question of alleged damage to fisheries from

the washings of tar-treated roads has selected Mr. A. J. Mason-Jones as biologist and observer to assist with experiments, which will be commenced in the near future. Mr. Mason-Jones has had a distinguished academic career and considerable experience as naturalist on the staff of the Marine Biological Association. He has recently been engaged in a study of the biological conditions of fresh-water streams.

THE third annual meeting of the Association of British Chemical Manufacturers was held on July 10. The chairman, Mr. R. G. Perry, reported a membership of 145 firms, representing a capital of about 70,000,000*l*. In addition, seven kindred associations are affiliated to the association. During the year much useful work has been accomplished in consolidating the industry and strengthening the position of its various branches. The chairman pointed out that we are only on the threshold of a great dye industry in this country, and the council of the association has paid close attention to this question. A strong commission of the association, representative of all branches of the industry, has recently returned from, and reported comprehensively upon, its visit, under Government auspices, to the chemical factories in the occupied area of Germany. Chemical industry has derived great benefit from the activities of the association since its formation in 1916.

THE death of Mr. Albert Vickers, formerly chairman of Vickers, Ltd., occurred at Eastbourne on Saturday last. Mr. Vickers resigned his chairmanship last September on attaining his eightieth birthday. He was born in Sheffield, and entered his father's business in 1854. After a few years in the United States he returned to this country, and took charge of the commercial side of the business. The success with which the firm has met the enormous demands made upon it during the war is striking testimony to the soundness of the policy pursued by Mr. Vickers. The construction of guns began with the introduction of Mr. (afterwards Sir Hiram) Maxim in 1883, and orders for large guns were secured from the Admiralty in 1888, as well as orders for armour-plate. A further development took place in the direction of enabling the firm to carry out the complete construction of products, *e.g.* battleships, instead of furnishing steel, etc., to other constructional firms for this purpose. The Naval Constructional Works at Barrow-in-Furness were absorbed in 1896, and the Maxim-Nordenfelt Works in 1897. Others followed until the company became independent of outside supplies, and the capital increased from 155,000*l*. to more than eight millions sterling, and the workers from 1000 to more than 100,000.

WE are glad to note that the publication of the *Quarterly Journal of Experimental Physiology* has been resumed after suspension during the past year. The editors announce that it is intended that the journal shall now again appear regularly. Of the eight papers in the present issue (vol. xii., No. 2, May, 1919) we have space to note only certain conclusions in one. Prof. P. T. Herring finds that the suprarenals of the young adult female white rat are normally some 40 per cent. heavier than the suprarenals of male animals of the same body-weight, and that the adrenalin content of the suprarenals of the female white rat is rather more than twice that of the suprarenals of the male animal of the same size. The larger suprarenals and adrenalin content of the female white rat are associated with sex differences in the other endocrine glands and organs of the body (*e.g.* thyroid and pituitary).

CRAWLING medusæ, or jellyfish, with their tentacles modified to form what may fairly be called legs, have long been known, but they are rarely met with, and the discovery of a new species at the Cape of Good Hope is a matter of considerable interest to zoologists. Dr. J. D. F. Gilchrist describes this species under the name *Cnidonema capensis* (*Quarterly Journal of Microscopical Science*, vol. lxiii., part 4), instituting a new genus for its reception, and associating with it generically four other southern species previously known. The medusa, which first appeared in a tank at the Marine Laboratory near Cape Town, is very small, usually less than 1 mm. in diameter. Its numerous tentacles divide, as usual in the crawling medusæ, into two branches, one of which is modified for "walking," while the other is provided with batteries of thread-cells and curves over the back of the animal. It is produced by budding from a small hydroid form, with a verticil of three capitate tentacles around the mouth, and a second verticil of six non-capitate tentacles lower down, which was also found in the aquarium.

MR. J. RUNNSTRÖM has made at Monaco and at Bergen some very careful observations on the movements and physiology of sea-urchin larvæ, now published in Bergens Museums Aarbok, 1917–18. Locomotion is generally in spirals or in large curves, accompanied by a revolution of the larva, so that the course reminds one of the moon's orbit. This is effected by the cilia, chiefly of the processes and epaulettes, but also of the general body-covering, and the curves are due to greater intensity of action on one side or the other. The direction of motion is affected by light, and by chemical or other stimuli. The course of the ciliary currents which convey food to the mouth is also studied, and they are found to have some selective power, not, however, free from error. The food-particles when they reach the œsophagus are retained by a slimy secretion, and are carried further by ciliary currents, the course of which is described. In his remarks on the action of the larval water-vascular system, Mr. Runnström mentions that the hydropore is at first on the left, but closes, and a new hydropore opens on the median line. There are many other points in this detailed study which should be of interest to general physiologists as well as to students of Echinoderms.

Two areas in the forest-lands of eastern Canada, easily accessible from the growing cities to the south, have been recently described by the Geological Survey of Canada. In Memoir 95 Mr. W. H. Collins deals with the Onaping map-area, and describes some interesting rocks from the pre-Huronian schist-complex, including what he believes to be the first discovery of variolite in Canada. He refers the cliff-bordered linear valleys of the district to faulting, and Mr. M. E. Wilson, in Memoir 103, on Timiskaming County, Quebec, comes to the same conclusion. These valleys are pre-Glacial, and are probably due to a Pliocene uplift. It may be remarked that similar valleys of recent origin in Finland are also ascribed to earth-movement acting on the hard pre-Cambrian rocks. The cliffs are thus uneroded fault-scarps. On both shores of Lake Timiskaming the passage from the Lorrain granite to a quartzite of the Cobalt series, through an arkose that represents the soil-surface of early Huronian times, is an interesting feature of the region; exploration is as yet practically confined to the waterways. The first hint of the mineral wealth of Canada was given when the veins of galena on the lake-side at Anse de la Mine were indicated on a map published in 1744.

PERSIA'S mineral wealth is great, but the greatest yet discovered is mineral oil, the exploitation of which will shortly be commenced (*Allgemeine Oesterreichische*

Chemiker- und Techniker-Zeitung, December 1, 1918). Deposits of unknown value underlie the extensive oil-field of the Irak districts. Trial borings have shown an oil-bearing tract of more than 1000 sq. km., apparently capable of yielding a larger output of oil than the Baku wells, and of better quality. The northern limits of the oil zone lie in the province of Kermanshah; to the east it reaches to near Ispahan, runs diagonally across Arabistan, continues along the border hills of Dashti and Dashtistan behind Bushehr, the most important of the Gulf ports, and ends in the neighbourhood of Banda-Abbas, the terminus of the great caravan-route, Meshed-Kirman. Borings made in 1890 proved the existence of rich oil deposits in the Island of Kishem, off the coast. Since that date great progress has been made in developing the industry. Persian oil is said to be superior to the American; it contains a large percentage of benzene and kerosene.

A WRITER in *Zeitschrift für Instrumentenkunde* (November, 1918) describes a series of tests made on a Benedick galvanometer of the differential type to determine the cause of variations in its zero reading. The instrument is of the d'Arsonval type, the moving coil being suspended by a quartz fibre and the current led in and out by four thin metal ligaments. Tests show that the sensitiveness depends on the curvature of the pole-faces, and an analysis of the results with the aid of the equations of motion of the movement shows that the change is due to an alteration in the restoring force. As the suspension was unaltered during the test, it follows that the effect is due to magnetic action. This action is caused by the presence of traces of iron in the copper winding. This assumption is borne out by tests, which are described, showing the change in sensitiveness due to varying the position of the moving coil in the field. There is an after-effect causing a permanent motion of the zero of the instrument in the direction of the last deflection.

A PAPER by Messrs. F. B. Silsbee and R. K. Honaman, of the United States Bureau of Standards, which appears in the Journal of the Washington Academy for May 4, summarises the results of their work during the last two years on the relative merits of the various insulating materials used in sparking-plugs. Cup-shaped vessels of the materials were tested between 200° and 900° C. in an electric furnace, the resistivity being determined from the fall of potential between the molten solder inside and that outside when a measured current passed through the cup. Measurements with direct currents were found to be useless owing to the polarisation produced, but with alternating currents of 60 cycles per second the results for the same specimen were always consistent. At 500° C. the resistivities of a few typical materials in megohms per cm. cube are:—Fused silica 340, best porcelain 80, typical mica 70, aeroplane plug porcelain 40, motor-car plug porcelain 0·8. A minute quantity of impurity in the material appears to reduce the resistivity considerably. The change of resistivity with temperature is given by $\log_{10}R=c-bT$, where R is the resistivity, c is a constant between 10 and 12, and b a constant between 0·0065 and 0·0085.

IN the science reports of the Tohoku Imperial University, vol. vii., No. 3, there is an account by Murakami of an investigation of the structure of ferro-carbon-chromium alloys. By utilising methods of magnetic analysis and microscopic examination, alloys containing less than 6 per cent. of carbon have been systematically investigated, and a structural and constitutional diagram of their normal states has been obtained. The author confirms the existence of a compound Cr_4C, having a hexagonal crystalline form as put forward by Moissan. The influence of this carbide on the A_1 change in steels has been investigated. Above this point the carbide dissolves in austenite, and, on heating to a high temperature, it dissociates as follows:—

$$2Cr_4C=Cr_3C_2+5Cr.$$

During cooling the reverse change takes place only slowly, and this influences the position of the transformation point. On one hand, if the rate of cooling is sufficiently slow, the change occurs at about 700° C.; while on the other, if it is quick, the transformation point is very conspicuously lowered, and in extreme cases completely suppressed. A specimen having a normal transformation point shows a pearlitic or troostitic structure, one having a lowered transformation point a martensitic structure, and when the transformation is suppressed an austenitic structure. The self-hardening of a chromium steel is related to the lowering, or, in extreme cases, the suppression, of the A_1 transformation, and hardness is caused by the solid solution of the carbide Cr_3C_2 in iron and chromium. The author has come to the conclusion that there are three ternary compounds, namely, α, β, and γ double carbides. The micrographic and magnetic characteristics of these compounds have been investigated by him.

THE results of some interesting tests on locomotive piston-valve leakage are given in *Engineering* for July 4. The tests were conducted by the test department of the Pennsylvania Railroad at Altoona, and have extended over several years; a specially arranged testing plant was employed. The results were erratic, and the following abstract of some of the results takes account only of all that appeared normal. With a standard two-ring valve, 12 in. in diameter, in plain bushing, the leakage at each end of the valve ranges between 171 lb. and 183 lb. per hour with saturated steam; between 194 lb. and 210 lb. with steam at 100° superheat; between 181 lb. and 197 lb. with steam at 200° superheat; and between 122 lb. and 132 lb. with steam at 300° superheat. For the bushing with ports a leakage between 302 lb. and 326 lb. per hour occurred with saturated steam; between 425 lb. and 448 lb. per hour for 100° superheat; and between 383 lb. and 414 lb. per hour for 200° superheat. The length of valve-travel, when it ranged between 2 in. and 6 in., was found to have but little effect upon leakage. The speed of the valve (strokes per minute) had no appreciable effect upon leakage. As much as 15 h.p. was required to drive the valve in tests at 300 revs. per minute.

Messrs. George Allen and Unwin, Ltd., have in preparation "Defective Housing and the Growth of Children," by Dr. J. L. Dick. Three lectures recently delivered before the University of Cambridge are announced for publication by the *Cambridge University Press*. They are "Science and War" (the Rede lecture), by Lord Moulton; "Italian Studies: Their Place in Modern Education," by Prof. T. Okey; and the Leslie Stephen lecture on Pope, by Dr. J. W. Mackail. The same publishers also promise a revised edition of Dr. A. Harker's "Petrology for Students." *Messrs. Longmans and Co.* announce for publication in the autumn a new book, limited to 105 copies, by A. Thorburn, entitled "A Naturalist's Sketch-Book," containing 60 plates, 24 in colour and 36 in collotype. It will form a companion volume to the same author's "British Birds." Among other books in the press for appearance by Messrs. Longmans we notice "An Introduction to General Physiology," Prof. W. M. Bayliss; "The Principles of Child Physiology, Pure and Applied," Dr. W. M. Feldman; "The Physiology of Muscular Exercise," Prof. F. A. Bainbridge; "Cement," B. Blount; "Applied Aero-

dynamics," L. Bairstow; "Aeroplane Structures," A. J. S. Pippard and Capt. J. L. Pritchard; "The Design of Propellers for Aircraft," H. C. Watts; "Telephonic Transmission, Theoretical and Applied," J. G. Hill; "Principles and Practice of Electrical Testing as applied to Apparatus, Circuits, and Machines," R. G. Allen; "Engineering Machine Tools and Processes," A. G. Robson; and "Efficient Boiler Management," C. F. Wade.

ERRATUM.—We regret that in the article on "Some Recent Atomic Weight Determinations" in NATURE for July 3, p. 346, the name of Prof. T. W. Richards was incorrectly given as "Theodore Williams," the surname being omitted.

OUR ASTRONOMICAL COLUMN.

THE MOVEMENT OF THE EARTH'S POLE.—The issue of *Scientia* for July contains an article by the Astronomer Royal on this subject, which comprises a concise statement of the movement predicted by Euler, and of suggestions that have been made to show why the observed movement does not conform to this. The Eulerian principle enunciates that the axis round which the earth would turn, assuming it to be a rigid body set spinning about an axis other than the axis of figure, would always point in the same direction in space (*i.e.* among the stars) within a very little, but would describe a cone in the earth in a period of 305 days, the radius of the circle described by the wandering pole being about 10 metres. Observations show that the movement is compounded of two circular motions of periods of a year and of 432 days respectively. Sir Frank Dyson writes that the dynamical causes underlying these movements are probably to be found in the changes of distribution of matter on the earth, and quotes Newcomb, who thought the amplitude of the Eulerian movement was increased or diminished irregularly by meteorological changes. Mr. Harold Jeffreys has lately shown that a shift of matter symmetrical about the earth's axis will not have any effect in shifting the earth's axis of rotation, and looks for the cause in an unsymmetrical increase of mass, such as is caused by the high barometer over Siberia in the winter, which, however, is not sufficient of itself to produce the observed effect. The lengthening of the free Eulerian period from 305 days, on the assumption of a rigid earth, to 432 days supplies information as to the possible amount of elasticity of the earth.

THE MASSES OF BINARY STARS.—There is a well-known formula by which the total mass of a binary system can be found if the parallax is known, as well as the elements of the orbit. The modern method of deducing stellar parallax by examination of the spectrum therefore provides much data for determination of mass, and Prof. Aitken, of Lick Observatory, has lately (Pub. Ast. Soc. Pac., June) used the parallax of twelve binaries taken from Messrs. Adams and Joy's list to find their masses. These had been already found by help of the trigonometric parallax, and though considerable discordance was shown for individual systems, the agreement of the mean mass of the twelve binaries, which was 1·61 times that of the sun by the one method and 1·67 times by the other, showed that the new parallaxes might be considered trustworthy for mean results. Prof. Aitken, therefore, determined the mass of seven other stars which are common to the list above cited and his own list of binary systems. These, with Sirius and α Centauri and the twelve before mentioned, make a list of twenty-one systems the mass of which is known. They range from 0·21 to 7·21 times that of the sun, the mean value being 1·88; and though some of the individual mass-values must still be regarded as uncertain, the mean result may be taken as confirmatory evidence that the short-period visual binary systems near to us are about twice as massive as our sun. It may be noted that five stars of classes K and M are, on the average, only half as massive as the sixteen stars of classes A to G, and are, on the average, nearly four magnitudes (absolute) fainter.

SCIENCE IN INDUSTRY.

LECTURES AT THE BRITISH SCIENTIFIC PRODUCTS EXHIBITION.

SIR WILLIAM TILDEN, in his lecture on "Chemistry in Reconstruction" at the British Scientific Products Exhibition on July 7, remarked that a visitor to the exhibition could not fail to experience the comforting conviction that British chemical manufacturers are now quite capable of holding their own in regard to quality and variety of products. They will undoubtedly be able to supply the wants of this country if they continue to exhibit the same skill, energy, and resource which have been gradually developed during the last five years, and to be protected for a time from foreign imports. With regard to trade outside the United Kingdom, it is too soon to indulge freely in optimism. The Prime Minister, in his recent speech in the House of Commons on the Peace Treaty, pointed to the condition of German territory, which has not been damaged or disturbed to any appreciable extent by the operations of the war, and still retains the famous chemical establishments with plant and machinery in working order, and even increased in power by the material stolen from Belgian and French factories. Moreover, Germany has the services of a very large body of technical chemists of great skill and experience. Germany will, naturally, make greater efforts than ever to penetrate into foreign markets. Then there is Switzerland, with good schools of chemistry and an already established chemical industry. The United States of America during recent years has vastly extended the chemical departments of its universities and technical schools, and devoted huge sums to the development of chemical manufactures. Japan also with a well-equipped university and many natural products, combined with cheap labour, will certainly appear in the field.

All these will undoubtedly prove very formidable competitors in the race in which the British chemist will have to enter. In this country also there is still a great deficiency in the number of well-qualified chemists available for the service of industry. The manufacturer has too long been satisfied with the services of the laboratory boy, who can be taught to perform routine testing without any knowledge of more than the most elementary chemical principles. We require a large number of well-educated men equipped with the fullest possible knowledge of modern chemistry in every branch. Lord Crewe referred at the opening of the exhibition to the several methods which have been so far employed for converting the academic into the industrial chemist. There can be little doubt that this is best accomplished in the works, and in the long run manufacturers will find it pay best to employ the academic chemist thoroughly drilled in the practice of analysis and well acquainted with all the methods of research, who must be assumed also to possess common sense, and give him facilities for gaining that knowledge of constructive materials and elementary engineering which is requisite for his work.

The exhibition contains a most instructive and

encouraging collection of definite products, the manufacture of which on a large scale has been made possible in the British factories during the last five years, when the chemical skill and energy available were largely absorbed in the business of making explosives and other war material. This is very satisfactory, but the applications of chemistry, apart from the manufacture of definite products, must not be overlooked. Examples of such application are to be seen on every side, in metallurgy, in agriculture, in physiology and medicine, in the treatment of water, and in sanitation.

Sir William Tilden concluded his lecture by pointing out that one great feature of modern chemical manufacture is the production by synthetic processes of compounds which hitherto have been derived from natural sources. Of these the most remarkable is the production of ammonia by combination of hydrogen with atmospheric nitrogen, which, notwithstanding the physical difficulties, is likely to proceed on a very large scale. Another case of a different kind is the production of rubber which has been going on in Germany during the war. There can be no doubt that in a few years this substance will appear on the market provided the initial material, at present acetone, is available at a sufficiently cheap rate. Synthetic rubber now obtainable in the laboratory costs about twenty times as much as the natural article from the plantation.

In his lecture on July 8 on the subject of transmitting and picking up sounds in water, Prof. W. H. Bragg first made clear the great difference between the noisy air-world above the sea and the quiet, almost soundless world below the waves. This is all the more remarkable in view of water being a much better carrier of sound than air. Being specially engaged during the war on an investigation of submarine sounds, he had visited the Zoo to study fishes and their hearing or sounds produced by them. Their powers were, however, found to be so deficient as to suggest that lack of noise in their movements under water had rendered acute hearing valueless to the fish in its struggle for existence, either as the hunter or the hunted. By means of gramophone records, lent by the Admiralty, Prof. Bragg showed how the silent submarine world was disturbed by the movements of ships or by the breaking of waves on the coast, and how difficult it was, among the loud noises made by neighbouring propellers, to distinguish the faint sounds caused by a submarine. The hearing of these was the real object in view, and a record of the German submarines entering Harwich was used to show their special character.

Some of the means used for locating the source of the sounds were also described, and a full-sized "hydrophone" was shown, consisting of a diaphragm carried in a heavy iron ring and shielded on one side by a special plate of xylonite enclosing several air-cells, which so blocked the sound-waves coming in that direction as to form the equivalent of turning a deaf ear in one direction. Lantern-slides were shown taken from kinema-films which illustrated graphically the vibrations received by a microphone placed at the centre of such a shielded diaphragm. Prof. Bragg's explanation of the films led to a most interesting deduction as to the post-war value of these investigations. He showed a film on which appeared six parallel records of receiving galvanometers representing the conditions at six different stations. Each station was equipped with such a hydrophone and connected up electrically to the galvanometer, which recorded their vibrations on the film as lines, which in this case remained perfectly even until a destroyer, sent straight out to sea for the purpose, exploded a depth-charge. As the sharp sound-wave sent out thereby reached each hydrophone, the corresponding line broke up into oscillations, and the moment at which these oscillations began was clearly indicated to a thousandth of a second by their position on the film, giving the exact time of arrival of the sound-wave at each hydrophone. The speed of sound in water being also well known, the position of the ship at the time of each explosion could therefore be ascertained.

The greatest distance recorded on the film was seventy-five miles, but the undiminished accuracy of its indications proved that the method of locating ships at sea would be successful at much greater distances, and at the present time it has been developed up to a range of 230 miles, with no sign of falling off in its efficiency. On shorter distances it has been found possible to signal with a simple detonator instead of the 40-lb. charge used in the first experiments. These preliminary successes open up a most promising field of practical applications, especially in coastal surveys and the exact location of rocks and shoals. At present it is being largely used in the North Sea, several stations being at work on the east coast of Britain. It has also been successfully used for the exact location of ships and aircraft during fog.

The lecture on "Coal Conservation" given by Prof. H. E. Armstrong on Friday, July 11, was a protest against the legislation foreshadowed in the Electricity Supply Bill now before the House of Commons as both premature and narrow, and a plea for a complete inquiry into the uses of coal, with the view of co-ordinating the various interests and the ultimate comprehensive treatment of all the industrial issues. Prof. Armstrong favours the production of a smokeless fuel, with the object of abolishing the smoke nuisance and also of saving the valuable volatile products which are wasted in burning raw coal. He would therefore have the use of raw coal entirely disallowed in the near future; in view of the prospective world-shortage of petroleum, it will be criminal folly if we fail to produce all the oil-fuel that it is possible to obtain by subjecting coal to a preliminary distillation at a relatively low temperature. He is an advocate of the establishment, at least in the larger towns, of fuel and power centres charged with the supply of all the forms of fuel and power required by the public within their areas. Coal should be carbonised at these centres in such a way as to secure the recovery of the maximum proportion of by-products, which might be in part distributed and in part further utilised at the centre in generating electric current. The advantages attending the use of an easily combustible solid fuel instead of gas as a domestic heating agent were insisted upon. In the subsequent discussion this recommendation was strongly supported by Prof. Bone, who spoke against the suggested provision of gas-heating appliances alone in the improved dwellings which it is contemplated to provide for the use of the masses. Whilst suitable for kitchen and occasional use, gas is not only much more costly than solid fuel but also a far less healthy means of heating dwelling-rooms over any considerable period. The scheme suggested would render possible the supply of a heating gas of higher quality than is now contemplated by the gas interests; for if the whole of our bituminous coal were carbonised at a low temperature, a large amount of rich gas would be produced which would bear dilution with "water-gas" and yet be superior as a calorific agent to that which the gas companies can provide in existing circumstances. The advantages the scheme has are such that, ere long, electricity should entirely supplant gas as an illuminating agent.

AMERICAN ASTRONOMY.

IN the year 1840 the Dana House Observatory of Harvard College was established by the aid of public funds and private subscription, with William Cranch Bond as director. It was not the first college observatory in America, and other eminent American astronomers had lived earlier in the century, but the date may be taken as the beginning of systematic astronomical observation in the Western continent. The U.S. Naval Observatory was established in 1844, and the present Harvard Observatory founded, largely by generous help from private benefactors, in 1846. Other institutions of the period might be named where the science of astronomy of position was pursued, and this, with the splendid work on planets, satellites, comets, asteroids, nebulæ, and the astronomy of the solar system generally done at Harvard by W. C. Bond and G. P. Bond, and afterwards by Winlock, is to be considered representative of the astronomy of the United States in the succeeding forty years. The accession of the late Prof. E. C. Pickering to the directorate of the Harvard Observatory in 1877 marks the beginning of the astronomical era in which we now live. Spectroscopy, stellar physics, and stellar statistics are the principal features. Prof. Pickering's work was stellar photometry on a wholesale scale. Stellar spectroscopy and the determination of the radial velocity of stars by its means had been begun by Huggins in 1864; the photographic plate came into general use as an adjunct to the astronomer's equipment in the decade 1880–90, and these three items have formed the basis of the work of the American observatories of recent creation. The Lick Observatory, with the 36-in. telescope, was completed in 1887 at the expense, as everyone knows, of an American business man. The Yerkes Observatory came into existence in 1897, and the observatory at Mount Wilson in 1904. These things are recalled at this moment because, during the past week, English astronomers have been gratified by a visit from a delegation of astronomers from across the Atlantic who were on their way to take part in the establishment of an International Astronomical Union at a conference now being held in Brussels (July 18–28).

At a meeting of the Royal Astronomical Society on July 11, specially arranged for the purpose, the visitors spoke in turn of the work on which they are each engaged, and the contrast between the astronomy of to-day and of sixty years ago is apparent. The absolute magnitude of a star or its actual luminosity independent of its distance is now a commonplace, and forms the subject of many investigations. Certain peculiarities of spectrum have been correlated with the absolute magnitude in cases in which the latter is known, and, generalising from this, a method has been devised for finding from the spectrum the absolute magnitude, and therefore the parallax, of stars. Prof. W. S. Adams, to whom this conception is due, was constrained to say that the data on which his first list of parallaxes was based are capable of improvement, but this research is as yet in its early stages. Dr. Seares, also of Mount Wilson, has devised new photographic methods for determining the colours of stars, and a correlation between colour, spectral type, and absolute magnitude is being established. Prof. Benjamin Boss, of the Dudley Observatory, whose name is associated more with geometrical astronomy than with physical, had some interesting facts to tell about the difference in direction of motion of the classes of stars known as the Giant and Dwarf, which is a distinction depending on luminosity.

Dr. Schlesinger, of Allegheny, and Prof. Joel Stebbins gave details of their work in determining the variation of brightness of variable stars, the method of the photo-electric cell used by the latter being a very recent adaptation of physics to astronomy not unknown in England; whilst Prof. Campbell, director of the Lick Observatory and president of the delegation, refrained from speaking of his well-known observations of radial velocity, but told his audience of the observations of the Lick Observatory party on the occasion of the eclipse of June 8, 1918. An attempt was made to detect the Einstein effect, or a light-displacement effect from any cause, by comparison of a photograph of the stars round the sun with a photograph of the same field in the night sky, but the comparison failed to show any displacement of this nature. It is regrettable that the Harvard Observatory was not represented owing to the recent death of Prof. E. C. Pickering.

This brief sketch of the proceedings at this meeting is sufficient to show the trend of modern astronomy. It was impressing to see so many men, comparatively young, who are devoting themselves to abstract science. That there is similar progress on this side of the Atlantic reference to recent volumes of the Monthly Notices will show. Here, as counterpart to the brilliant invention of new methods of attack by observation above recorded, we have development by mathematical theory and the statistical discussion of results.

THE MUSEUMS ASSOCIATION.

THE thirtieth annual conference of this association, held at Oxford on July 7–10, under the presidency of Sir Henry Howorth, showed the return of peace conditions in a particularly large attendance. An important discussion was opened by Mr. E. E. Lowe on a recent recommendation by the Adult Education Committee of the Ministry of Reconstruction that the control of municipal museums (including art galleries) should be transferred to the local education authority. While this recommendation was supported by two officials of the Board of Education, who spoke in their private capacity, it was opposed by all the museum curators and by several members of museum committees, some of whom also served on education committees. Though museum authorities are, as they long have been, anxious to co-operate fully and intimately with schools and other educational institutions, they feel that many of their important functions cannot properly be described as educational, and they deprecate any form of control that would obscure this fact. On the other hand, they would welcome assistance and inspection by a separate museum department that should link up all the museums of the country and be directed by men familiar with museum work. A special committee was appointed to draw up a statement on behalf of the museums, and, if possible, to arrange conferences with the Government Departments concerned.

For some years the association has been trying to induce British manufacturers to provide for museum purposes glassware of a quality equal to that previously procurable only from Germany. Under war conditions no great success has attended its efforts, but Messrs. Standley Belcher and Mason, Ltd., of Birmingham, now submitted a small flat-sided jar which appeared suitable. Trial orders were solicited, and, to attain a reasonable price, it is important that museums and laboratories should support the association in this matter. Communications may be addressed to Mr. E. E. Lowe, Leicester Museum. In this connection it was of interest to learn from Mr. Renouf, of Rothesay, that when he wanted some trimmed glass squares he was told that there was no glass-planing machine in Great Britain. There are

some things we must have, and we do not want to be driven back to Germany for them, but our manufacturers must wake up.

These glass squares were for mounting marine animals in formalin under large watch-glass covers—a mode of exhibition that had proved effective and durable. Mr. Renouf also explained a method of cutting large holes in glass with a screw-tap, and recommended Steubner's waterproof ink for injecting fine blood-vessels. Mr. Rowley described an exhibit for children in the Exeter Museum; Mr. Lowe showed a revolving frame for exhibiting coins; Mr. Carline discussed open-air folk-museums; and Prof. Myres advocated the preservation of objects rapidly changing under present conditions. Profs. Poulton, Sollas, Bourne, and Bowman vied with Messrs. Balfour, Hogarth, and Leeds in demonstrating the riches and methods of their respective museums and departments.

Sir William Martin Conway was elected president of the association for the coming year, and the new secretary is Dr. W. M. Tattersall, Manchester Museum

THE NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.

WITH the view of honouring some of those who helped to win the war, of recording the work done on the North-East Coast for the war, and of commemorating those members of the institution who fell during the war, the North-East Coast Institution of Engineers and Shipbuilders held a Victory meeting at Newcastle-upon-Tyne on July 8–11. The honorary fellowship of the institution was presented to the Hon. Lady Parsons, Marshal Foch, Sir David Beatty, Sir Douglas Haig, Lord Weir, and Sir Joseph Paton Maclay.

Lady Parsons read a paper on women's work in engineering and shipbuilding during the war. The record of skilled work done by women given in the paper controverts the impression which many people have that women are only capable of doing repetition work on fool-proof machines. There is no doubt that many women developed great mechanical skill and a real love of their work. The engineering industry is again barred to women by an agreement made between the Treasury and the trade unions, with the result that women wealth-producers are scrapped. The meeting agreed with Lady Parsons's condemnation of the Labour Party, which, while demanding full political equality for women and their right to sit in the House of Lords and to practise at the Bar and as solicitors, will not grant to women equality of industrial opportunity.

Mr. A. H. J. Cochrane gave a short record of the work of the principal industries of the North-East Coast during the war. There have been two important developments in marine engineering for which the war period is partly responsible. These are the increased and increasing use of speed-reduction gearing in turbine-driven sets—the output of gearing by one firm during 1915–18 amounted to 2,830,000 shaft-horse-power—and, secondly, the high standard of accuracy which has been reached in the design, construction, and installation of turbine machinery. This efficiency has enabled the Admiralty to dispense with exhaustive preliminary trials of machinery. Probably the most remarkable case cited in the paper is that of the destroyer *Nonsuch*, which, under conditions of emergency, actually raised her full power within seven minutes of leaving the piers. It is also of interest to note that the total stoppages of work due to raids and raid-alarms amounted to 47 hours 24 minutes during the whole war period of 221 weeks. The total output was 1130 vessels, with a tonnage of 3,324,912, which gives an average of five ships per week.

A long paper on developments in aircraft design and application during the war was read by Lord Weir. The section dealing with future developments is of special interest. An outbreak of war should see us with the very best designs of engines and aircraft, tried and tested, and with a manufacturing nucleus on which war production may be readily expanded. In civil aviation the more immediate problems of international and domestic aerial legislation have been provisionally solved by the International Aerial Convention and by the Civil Aviation Act, and it is gratifying that in both these directions Great Britain has taken the lead and shown the way. In another direction much remains to be carried out quickly. We possess fleets of aircraft of trustworthiness and of great performance possibility, but our navigational facilities are still almost non-existent, and herein lies one of the main fields of action of our new Department of Civil Aviation. The two qualities of outstanding merit in the new form of transport are speed and independence of action as against land transport requiring roads or rails. Speed in transport is associated with high cost, and speed will always command a high value. Early action should be taken in regard to a few main routes, especially in countries with equable weather conditions, and in new countries backward in rail development. Two such main routes would be Egypt to India, and Egypt to South Africa.

Lt.-Com. Norman Wilkinson gave some interesting particulars regarding his methods of dazzle-painting of ships, from which it appears that the object was not to secure invisibility, but to perplex submarines in the attempt to determine the precise course of the "dazzled" ship. The author, who is a marine painter of long experience, does not consider it possible to secure invisibility at sea. Success in submarine attack depends upon the attaining of a position which enables the attack to be made, and if a submarine once fails to secure the favourable position it is not likely to have a second opportunity. Reports from other ships bear striking testimony to the value of dazzle-painting:—"The vessel, at a distance of two or three miles, appeared as a wreck." "At four miles' distance I decided it was a tug towing a lighter." "I was on the point of stopping my engines and going full speed astern to avoid a collision, when I discovered that she was altering course to starboard. After passing the vessel it was almost impossible to say how she was steering."

Sir Dugald Clerk gave a paper on the limits of thermal efficiency in Diesel and other internal-combustion engines. The author considers that conditions all point to ultimate success in the construction of large gas-engine units composed of many cylinders geared to a common shaft. Large cylinder engines, such as had been developed in Germany before the war, do not permit of very large unit powers except at an extravagant weight and cost, and have no chance of competing with the steam turbine.

The paper on ship repairing by Messrs. M. C. James and L. E. Smith contains many interesting photographs and descriptions of extraordinary and urgent repairs executed during the war.

One of the most valuable papers of the meeting was that on science and its application to marine problems by Prof. J. C. McLennan. Reference is made to the development of listening devices in the submarine campaign. An echo method consists in the use of a beam of sound-waves used in a manner analogous to the use of a searchlight. If an object of sound such

as a submarine happens to come within the beam, the sound-waves are reflected and echo effects are obtainable. Success has been obtained in the picking up and closing on a submarine situated more than a mile away. A very important application of an electromagnetic effect is the Leader gear. A cable is laid on the bottom of the sea along the course of a narrow, tortuous channel leading into a harbour or through a minefield. Alternating currents passed through the cable can be detected on the ship by aural or visual indications, and by these indications the ship can be guided in safety in fog or darkness at speeds as high as twenty knots almost with as much precision as a tramcar over a railway. In water of suitable depth experience shows that it is a simple matter to apply this method for distances as great as fifty miles or longer.

Invisible signalling by polarised light, or ultra-violet and infra-red radiations has been employed where it is not advisable to use wireless communication. In wireless methods, by the use of oscillating thermionic valves especially, great progress has been made. Some extraordinary advances have been made in the measurement of the pressure of explosive waves. Changes which take place in 1/100,000 of a second have been recorded by the method suggested by Sir J. J. Thomson and applied by Mr. D. A. Keys, in which the inertia of a beam of cathode-ray particles is made use of; such rays are deflected by electrostatic and magnetic fields. The advances made in the production of helium warrant the opinion that, had the war continued after November 11, 1918, supplies of helium at the rate of 2,000,000 cubic ft. per month would have been produced within the Empire and the United States, and helium-filled aircraft would have been in service.

It is impossible within the limits of our space to deal adequately with Prof. McLennan's paper, both as regards what science has done in marine problems during the war and the large number of suggestions he makes regarding the application of what has been discovered to peace conditions.

THE SIGNIFICANCE OF THE CEREBRAL CORTEX.

IN the series of Croonian lectures delivered at the Royal College of Physicians (June 12, 17, 19, and 24) Prof. Elliot Smith claimed that much of the obscurity concerning the meaning of the structure and functions of the cerebral cortex was due to the failure on the part of biologists and physicians to face the fact that the cortex is the organ of intelligence, and its chief significance of a psychical nature. It is no more possible to understand the cerebral cortex without recognising to the full its real purpose than it would be to explain the mechanism of an aeroplane if the investigator ignored the fact that the machine was made to fly.

The aim of these lectures was to discuss the means whereby the cerebral cortex acquired its supreme powers as the organ of intelligence. Dr. Henry Head's researches have given us a new vision of the meaning of nervous and mental processes, and have provided all workers in neurology with a new generalisation which compels them to review their own work in the light of the new illumination.

Much that was dark and unintelligible in the evolution of the cerebral cortex acquires a definite significance when the facts are examined in conjunction with the results of Dr. Head's clinical work and Prof. Sherrington's experimental researches.

The mammalian cerebral cortex, *i.e.* the neopallium, is the repository of past impressions, and these sensory dispositions profoundly modify the effect produced by the arrival of fresh impulses. But Dr. Head has shown that, in addition, "the function of the cortex in sensation is to endow it with spacial relationships, with the power of responding in a graduated manner to stimuli of different intensities, and with those qualities by which we recognise the similarity or difference of objects" that appeal to the senses. On the other hand, the appreciation of the affective side of experience, the pleasantness or unpleasantness, and the crude awareness, are functions not of the cortex, but of the thalamus.

Since the discriminative functions of the cortex are particularly associated with the neopallium, which is found in a fully developed form only in mammals, the first inquiry must be directed towards an understanding of the psychical activities of the classes of vertebrates other than mammals; and from such investigations the nature of the circumstances which called the neopallium into being must be determined.

The fundamental fact in the evolution of intelligence is the significant part played by the sense of smell. In the primitive generalised vertebrate it provided the animal with information of varied kinds, but of direct and obvious psychological meaning, by which behaviour was determined in respect of most of those activities that affect the preservation of the individual and the species, namely, the search for food and the appreciation of its quality, the recognition of friends and enemies, as well as of sexual mates or rivals.

One factor which added to the dominating influence of smell and emphasised the directness of its appeal was the result of the circumstance that in an animal living in the water the sense of smell was very nearly akin to that of taste. When such an animal scented food it got, so to speak, a foretaste of the satisfying consummation of the experience when the food was seized, tasted, and swallowed with a feeling of intense satisfaction. The whole incident, from the first anticipation of the pleasure in store until the satisfying consummation, was under the dominance of the sense of smell, which became more and more intensely stimulated as the animal approached its quarry, until it culminated in the gratification and the appeal to the sense of taste. The affective tone of the sense of smell linked into a connected series all the incidents of this experience, and the psychical integration that resulted formed the basis of the appreciation of time and space, of memory, the recall of the earlier incidents of the episode, and of anticipation, the end-result and the joyful consummation.

In the course of the pursuit of its prey the animal is subjected to the influence of many other circumstances that appeal to the senses of vision, touch, pressure, temperature, etc., and affect the organs of equilibration; and the effects of all these events tend to become involved in the process of psychical integration. When such information as is collected by these other sense-organs acquire some biological significance to the animal, the visual, tactile, acoustic, and other sensory tracts make their way into the cortex in increasing numbers: and they stimulate the growth and differentiation of such special receptive areas as the hypopallium and neopallium. But this does not happen until the reptilian stage of development is reached.

When, attracted by its scent, the primitive vertebrate (such as an Elasmobranch fish) is impelled to pursue its prey, it circles about in the search because at first it has no more exact indication of the position of the object of its pursuit than the relative intensity of the odour as the pursuer moves about. But when it comes within visual range it acquires a more precise

knowledge of its prey's exact position and movements in space; then it can direct its own course with greater directness and precision to its goal.

At first vision conveys little or no affective feeling or psychological meaning; it acquires this secondarily from the sense of smell. But the visual mechanisms in the brain control the direction of the animal's movements; and the receptive centre for the optic nerve (the tectum of the mid-brain) is put into direct connection with all the motor nuclei to effect this purpose. So far as influences from the outside world are concerned, smell determines the animal's behaviour, vision directs it, and the vestibular mechanism (cerebellum) provides the means by which the actions of the muscles can be co-ordinated to perform the movements in an orderly and useful way. As the result of these events the influences of all these other experiences are integrated with sensations of smell. Not only are vision, touch, the sensation of movement, etc., thus afforded the opportunity of participating in the mental life, but a fuller appreciation of spacial relations also is acquired by the animal as these other senses add their quota to the creature's knowledge, and obtain a fuller representation in the cerebral cortex as the means towards this end.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

ABERDEEN.—Prof. A. Findlay, professor of chemistry, University College of Wales, Aberystwyth, has been appointed to the chair of chemistry in succession to Prof. Soddy.

BIRMINGHAM.—Mr. Humphrey F. Humphreys has been appointed lecturer on dental anatomy and physiology and curator of the Odontological Museum in succession to Mr. John Humphreys, who has resigned.

The Ingleby lecture for 1920 will be delivered by Mr. Beckwith Whitehouse.

Dr. B. Muriel Bristol has been awarded an 1851 Exhibition scholarship of the value of 200*l.* as a result of the excellence of her work on the algæ of soil, carried out in the botanical department during the past three years.

Dr. Nellie Carter has been awarded 150*l.* for the next session by the Department of Scientific and Industrial Research on the condition that she continues her research work under Prof. G. S. West in the University botanical department.

The Council has gratefully accepted from the family of the late Mr. W. H. Wilkinson, of Sutton Coldfield, a very valuable gift for the herbarium of the botanical department, consisting of a collection of lichens and the associated library collected by the late Mr. Wilkinson. The Council has received a further very valuable gift from Prof. West of the collections of mosses, hepatics, and lichens made by his father, the late Mr. W. West, of Bradford. This, combined with Mr. Wilkinson's collection, will give the University one of the finest collections of lichens in Britain.

BRISTOL.—The University has made the following appointments to the professorial chairs mentioned:—*Botany:* Dr. Otto Vernon Darbishire, lecturer in botany in the University. *Education:* Dr. Helen Marion Wodehouse, Principal of the Bingley Training College, Yorkshire. *Henry Overton Wills Chair of Mathematics:* Dr. H. Ronald Hassé, late fellow of St. John's College, Cambridge; senior lecturer in mathematics in the University of Manchester. *Mechanical Engineering:* Major Andrew Robertson. *Henry Overton Wills Chair of Physics:* Dr. Arthur Mannering Tyndall, acting head of the department of physics in the University during the war. *Henry Overton Wills Chair of Physiology:* Dr. George A. Buckmaster, assistant professor of physiology in the University of London.

LIVERPOOL.—A course of lectures on oceanography, open to the public, without fee, will be delivered by Prof. W. A. Herdman during the autumn and Lent terms, commencing on October 14.

Dr. Leonard Doncaster, F.R.S., has been appointed to the chair of zoology in the University. He is a fellow of King's College, Cambridge; was lecturer in zoology, Birmingham University, in 1906–10; special lecturer in heredity and variation at Cambridge in 1909; and University lecturer there in zoology, 1911–17.

DR. ADDISON, Minister of Health, has provisionally promised to deliver the inaugural address at the opening of the session at the London (Royal Free Hospital) School of Medicine for Women on Wednesday, October 1.

To a private deputation from the Education Committee of the Parliamentary Labour Party, who urged upon him the desirability of an inquiry into the organisation and financial position of the Universities of Oxford and Cambridge, Mr. Fisher has made the important announcement that the Government has decided to appoint Commissions to inquire into the position of the Universities of Oxford and Cambridge. At both Universities the existing resources have proved inadequate to meet the increased cost of maintenance of the various departments, and a few months ago the authorities of each independently applied to the Government for financial aid. In reply to these requests Mr. Fisher, on behalf of the Government, stated that such grants out of Parliamentary funds could be sanctioned only on the condition that in due course comprehensive inquiries into the whole resources of the Universities and their colleges and the use made of them should be instituted by the Government. The Cambridge Senate on May 31 authorised the Vice-Chancellor to inform Mr. Fisher that the University would welcome a comprehensive inquiry into its financial resources, and at Oxford a similar decision was taken by Convocation on June 10.

THE President of the Board of Education has appointed a Committee to inquire into the organisation of secondary education in Wales, and to advise how it may be consolidated and co-ordinated with a view to the establishment of a national system of public education in Wales, regard being had to the provisions of the Education Act, 1918, and to the recommendations of the Royal Commission on University Education in Wales. The members of the Committee are as follows:—The Hon. W. N. Bruce (chairman), Mr. W. R. Barker, Mr. J. N. Davies, Sir Owen Edwards, Miss M. L. Faithfull, Mr. William George, Mr. Thomas Griffiths, Miss E. P. Hughes, Prof. Ramsay Muir, the Rev. Prebendary Prosser, and the Rev. D. H. Williams. The secretary will be Mr. T. O. Roberts, to whom all communications on the subject should be addressed at the Board of Education, Victoria and Albert Museum, South Kensington, S.W.7.

THE Surveyors' Institution offers annually four scholarships, two of 80*l.* per annum and two of 50*l.*, for intending land agents, valuers, building surveyors, municipal surveyors, etc. Each scholarship is tenable for three years at any university or affiliated college selected by the candidate successful in the competitive examination and approved by the council of the institution, subject to the scholar satisfying the authorities of his university or college in regard to progress and conduct. Each scholar, on election, must become a member of the university or college selected,

and must sign an agreement, with the concurrence of his parents or guardians if a minor, to enter the office of a surveyor approved by the council with the view of practising as a surveyor in the future, or as an alternative to engage in advanced research work in subjects approved by the council as of value to the profession, and in due course to sit for the intermediate and final examinations of the institution. Election to the scholarships will be by competitive examination conducted by the Oxford and Cambridge Joint Examination Board. In the examination candidates will be required to write an English essay chosen from four subjects set by the examiners and to present themselves for examination in either (*a*) language, (*b*) mathematics, or (*c*) science. If (*a*), not more than two of the following: Latin, Greek, French, German; if (*b*), mathematics only, or mathematics and one science subject; if (*c*), not more than two of the following: physics, chemistry, botany, physical geography, and elementary geology. The next examination will be held about the end of January. Entries should be addressed to the Secretary of the Surveyors' Institution, 12 Great George Street, Westminster, by December 15 next.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 26.—Sir J. J. Thomson, president, in the chair.—Dr. A. E. H. **Tutton**: Monoclinic double selenates of the cobalt group. This memoir deals with the four double selenates of the series $R_2M(SeO_4)_2.6H_2O$, in which M is cobalt and R is potassium, rubidium, cæsium, and ammonium. A complete crystallographic and physical investigation has been carried out on parallel lines to the work previously published concerning the magnesium, zinc, iron, and nickel groups, and to that concerning the complete analogous series of double sulphates. The results are in full accord with those derived from the previous investigations. Two dominant facts emerge, namely, (1) the progressive order of all the crystallographic and physical properties, following the progression of the atomic numbers (and therefore atomic weights) of the interchangeable alkali metals concerned, potassium, rubidium, and cæsium; and (2) the almost perfect isostructure—that is, congruency, coincidence, and equality of dimensions of the elementary cells of the monoclinic space-lattices—of the crystals of the ammonium and rubidium salts of the group. The progression with atomic number referred to under (1) is completely explained by the operation of Moseley's law, governing the progressive structural complexity of the atoms in accordance with the sequence of the atomic number.—Hertha **Ayrton**: A new method of driving off poisonous gases.—Dr. F. W. **Aston**: Experiments with perforated electrodes on the nature of the discharge in gases at low pressure. Experiments are described on the discharge between electrodes of a large flat form perforated with a long narrow slit, the charge passing through the slit being collected and measured in a Faraday cylinder. Direct measurements made with the Faraday cylinder behind the cathode and at the same potential seem to indicate that about half the total current in the discharge is brought up to the cathode by positive ions. Attempts to discover the distribution of velocities in this stream show that this is not directly determinable, owing to the very high ionisation in the region of the slit and other reasons, which are discussed. Using a perforated anode, it is found that as the distance from the cathode is increased arithmetically the current carried by the cathode rays into the Faraday cylinder decreases geometrically when the current is constant.—Mary **Seegar** and Prof. Karl **Pearson**: De Saint-Venant solution for the flexure of cantilevers of cross-section in the form of complete and curtate circular sectors; and the influence of the manner of fixing the built-in end of the cantilever on its deflection.—Dr. H. **Jeffreys**: The relation between wind and the distribution of pressure. A classification of some six hundred wind observations over the North Sea, according to their velocities and directions, showed that the most striking feature of the resulting values was their asymmetrical frequency distribution. From the fact that this was noticeable in nearly every class, it was inferred that it could be produced only by variation in turbulence or systematic contortion of the isobars, on a scale too small to be recorded on the weather map. The latter cause, however, and also such variations in turbulence as keep the coefficient of eddy viscosity the same at all heights, would lead to strong correlations between S/G and α, which are not observed. Hence it is concluded that the principal cause of variation in the relation of the surface wind to the gradient is variation in the vertical distribution of turbulence; and it is shown that such variation could give the effects actually observed.—Prof. C. H. **O'Donoghue**: The blood vascular system of the Tuatara, *Sphenodon punctatus*.—G. H. **Livens**: The fundamental formulations of electro-dynamics. The object aimed at in this paper is the removal of certain difficulties and discrepancies which exist in the usual formulations of electro-dynamic theory. After a brief statement of the differential theory in which a new equation,

$$\frac{dB}{dt}=\frac{dH}{dt}+4\pi\frac{dI}{dt}+4\pi\,\mathrm{Curl}\,[Iv],$$

is introduced to express the time-rate of change of the magnetic force H when the magnetic media are in motion with a velocity v, a general formulation of the theory based on the principle of least action is developed, in a manner which leads directly to expressions for the intrinsic energies of the polarised media, for the forces per unit volume on the polarised and charged media, and, finally, for the complete electro-motive force on the moving electrical elements.—Dr. A. E. **Oxley**: The influence of molecular constitution and temperature on magnetic susceptibility. Part iv.: Further applications of the molecular field. The main paper is a continuation of the work published in Royal Society Transactions, A, vols. ccxiv. (1914), and A, ccxv. (1915), and Royal Society Proceedings, A, vol. xcv. (1918). It deals with the additional applications of the local molecular forcive in crystalline and vitreous media. It is shown that the change of volume on crystallisation can be interpreted as a magneto-striction effect of the molecular field. The molecular field is assumed to be proportional to the local intensity of magnetisation, the coefficient of proportionality being the reciprocal of the limiting susceptibility under field strengths equal to the respective molecular fields at different temperatures. A discussion of the nature of the molecular field is given, and the conclusion is reached that the forces of crystallisation are of a magnetic nature. The large value of the local magnetic forcive suggests that they may play an important part in chemical combination, and further evidence is given for the existence of the magneton in diamagnetic media.—A. **Mallock**: Diffusion of light by rain, cloud, or fog. In this note attention is directed to the similarity between the diffusion of light by small drops and the diffusion of heat by conduction. The drops under consideration are supposed to have, at least, diameters of many wave-lengths of the light scattered by them, so that peculiarities of diffusion dependent on the relation of

diameter to wave-length do not affect the results. Rain, cloud, and fog are formed of such drops. The opacity of a space containing a number of drops insufficient completely to obliterate objects on the far side depends on the lowering of the contrast between light and shade brought about by the light scattered by them, and not on any blurring or lack of definition. The amount of direct light which reaches the eye from a source within a fog or shower is proportional to 2^{-m}, where ml is the distance of the source from the eye, and l is the thickness of the stratum which reduces the direct light by one-half. The reduction to one-half will be caused by such a number of drops as would, if placed side by side in a plane to which the ray is normal, cut off all the direct light; but when the same number of drops are distributed at random in a volume of thickness l in the direction of the ray, they allow half the direct light to pass, in consequence of the probability that some of them screen others, and thus leave space for direct radiation. A relation is shown between the rate of rainfall (1 in. per day = 1/86,000 in. per second) and the opacity of a shower.

Physical Society, June 13.—Prof. C. H. Lees, president, in the chair.—Dr. Balth. **van der Pol**, jun.: Comparison of the wave-form of the telephone current produced by a thermal detector and by a rectifier in heterodyne reception.—Profs. E. **Wilson** and E. F. **Herroun**: The magnetic properties of varieties of magnetite. The magnetic properties of certain varieties of magnetite as exhibited by crystallised, compact, or massive specimens and detached particles have been examined. In each case the susceptibility has been found to vary with the magnitude of the magnetising force after the manner of iron, the relative variation being much more pronounced in the case of those specimens having the higher susceptibility. The maximum susceptibility in the specimens examined occurs at a force ranging from 13 C.G.S. units in the crystal to 368, its magnitude varying from 3·12 to 0·127 C.G.S. units. The effect of heating has been greatly to increase susceptibility in some cases, and in others a negative effect has been produced. In the case of a specimen of Penryn magnetite, the large increase in the susceptibility was traced to the conversion of ferrous carbonate and ferric oxide into magnetite. Very high susceptibility in magnetite is never associated with high coercive force or retained magnetisation, the greatest values for the latter exhibited by specimens having an intermediate value of susceptibility of the order of 0·3 or 0·4. Lower susceptibility may be associated with high coercive force, but naturally the retained magnetisation is not very great, owing to the lower maximum of induced magnetisation.

Geological Society, June 25.—Mr. G. W. Lamplugh, president, in the chair.—A. E. **Kitson**: Outlines of the geology of Southern Nigeria (British West Africa), with especial reference to the Tertiary deposits. The oldest rocks in Southern Nigeria comprise a series of quartzites, schists of various kinds, blue and white marble, grey limestones, altered tuffs and lavas, amphibolites, and gneisses. They may be classed provisionally as pre-Cambrian. So far as they have been observed, there is a great hiatus between the pre-Cambrian and the next known sediments, the Upper Cretaceous. Normally, these are slightly inclined rocks. Flanking the Udi plateau on the south and south-east, and extending thence over the southern part of the great valley to the Cross River, is a series of Eocene estuarine shales, clays, and marls, with septarian nodules and pieces of coal and resin, and a rich fauna consisting principally of mollusca, but including fragmentary remains of whales, birds, fishes, and turtles. A thick series of sandstones, mudstones, shales, and seams of brown coal forms a large portion of the basin of the Niger, west of the Udi plateau. In the Ijebu Jebu district are bituminiferous sands and clays with Pliocene estuarine shells. Extending over practically the whole of the country south of lat. 7° 10′ N., and west of the great valley of the marine Cretaceous, is a varying thickness of (usually unstratified) clayey sands, probably late Pliocene—the Benin Sands series of Mr. J. Parkinson. Along the coast-line and extending for considerable distances up the Niger and Cross Rivers are fluviatile, deltaic, littoral, and swamp gravels, sands, and muds of Pleistocene and Recent age. In the Cross River basin, intruded into the marine Cretaceous, are volcanic necks of decomposed agglomerate, and sills (?) and dykes of olivine-dolerite. These are probably pre-Eocene. The Yorubaland crystalline rocks contain magnetite in considerable quantities, while these and the crystalline rocks of the Oban Hills show smaller quantities of cassiterite, gold, monazite, and columbite.—J. B. **Harrison** and C. B. W. **Anderson**: Notes on the extraneous minerals in the coral-limestones of Barbados. Characteristic representative specimens of the fossil reef-corals and of the beach-rock of the high-level and low-level limestone terraces of Barbados were examined chemically and microscopically in order to ascertain the composition, nature, and origin of their extraneous mineral contents. Chemical analyses of the residua were made, and the results of these and of the microscopical examinations are tabulated in the paper. The extraneous minerals present were found to be apparently fresh and largely unaltered fragments of wind-borne volcanic minerals and glass. It was found that the volcanic minerals enclosed in the reef-corals on which they fell have been protected from change; those in the clastic limestone or bed-rock show signs of detrition and weathering prior to the consolidation of the limestone. Similar minerals separated from clay normally formed and accumulated in a pothole in the limestone supply evidence of weathering changes after being set free from the rock. It is shown that the composition of the sedentary residual soils on the higher limestone-terraces of Barbados corresponds in its essential parts with the residua separated, either naturally or artificially, from the limestone. The proportions of magnesium carbonate present in the coral-rock are briefly discussed, and complete analyses of the high-level and the low-level limestones are given.

DUBLIN.

Royal Irish Academy, June 23.—The Most Rev. J. H. Bernard, president, in the chair.—A. **Henry** and Miss M. G. **Flood**: The history of the Dunkeld hybrid larch, *Larix eurolepis*. This tree is raised in large quantities from the seed of ten Japanese larches (*L. leptolepis*) growing at Dunkeld in the vicinity of numerous European larches (*L. europaea*), from which pollen is wafted by the wind. The seedlings are intermediate between the two parents, as shown by microscopical examination of the sections of the leaves, by the colour and form of the bracts and scales of the cones, and by the colour of the twigs, leaves, etc. The hybrid seedlings, of which more than 100 acres have been planted on the Dunkeld, Athol, and Murthly estates, are very vigorous. Attention is directed to the function of the papillæ on the surface of the leaf, which are constant in *L. leptolepis*, absent in *L. europaea*, and only present on a few cells in the case of the hybrid. Reference is also made to other hybrid conifers, including *L. marschlinsii*, Coaz, which has recently appeared in Switzerland; *L. pen-*

dula, Salisbury; and *Tsuga jeffreyi*, A. Henry. The last is a peculiar hemlock spruce, originally raised at Edinburgh in 1851 from seeds collected by Jeffrey. It has recently appeared again at Cowichan Lake, Vancouver Island, from which locality a single plant has been sent to Knapton, Abbeyleix, Ireland.

CALCUTTA.

Asiatic Society of Bengal, June 4.—N. **Nath Sen**: Interaction of phosphorus halides and arsenious and arsenic compounds.—H. H. **Haines**: Some new species of plants from Bihar and Orissa.—H. C. **Das-Gupta**: Notes on the Panchet reptile. In part i. a few bones of the celebrated Panchet reptile obtained from the neighbourhood of Asansol are described, and in part ii. the question of the systematic position of the reptile is reviewed, as of late doubts have been raised regarding its Dicynodont nature. An examination of all the materials available shows the author that though, without the discovery of an entire skull, the zoological position of the Panchet reptile cannot be definitely settled, there is no reasonable ground to suppose that Lydekker was mistaken when he placed the Panchet reptile under his new generic name Ptychosiagum = Ptychognathus, Owen. The only other genus with which some of the Panchet bones agree is Oudenodon, but the presence of tusks shows that it cannot be assigned to that genus.—H. C. **Das-Gupta**: Note on a mammalian fossil from Bhavanagar (Kathiawar). In this paper the author has described a mammalian humerus obtained at Hathab. The fossil is fragmentary, and no generic determination is possible. It is, however, interesting as being the first record of a Gáj mammal obtained in Kathiawar.

BOOKS RECEIVED.

A Comparative Study of the Bantu and Semi-Bantu Languages. By Sir H. H. Johnston. Pp. xi+815. (Oxford: At the Clarendon Press, 1919.) 3*l.* 3*s.* net.

Eugenics and Environment. By Prof. C. L. Morgan. Pp. 82. (London: John Bale, Sons, and Danielsson, Ltd., 1919.) 2*s.* net.

The Problem of Sex Diseases. By Major A. Corbett-Smith. Second edition. Pp. xv+107. (London: John Bale, Sons, and Danielsson, Ltd., 1919.) 2*s.* 6*d.* net.

Salt and the Salt Industry. By A. F. Calvert. (Pitman's Common Commodities and Industries Series.) Pp. vii+151. (London: Sir Isaac Pitman and Sons, Ltd., n.d.) 2*s.* 6*d.* net.

The Return to Oxford: A Memorial Lay. By W. Garstang. Pp. 14. (Oxford: B. H. Blackwell, 1919.) 1*s.* net.

The Mechanism of Evolution in Leptinotarsa. By W. L. Tower. (Publication No. 263 of the Carnegie Institution of Washington.) Pp. viii+384+19 plates. (Washington: Carnegie Institution, 1918.)

History of the Theory of Numbers. Vol. i., Divisibility and Primality. By Prof. L. E. Dickson. (Publication No. 256 of the Carnegie Institution of Washington.) Pp. xii+486. (Washington: Carnegie Institution, 1919.)

The Adolfo Stahl Lectures in Astronomy. Delivered in San Francisco, California, in 1916–17 and 1917–18, under the auspices of the Astronomical Society of the Pacific. Pp. xiv+257+liii plates. (San Francisco: Astronomical Society of the Pacific.) 2.75 dollars.

Problèmes Scientifiques d'Alimentation en France pendant la Guerre. Bibliographie Analytique des Travaux Français publiés pendant la Guerre (1914–18). Par R. Legendre. Pp. 160. (Paris: Masson et Cie, 1919.) 6 francs net.

Number Stories of Long Ago. By Prof. D. E. Smith. Pp. vii+136. (Boston, Mass., and London: Ginn and Co., 1919.) 2*s.* 3*d.* net.

Number Puzzles before the Log Fire: Being those Given in the "Number Stories of Long Ago." By Prof. D. E. Smith. Pp. iv+14. (Boston, Mass., and London: Ginn and Co., 1919.) 6*d.* net.

Board of Agriculture and Fisheries. Guides to Smallholders. No. 3: Co-operation for Small Producers. Pp. 15. (London: Secretary of Board, 3 St. James's Square, London, S.W.1, 1919.) 2*d.*

Board of Scientific Advice for India. Annual Report for the Year 1917–18. (Calcutta: Superintendent, Government Printing, India, 1919.) 14 annas, or 1*s.* 3*d.*

DIARY OF SOCIETIES.

THURSDAY, JULY 17.

SOCIETY OF CHEMICAL INDUSTRY (at the Salters' Hall, St. Swithin's Lane, E.C.), at 10.30 a.m.–1 p.m., and 3–5 p.m.—Conference on Dye Stuffs, Synthetic Drugs, and Associated Products. Dr. Herbert Levinstein: Progress in the British Dyestuff Industry.—James Morton: Dyestuffs and British Textiles.—Prof. G. T. Morgan: Certain Colour-producing Intermediates.—E. V. Evans: The Manufacture of Intermediates.—F. H. Carr: The Manufacture of Synthetic Drugs.—Dr. W. R. Innes: Photographic Chemicals.—Dr. M. O. Forster: The Organised Preparation of Laboratory Chemicals.—At the Goldsmiths' Hall, Foster Lane, E.C., at 10.30 a.m.–1 p.m.—Conference on the Chrome Tanning Industry. Prof. D. McCandlish: The Development of the Chrome Tanning Industry in the United States of America.—M. C. Lamb: The Progress of the Chrome Tanning Industry in Great Britain.—Dr. Gordon Parker: The War Services of the Chrome Tanning Industry.—At 3–5 p.m.—Conference on Recent Developments in the Fermentation Industries. Sir Frederick Nathan: The Manufacture of Acetone.—Amos Gill: The Acetone Fermentation Process and its Technical Applications.—A. Chaston Chapman: The Employment of Micro-organisms in the Service of Chemical Industry—A Plea for a National Institute of Micro-biology.

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