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Landowners and the State.

LORD BLEDISLOE, as president of the Agricultural Section of the British Association at Hull this year, struck a new note in his address. Put very briefly, his text was a demand for more leadership, and in particular for educated leadership by landowners in the business of farming. British farming has for the last two centuries in the main been carried on by tenants possessed of considerable capital, which is employed in the business and not in the land itself nor in its permanent equipment. The result, at any rate until fifty years ago, was successful. Complicated as the question of tenure was in detail, by custom it worked well on the whole ; a sufficiency of capital was attracted to the land to permit of cultivation on a comparatively large scale with sufficient continuity to encourage experiment and improvement, until British farming, whether as regards operations of cultivation, productivity of crops grown or quality of stock bred, stood easily foremost in the whole world.

British agriculture no longer enjoys the same undisputed position. We can still point with pride to its technical excellence, but it has not succeeded in so adapting itself to the changed economic conditions as to continue to be regarded as a prosperous industry or to attract the confidence of capitalists. Farmers, despite some protestations, can still make a living out of it, because they can always adjust their style of farming to any range of prices, but the position of the other two parties to the occupation of the land is far from satisfactory. Landowners' rents do not represent a reasonable rate of interest on the money that has been expended on the buildings, etc. necessary to the working of the farm. A piece of average English land in prairie condition could not to-day be equipped as a farm and then let at a rent which would pay market interest on the capital expended in equipping it, even though no charge were made for the land itself. Landowners who sold their farms during the last few years were able after reinvestment to double and treble the income they had derived from them, and at the same time to relieve themselves of many of the calls upon the landlord's purse. Agricultural labourers, again, though they effected some improvement in their position during the war, are still the worst paid industrial class of any magnitude in the community. In the villages it is well recognised that a boy is likely to be better off if he can get on the railway, into the police, or any of the other occupations more or less available, rather than go upon the land.

The tenant-farming system, for all its advantages, appears to be breaking down, and Lord Bledisloe regards the landowners of the last generation or two as in part responsible. From an abstract point of view the ordinary English tenant farm of 200 to 500 acres is no longer the economic unit it once was. At its inception it represented wholesale large scale production as compared with the generality of European farming, and as such it provided the food needed for the early industrial development of the country.

But with the enormous extension of wheat growing and meat production in the newer countries, the effect of which upon our markets began to become so apparent from the 'seventies of last century onwards, and with modern organisation of the import trade in food products from countries with a low wage standard, the English farmer no longer controls prices, and when he stands alone, he is selling as a retailer in a market dominated by much larger interests. It has become a terribly difficult market because Great Britain is now the one absolutely free emporium to which the surplus food products from every other food-producing country in the world are directed. With one or two minor exceptions (Denmark and Belgium are practically free-trade countries, but they are normally food exporters rather than buyers), the British farmer is met by a tariff wall whenever he has a surplus to export or a speciality to develop, and these difficulties are, at the moment, accentuated by the break in the Continental exchanges, which diverts to Britain even the limited quantities of food-stuffs the foreign industrialist had begun to purchase.

Some of these difficulties may be overcome by co-operation, never an easy matter to organise in a conservative community such as our farmers form, bred as they have been in an individualist organisation of business and imbued with the characteristic British tradition of standing alone. In any case, co-operation may be only a palliative; the economic flaw in the tenant-farming system probably is that the unit of management is too small. There is not work for a master in controlling the five to ten men employed on the ordinary English farm; as a managing head one man should be able to supervise the working of 1000 to 2000 acres, according to the class of land. Economic pressure would thus appear to be tending to move away from the present type of British farm in two directions, either towards the single-man holding, uneconomic as an instrument of production but in which compensation is found in the extra labour the occupier will give in exchange for his independence, or on the other hand, towards the really large farm which can take advantage of machinery and organisation.

Lord Bledisloe's main contention is that the landowner must either take the latter option and become the instructed business head of his estate treated as a single farm, or if he prefers not to take over the actual management, he must at least be the leader and *entrepreneur* of the associated businesses of his tenants. Not only is the holding of land a bad investment, but in a modern State the mere rent receiver will eventually be eliminated. Landlords must give service or perish as such, and Lord Bledisloe appeals to a class which has a long and honourable tradition behind it of service to the State to return to the land and so render a necessary service to a State that is becoming overweighted on the industrial side. He points out the two directions in which the landowner can lead his tenants and benefit both his estate and the course of agriculture. In the first place, the farmer to-day is not getting his fair share of the prices the consumer pays for food. While all the producing interests connected with the land are unprosperous and are being forced to contract their activities, the trading organisations which deal in the produce of land are paying handsome dividends and individual middlemen are growing rich. The consumer reviles the farmer because of the scarcity of food; the farmer knows he must restrict his production in order to make it pay at present prices, while the slightest production above the normal demand cuts away not merely profits but often cash returns, as may be seen over plums and potatoes at the moment. The distributing trade has entrenched itself in order to retain its war scale of margin, and the building famine in the country hinders the growth of competition. Lord Bledisloe gives a series of tables to show the discrepancy between retail and farmers' prices and the increase of that discrepancy since the war; in most cases the distributing trades take more than half the price the public pays. Coarse 'middlings' cost more than wheat, and readers of the *Times* a few days ago may have noticed that on the same day the price of London flour was put up while wheat was, in another column, reported as cheaper.

It is to this state of things Lord Bledisloe recommends landowners to turn their attention; can they not organise the businesses of their farmers into something capable of keeping the middlemen in check? They should be able to see further than the farmer, who has to look after his own business of production. Co-operation has made but little headway among farmers themselves; would it not be in a very different position if it had been whole-heartedly and intelligently backed by the landowners? Here is one opening for intelligence and leadership on the part of owners of land.

The other great opening is in connexion with education and research. The old race of landlords numbered among them great improvers of farming, such as Weston, Townshend, Coke, and Lawes. Even the much-abused farming covenants represented, to begin with, better systems imposed upon their tenants by landlords. To-day, if English farming practice is in many respects still ahead of its competitors, it has become, comparatively speaking, not so alive to the applications of science. Farmers themselves are not quite what they were; the great industrial development of the last sixty years has been drawing away the brains from the more slowly moving pursuit of agriculture, and, speaking broadly, the present race of farmers are not educated up to their needs or their opportunities.

Here again the landowners have not been, but can be, leaders; they can become intelligence centres, they can stimulate the education of their tenants and of their tenants' sons, they can even insist on education in selecting their tenants. It is the lack of appreciation of science among landowners that has made it a plant of slow growth among their tenants.

The address is really a powerfully worded appeal from Lord Bledisloe to the landowning class to treat landowning as a vocation and to educate themselves for it. It is a far-sighted call for service, and coming from one who has so notably put into practice what he preaches, carries with it an authority which no ordinary admonition to progress can possess.

Bergson and Einstein.

Durée et Simultanéité: À propos de la théorie d'Einstein. Par Henri Bergson. Pp. viii+245. (Paris: Félix Alcan, 1922.) 8 francs net.

EINSTEIN in his theory of relativity may be said to have thrown down a challenge in the scientific world of the same kind as that which Bergson in his theory of duration has thrown down in the philosophic world. Both theories are primarily concerned with a certain fundamental character in the experience of time. Both recognise a difference of nature, that is, a qualitative difference, between the time which enters into our equations of measurement and the time which is lived. At one point, however, Bergson seems to come into direct conflict with the Minkowski-Einstein scheme of a space-time continuum. This is in his conception of creative evolution. Creation means that the reality of the physical universe is of the nature of life or consciousness, a conception which implies the continued existence of the past in the present, and a universal moving forward into an open future. How is this consistent with the view that there is not one single universal time but as many different times as there are systems, and that there is no absolute simultaneity between events which take place at any two points if they are separate from one another in space?

Bergson has evidently been of opinion that for his own sake he must clear up his position on this crucial point. To do so has been no slight undertaking, for he has not been content to accept the principle of relativity from the physicists or to assume that its mathematics is correct. He has, therefore, deferred the resumption of his own philosophical work, interrupted by the war, and has set himself to study at first hand the mathematical equations of Lorentz and Einstein. It may interest readers of NATURE to know that Bergson specialised in mathematics in his student days to the extent of hesitating between it and philosophy when he had to choose a profession. The argument in his new work deals almost exclusively with the restricted theory, for it is that which affects directly the question of the reality of time. The relevance of the generalised theory is only touched upon. It is the subject of a "Final Remark," in which the nature of its importance for philosophy is indicated, but general relativity does not seem to Bergson to challenge, as the restricted relativity does, his theory that time as a universal flux or change is an intuited reality, while successive states are a spatialised time due to the intellectual mode of apprehending it.

Descartes in the Principles (ii. 29) declares that in movement there is complete reciprocity; either of two objects changing their relative position may be considered as having moved or as having remained at rest. To this Sir Henry More replied (March 5, 1649): "When I am sitting still, and someone moving away a mile from me is red with fatigue, it is he who moves and I who am still." Nothing science can affirm concerning the relativity of perceived movement, measured by foot-rules and clocks, can disturb the inward feeling we have that we ourselves can effect movements and that the efforts we put forth in doing so are under our control. Here we have, then, in the most striking manner, the contrast between the intuitive mode and the intellectual mode of apprehending reality. Is there anything in the principle of relativity which conflicts with the conception of reality as fundamentally a duration which is intuited or lived? *Prima facie*, yes. The denial of absolute simultaneity seems completely inconsistent with it. This comes out most clearly in Einstein's paradox. "Suppose a traveller to be enclosed in a cannon-ball and projected from the earth with a velocity amounting to a twenty-thousandth of the velocity of light; suppose him to meet a star and be returned to earth; he will find when he leaves the cannon-ball that if he has been absent two years, the world in his absence has aged two hundred years." Any one who applies the mathematics of relativity and makes the simple calculation for the two systems, earth and cannon-ball, will find that the conclusion follows with the same logical necessity as in Zeno's paradox that Achilles cannot overtake the tortoise.

There is, however, a limitation even for the relativist which, although it falls short of establishing an absolute, is important to keep in mind. There is no system of reference which a traveller can choose, by entering which he might depart and return to find the world younger, so that his journey would have been backward in time. The reason is not the inconceivability of such a system, but the fact that it would bring us into conflict with the law of causality. The reversibility of causality which would require the effect to come into existence before the cause, is unthinkable. Such then is the paradox. Relativity requires that as we pass into a new system of reference the relative movement of the new system shall be compensated by changes in the spatio-temporal axes of co-ordination in order to keep constant the velocity of light. This means in the case supposed that two years of the one system is the equivalent of two hundred of the other.

Bergson's solution of Einstein's paradox follows the same line as his solution of the paradoxes of Zeno, but the special application of his principle has a particular interest. In the case of Zeno the essential point was the insistence on the continuity, in the meaning of absolute indivisibility, of true duration, the duration which is lived and intuited, as distinct from the infinitely divisible continuity, mathematically defined, of the schematised trajectory of the movement. The mathematical time which we measure is really space. In the case of Einstein's paradox Bergson argues that the two systems, which are discordant as to their simultaneity when taken as integral systems, must be considered as continuously related, and this is possible only so long as we do not abstract from the observer who is attached to each. If, he says, we consider the two observers in their different systems to be continuously in communication it is clear that each, while regarding the other as a physicist co-ordinating a system, will regard that co-ordinated system from the standpoint of his own, and therefore, however different the system may be, in so far as the two observers are physicists and in so far as they are related observers, the duration intuited is one and the same for both. But here we shall ask, if the explanation is so simple, how does the paradox arise? Quite naturally, Bergson replies, and this is the striking part of his argument, because what the philosopher can do the physicist cannot. The philosopher's concern is with reality perceived or perceptible; he, therefore, can never lose sight of the interchangeability of the two systems. He keeps them together by a kind of continual coming and going between them. The physicist, on the other hand, whose only business is to co-ordinate the system as a whole, must choose one and stand by his choice. He cannot relate all the events of the universe to two systems of different axes of co-ordination at one and the same time. He must therefore regard the whole system as concordant or discordant with the whole of the other system, each taken as one and integral. For the physicist is not concerned with time intuited but only with time as a measurable dimension.

We may see, then, how Einstein is able to affirm that there are multiple times. We can place an imaginary physicist at every point of space and his time-system will necessarily be different from every other time-system; and our own time-system, so far as we are physicists, has no privilege over the imaginary time-systems. But, Bergson replies, into whichever of these imaginary time-systems we project ourselves, it becomes thereby time lived or intuited, and as we can conceive ourselves to pass into any of them, there is a real duration to which all the imaginary time-systems belong. Thus is restored to us the unique time, one and universal.

Such is Bergson's solution. Does it dispose of the problem? The argument is certainly calculated to reassure those who have been disturbed by the principle of relativity, and to comfort those who are made unhappy, rather than stimulated to activity, by paradox. Yet there are many indications in his book that Bergson himself does not feel he has said or is now saying the last word. In the final remark, to which we have already referred, he regards the generalised theory as an extension of the argument of the restricted theory with the difference that the emphasis is on space rather than on time. He suggests that the treatment of space on the same lines as those on which he has dealt with time would show that the multiple geometries are imaginary physicists' geometries abstracted from their relation to and transformability into the one and universal space-system which is the intuition of the living individual.

To a certain extent he is undoubtedly right, for we may say truly that the restricted relativity is a case in point of the generalised relativity. But there is a problem which Bergson has left untouched while giving indications that he is aware of it. This is the relativity of magnitudes. Even Einstein has not, so far, dealt with it specifically. Weyl, in his endeavour to make the generalised theory include the whole realm of electro-magnetic phenomena, has foreshadowed a relativity even more fundamental and more universal than Einstein's, although so far he has found no means, such as Einstein found, of submitting the principle to experimental tests. In philosophy it is of the deepest significance. Not only is there no absolute criterion of magnitude, but systems of reference are not even relatively in relations of magnitude to one another. It is only for the observer in a system of reference that there is a relation of magnitude within the system and that the system itself has relations of magnitude to other systems. Into whatever system an observer passes he carries into it his own constant norm of magnitude and he does not have to submit to the dimensions which the new system imposes on him. It is this aspect of the principle of relativity which has seemed to the present writer to require a philosophical principle like that of the Leibnizian monad to give it full expression. It is not enough to return to the mathematical principle of Descartes's mechanism. Mathematics and physics alike rest ultimately on the experience of active subjects, and this is why experimental tests are relevant. The monadic conception derives new meaning from the theory of reality as psychical duration, the concept which Bergson has made a new possession of human thought.

H. WILDON CARR.

The Molecular Scattering of Light.

Molecular Diffraction of Light. By Prof. C. V. Raman. Pp. x+103. (Calcutta: University of Calcutta, 1922.)

READERS of NATURE are already familiar with the important work which Prof. C. V. Raman has been carrying out in connexion with the scattering of light by small particles, for many of his results have been announced in these columns. In a small volume published by the University of Calcutta he has reviewed the present position of the subject of molecular diffraction of light, and has discussed the theory in a comprehensive survey which includes the case of gases, vapours, liquids, crystals, and amorphous solids.

Lord Rayleigh was the first to indicate the principles on which the problem may be handled, and he obtained a relation between the scattering power of the molecules of a gas, their number per unit volume, and the refractivity of the medium. As the energy scattered must be derived from the primary beam, the intensity of the latter must suffer an attenuation as it passes through the medium, and an expression can be derived for the attenuation coefficient. Prof. Raman discusses some criticisms of the theory and concludes that the principle of random phase which is assumed in the argument is justified, provided there exists the random distribution of the molecules which is required by Boyle's law. The ultimate justification of the principle rests on the complete non-uniformity in the spatial distribution of the molecules in so far as very small volume elements are concerned.

The first successful attempt to observe the scattering of light by dust-free air in the laboratory was made by Cabannes in 1915. Experimental work of great interest has been carried out by Prof. R. J. Strutt (the present Lord Rayleigh), who obtained the remarkable result that, in many gases, the scattered light is only partially polarised. This may be explained as due to the lack of symmetry of the molecules, and may furnish valuable information with regard to molecular configuration.

To the late Lord Rayleigh we owe the brilliant suggestion that the scattering of light by the molecules of air accounted in large measure both for the blue light of the sky and the observed degree of transparency of the atmosphere. Recent observations, principally at the Observatory on Mount Wilson, have confirmed the theory and have furnished a value for Avogadro's constant which is practically identical with that deduced from Millikan's measurements of the electronic charge. Prof. Raman has made observations on the polarisation of skylight on Mount Dodabetta (8750 feet above sea level) in the Nilgiris. As is well known, dust and haze are largely confined to the lower levels of the atmosphere. The influence of secondary scattering may be reduced very considerably by using a deep red filter, and allowance can be made for the effect of earthshine. The weaker component of polarisation was found to have 13 per cent. of the intensity of the stronger component. Only 4 per cent., however, was ascribable to molecular anisotropy, a result in good agreement with the latest laboratory measurements.

The principle of random phase on which Rayleigh's theory depends is not applicable in the case of highly condensed media such as dense vapours, liquids, and solids. In liquids, we may apply the theory developed by Einstein and Smoluchowski, in which scattering is considered not as due to individual particles but to small local variations of density arising from the heat movements of the molecules. A formula is obtained showing how the scattering power of a fluid is related to its refractivity. It is worthy of notice that the scattering power is proportional to the absolute temperature and to the compressibility of the liquid. When corrected for the effect of molecular anisotropy, the formula gives results in fair agreement with observations in non-fluorescent liquids, and it reduces automatically to the Rayleigh formula in the case of gaseous media. But, surprisingly enough, the law seems to break down in the case of gases under high pressure. Prof. Raman makes the interesting suggestion that this failure may mean that the continuous wave theory of light does not strictly represent the facts, and that we may perhaps find here experimental support for Einstein's conception that light itself consists of quantum units.

The colour and polarisation of the light scattered in the sea is discussed by Prof. Raman in a chapter which must interest biologists as well as physicists. The colour of the deep sea is not mainly due to reflected skylight, as has sometimes been suggested, but to light molecularly diffused from within the water. The reflecting power of water at normal incidence is quite small (only 2 per cent.), and consequently to an observer flying at a great height above the surface of the water the luminosity of the sea would be determined almost entirely by internal scattering.

In crystals such as quartz and rock-salt the scattering of light can be observed visually, the Tyndall cone being of a blue colour. The effect may be attributed to the thermal movement of the atoms in the crystal introducing local fluctuations of optical density. Thus there is a close connexion between this phenomenon and the well-known influence of temperature ("Debye effect") on the intensity of X-ray reflection as illustrated, for example, in the experiments of Sir W. H. Bragg on rock-salt. It may be suggested that further study of the scattering of light in amorphous solids like glass would yield information of value regarding the molecular structure of such bodies.

H. S. A.

Technical Electricity.

(1) *Principles of Electrical Engineering.* By Prof. W. H. Timbie and Prof. Vannevar Bush. Pp. viii + 513. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1922.) 20*s.* net.

(2) *High Voltage Power Transformers.* By W. T. Taylor. Pp. x + 117. (London: Sir I. Pitman and Sons, Ltd., 1922.) 2*s.* 6*d.* net.

(3) *Electric Power Systems.* By W. T. Taylor. Pp. xii + 107. (London: Sir I. Pitman and Sons, Ltd., 1922.) 2*s.* 6*d.* net.

(1) THIS book is intended for students of electrical engineering. Although much of the ground has been covered in a similar way before, yet there are several novel features. The magnetic circuit—the importance of the theory of which in electrical engineering can scarcely be over-estimated—is allotted the space it deserves. The electron theory, which is admirably adapted for giving easily intelligible explanations, is freely used. Thermionic emission, conduction through gases, and electrolytic conduction are all discussed. There are also about 500 practical problems, some of which give interesting engineering data.

The authors divide electrical engineers into three classes. The first class comprises the men who apply scientific laws to electrical development. This includes the research engineer and the designer. The second class includes the distributing engineer who plans, constructs, and operates power-transmission lines, telephone and telegraph circuits, and electric railway systems. There is, finally, the engineer who acts as liaison officer between electrical engineering and civil and mechanical engineering, including all industrial applications. The consulting engineer and the promoting or "commercial" engineer belong to this class. This type of engineer must be well grounded in economics, and well versed in business, law, and procedure.

The authors state that the terminology they use is that recommended by the American Institute of Electrical Engineers. It differs in several important respects from that recommended by the International Electrical Commission. The Gauss is defined as the unit of magnetic induction density. In I.E.C. nomenclature the unit of magnetic induction density is one Maxwell per square centimetre. In Europe the Gauss is defined practically always as the unit of magnetic force. The authors take as the unit of magnetic force "one Gilbert per cm.," and the unit of reluctance is called the "Oersted." We do not think that the Gilbert and the Oersted will be accepted internationally. In our opinion also a case has not been made out for the use of such words as "abohm," "abvolt," "statvolt," etc. Abohm is the unit of resistance in the absolute system of units and "statvolt" is the unit of electric pressure in the electrostatic system of units.

In discussing sparking voltages between spherical electrodes (p. 417), it is stated that "small balls with a given separation break down at a smaller potential than large balls." This is not true in all cases. Russell (Journ. I.E.E., vol. 57, p. 228), for example, states that for half a centimetre spark at 25° C. and 76 cm. the disruptive voltages for spheres of 1 cm., 5 cm., and 25 cm. radius are 17·7, 16·3, and 15·0 kilovolts respectively. It will be seen that the voltages required for a break-down in this case are appreciably higher for the small electrodes. For still smaller-sized electrodes for the same air-gap the disruptive voltages get smaller. Similarly when the air-gap is 1 cm. it can be shown that the sparking voltage has its maximum value of 32 kilovolts when the diameters of the electrodes are each equal to 2 inches very approximately.

(2) Mr. Taylor's book will be of interest to the electrical engineer, as it discusses problems in which he takes great interest. The rating of a transformer, and consequently its price per kilowatt, depends on the "hottest spot" temperature after a full-load run. Considerable space is therefore devoted to methods of keeping transformers cool. It is stated that a cast-iron case will

radiate more heat than one made of boiler-plate, since the roughness increases the surface exposed to the air and to the oil in which the transformer is immersed. This is true so far as the heat conducted from the oil is concerned, but as the great bulk of the heat is carried away by convection currents in the air, it is of importance to increase these currents as much as possible, and so a rough surface may be a disadvantage.

(3) The principles that have to be taken into consideration when designing power systems are discussed. The advantages and disadvantages of the various systems are clearly stated, and will be a help to young engineers. Specimen record forms are given. These are apparently American in origin, as the lineman is warned not to "throw on the current" until he receives the signal. The consumer also gets his lamps free.

Modern Metallurgy.

The Metallurgy of Iron and Steel. Based mainly on the Work and Papers of Sir Robert A. Hadfield. Compiled by the Editor of Pitman's Technical Primers. (Pitman's Technical Primer Series.) Pp. xv+122. (London: Sir I. Pitman and Sons, Ltd., 1922.) 2*s*. 6*d*. net.

THIS small volume, which is written in a very interesting manner, gives the reader a clear idea of the developments made in the metallurgy of iron and steel in recent times. The work contains seven chapters, the first of which deals with the possibilities of an approaching exhaustion of the supplies of both iron ore and coal at some future date; the author, however, points out that, as regards coal, substitution may be arranged by employing the energies of waterfalls, tides, solar radiation, plant life, winds, and finally the enormous power contained in the atoms may some day be released for useful work. Reference is made to the anxiety of the German industrial leaders and others during the Great War of 1914–1918 for the retention of the iron-fields of Northern France, thereby indicating the value that was placed on the commercial prosperity due to iron and steel manufactures.

Chapter 2 contains a brief account of the work of the pioneers in scientific metallurgy. Details are given of the Delhi Pillar, a solid column of nearly pure iron 24 ft. in length and weighing 6½ tons, which was erected about sixteen centuries ago. The author points out that "the finest armour and swords made during the Middle Ages cannot be excelled to-day without using special alloys." Nevertheless, these fine results were obtained empirically, and it was not until recent times that any exact knowledge of the reasons for the various methods of treatment were understood. Tribute is paid in an appendix to the early British workers who have done so much to elucidate these matters, and in more recent years to Faraday, Heath, Percy, Bessemer, Gilchrist, Thomas, Able, Sorby, Lothian Bell, Roberts-Austen, Stead, Arnold, Hadfield, and many others.

Chapter 3 deals with iron ores and the manufacture of iron and steel, while chapter 4 is devoted to hardening, heat treatment, and microstructure. In chapter 5 alloy steels are considered, and here the work of Sir Robert Hadfield is frequently referred to, especially in connexion with nickel and manganese steels. It has been stated by the well-known German writer Mars in "Die Spezialstahle" that: "The most extensive experimental researches, which may be said to have laid the foundation of our entire knowledge of steel alloys, were carried out by Hadfield in the 'eighties of the last century." Reference is also made to the direct and indirect saving effected by alloy steels of low hysteresis discovered by Sir Robert Hadfield about twenty years ago. Mr. T. W. Yensen, of the American Westinghouse Electric Company, estimates that the total saving effected to the world by the use of this material amounts to about 340,000,000 dollars.

Fuel economy and research are dealt with in chapters 6 and 7 respectively, and the work is concluded with two appendices, one containing a list of early workers in scientific metallurgy, and the other a list of research papers and scientific addresses by Sir Robert Hadfield from 1888 to 1921.

The little book is both interesting and useful, and should certainly find a place in every metallurgical library.

W. H. M.

The British Association Addresses of 1922.

The Advancement of Science: 1922. Addresses delivered at the 90th Annual Meeting of the British Association for the Advancement of Science, Hull, September 1922. Pp. 15+9+24+30+15+12+27+17+14+15+14+11+15+34. (London: John Murray, 1922.) 6*s*. net.

UNDER the title of "The Advancement of Science," the British Association now issues in collected form, and as a separate volume of a convenient size, even before the conclusion of the annual meeting, all the addresses, presidential and sectional, which have been delivered at that meeting. Although, perhaps, some exception might be taken to the appropriateness of the main title, as not sufficiently indicative of the actual contents of the volume, any ambiguity is removed by the subsidiary title, which states explicitly of what these contents consist. This issue is, of course, in anticipation of the annual volume, which gives a complete record of the Association's proceedings at the particular meeting, but which cannot, in the nature of things, make its appearance until some time after its conclusion.

This practice of the Association, which is of comparatively recent origin, is altogether to be commended, and as a business proposition is to the credit of the management. Experience has shown that it meets a public demand. Members who attend a meeting are ready to purchase, at the comparatively low price of issue, a collected edition of the addresses, as are those who are unable to be present. The fact is significant of the increasing appreciation in which these addresses are held by the public. In the early days of the Association it was not considered obligatory on the part of a president of a section to prepare a special address by way of opening its proceedings, and he occasionally contented himself with a few general remarks before calling upon a member charged with the preparation of a report on the progress of the particular department of science with which the section concerned itself, either to read the report or to give an abstract of its contents. Failing the report he would call upon a member to present the first communication on the list, and in some such manner the business of the section would be begun. Gradually the present custom has been evolved, and the presidential addresses have become a valuable and most important feature of the work of the section—some people, indeed, would say the most valuable and important.

The presidents of sections nowadays are invariably representative men or women—recognised authorities on the special subjects with which the section deals. They are usually active workers in the development of knowledge on these subjects—persons with experience of research and of matured judgment, with a message of advice, counsel, or warning to communicate, or they may even promulgate a wholly new departure in scientific thought. Hence the eagerness and expectancy with which these utterances are awaited, not only by the professional members of the section but also by such portion of the general public as shows its interest in the progress of science either by attending the meetings of the Association, or following its proceedings in the press. The appreciation in which these sectional addresses are now held is further shown by the measures which the executive have been required to take in deference to public demand. Formerly the addresses were all given on the same day, and as a rule at the same hour, and they initiated the work of their respective sections. Nowadays special arrangements are made, so that members may have an opportunity of hearing as many as possible during the week over which the meeting extends. Their publication in collected form during the week of the meeting will be of service to those who for various reasons are unable to take advantage of such opportunity, and will be welcomed by others who may wish to study them in detail and at leisure. There are, of course, some, and they are particularly common among those of the student habit, upon whom the printed word makes a more effective impression than that spoken.

It is unnecessary on the present occasion to say anything at length concerning the contents of the volume before us. Any detailed examination or criticism is the more uncalled for, as most of the addresses themselves, slightly abridged in some cases, have been, or are being, reproduced in these columns. It is sufficient to say that the 1922 book worthily sustains the reputation which British Association addresses now enjoy, as well-written, scholarly productions, pregnant with thought, replete with fact and suggestion, stimulating and full of interest and inspiration to the contemplative kind. In an age which is pre-eminently scientific these books deserve the widest possible circulation, and in the interests of knowledge it is to be hoped that they will attain it.

Our Bookshelf.

Der fossile Mensch: Grundzüge einer Paläanthropologie. Von Prof. Dr. E. Werth. Erster Teil. Pp. iv+336. (Berlin: Gebrüder Borntraeger, 1921.) 20*s*.

ENGLISH students who wish to know what their German colleagues think of recent discoveries of fossil man will be somewhat disappointed when they consult this work. Its author, Prof. Werth, who has published several books on the Ice-age and allied geological subjects, has either never heard of the fossil remains discovered at Piltdown and fully described by Dr. Smith Woodward, or refuses to believe in their authenticity; at least no mention is made of them. Nor is any allusion made to the remains found at Boskop, South Africa, the fossil skull found at Talgai, Queensland, nor those found by Prof. Eugene Dubois at Wadjak-Java. On the other hand, full and welcome accounts are given of two important finds made in Germany during war-time. One of these was made at Ehringsdorf, near Weimar, where two fossil lower jaws were found. These are attributed —and rightly so—to Neanderthal man, whose distribution is thus carried beyond the watershed of the Rhine. The other discovery, which was made at Obercassel, near Bonn, has revealed the remains of a man and of a woman belonging to the last phase of the Ice-age, and regarded by their discoverers as members of the so-called Cromagnon race. The skull of the man serves very well as the prototype of many a specimen found in neolithic graves in Scandinavia and Britain, but has such outstanding cheek-bones, zygomatic arches and angles of the jaw (or jowls) as have never been seen in

European skulls hitherto. The width of the face in front of the ears is 153 mm., at the angles of the lower jaw 127 mm., betokening an extraordinary development of the masseter muscles. Notwithstanding these features, the skull is that of a strong, handsome, and big-headed man.

The opening chapters of this work are devoted to an orthodox and clearly worded description of Europe in the Ice-age. In dealing with human remains, Prof. Werth depends very largely on the methods and conclusions of Schwalbe and of Klaatsch. Prof. Werth accepts Schwalbe's verdict that Neanderthal man was not the precursor of modern man, but was extinguished by the arrival of the Aurignacian race in Europe. He is inclined to think the Cromagnon type represents a later invader of Europe, and accepts this type as the precursor of the long-headed modern Europeans—both of the dark Mediterranean and of the fair Scandinavian type. The work, of which this is Part 1, is well illustrated.

Studien an Infusorien über Flimmerbewegung, Lokomotion und Reizbeantwortung. Von Dr. Friedrich Alverdes. (Arbeiten aus dem Gebeit der experimentellen Biologie, Heft 3.) Pp. iv+130. (Berlin: Gebrüder Borntraeger, 1922.) 12*s*.

THE little book under notice is a record of careful work, chiefly upon the behaviour of *Paramœcium caudatum*, although the three other species of Paramœcium, *Stentor polymorphus*, and other Infusoria, figure in some of the experiments. The author has made an especially detailed study of the movements of Paramœcium and of the action of its cilia, and his observations on its morphology are not without interest. He discusses the behaviour of these organisms when operated upon, and also their reactions to narcotics and other chemical stimuli and to the galvanic current.

While the author admits the merit of Jennings's work in this field of study, he is, nevertheless, frequently in conflict with this worker, both in his observations of behaviour and his interpretations of them; but it is not certain that he thoroughly grasps Jennings's views, and it is noteworthy that the latest edition of "The Behaviour of the Lower Organisms" (Columbia Univ. Press, 1915) is not in Dr. Alverdes's Bibliography. Dr. Alverdes ranges himself energetically against all those who see in the Infusoria nothing but "small automata," and vigorously opposes the mechanistic interpretation of their behaviour. Like Jennings, he denies that the local action theory of tropisms can explain completely the behaviour of these organisms. He would substitute for it another view to which his researches have led him, but it is impossible, in the short space at our disposal, adequately to present this view or to criticise it. Undoubtedly Dr. Alverdes's work is careful, and is marked throughout by independence of mind. He insists, with admirable emphasis, that little progress can come from the study of the Protista in unusual media or in media which are artificially prepared upon physico-chemical principles alone. The same argument might be applied with profit to all other work on the Protista.

In spite of a rather difficult and discursive style, the book should not be neglected by those who are interested in the problems with which it deals.

An Introduction to Electrodynamics: From the Standpoint of the Electron Theory. By Prof. Leigh Page. Pp. vi+134. (Boston and London: Ginn and Co., 1922.) 10*s*. net.

HITHERTO the mathematical equations of electrodynamics have been based on the experimental conclusions of Coulomb, Ampère, and Faraday. Even books which discuss relativity go no further than showing that these equations are co-variant for the Lorentz-Einstein transformation. In Prof. Page's book, however, the equations are derived directly from the principle of relativity. The mathematician will appreciate this procedure as it is more logical, but we think that the average reader will find the older methods more convincing. The units chosen are those advocated by Heaviside and Lorentz. The value of the charge at any point is equal to the number of tubes of force diverging from the point; all matter is assumed to be made up of positive and negative electrons; electromagnetic force is defined in terms of the electric intensity of lines of force, and gravitational attraction between two electrons is supposed to be negligibly small. The electrons carrying a current are all of the same sign, and their masses are positive. Hence the "mass of the current" is greater than the sum of the masses of the individual electrons composing it.

The author's methods of calculating the radiation from electrons are to be commended, and he also gives a good account of Laue's theory of the diffraction of X-rays. The formulæ deduced for specific inductive capacity, magnetic permeability, and metallic conductivity agree fairly well with experimental results. The theories of Faraday's experiment showing the rotation of the plane of polarisation of light by a magnetic field and of the Zeeman effect are given briefly, but in a convincing way. We can commend this book to the electrician who has an advanced knowledge of mathematics and is interested in the latest theories.

Handbuch der biologischen Arbeitsmethoden. Herausgegeben von Prof. Dr. E. Abderhalden. Lieferung 55. Abt. V: *Methoden zum Studium der Funktionen der einzelnen Organe des tierischen Organismus.* Teil 6, Heft 3. *Sinnesorgane: Lichtsinn und Auge.* Pp. 365-462. (Berlin und Wien: Urban und Schwarzenberg, 1922.) 117 marks.

THIS portion of the work, Abderhalden's "Handbuch," is the direct continuation of parts 3 and 41 which dealt with the biophysical methods used in investigating the living eye and its sensitivity to light. The first section, by Dr. Vogt of Basel, is devoted to the method of examining the eye with light from which the red rays have been absorbed by passage through a concentrated solution of copper sulphate and a weak solution of erioviridine. With such light, investigations of the yellow spot are rendered much easier and more accurate. The second section of 76 pages, by Dr. Basler of Tübingen, deals with methods which in the main are intended to investigate the functions of the retina and its various parts. Sharpness of vision, irradiation, and detection of movement are some of the subjects dealt with. The concluding section, by Dr. Struycken of Breda, describes the photographic method he uses for studying the movement of the eyeball from side to side. The treatment is in general more wordy than is desirable, but the work brings together in an accessible form a large amount of information hitherto buried in memoirs, published in most cases abroad.

Our Homeland Prehistoric Antiquities, and How to Study Them. By W. G. Clarke. (The Homeland Pocket Books, No. 13.) Pp. 139 + plates. (London: The Homeland Association, Ltd., 37-38 Maiden Lane, 1922.) 4*s.* 6*d.* net.

MR. CLARKE'S little handbook on the prehistoric antiquities of Britain covers the whole subject from Eoliths to the Iron Age. One of its main objects, however, is to help the novice to discriminate between stones shaped by natural forces and those chipped by man. In so far as this is possible by means of the printed word, Mr. Clarke is a good guide, while his practical hints on where and how to look for implements will be of great assistance to those taking up field work for the first time. As it covers so wide a field the treatment is necessarily summary, while in dealing with controversial points conclusions are stated dogmatically, which, in a more ambitious work, would require extended discussion. For this reason, Mr. Clarke must be forgiven some over-hasty statements. The amount of information which he has succeeded in condensing into so small a compass is remarkable. There are few subjects connected with prehistoric peoples of these islands, whether it be their implements, their dwellings, or their modes of life, about which the beginner will not find sufficient information here to open a path to further study, and this, in a book of this type, is in itself a great achievement.

Homo (Os Modernos Estudos sobre a Origem do Homem.) By Prof. A. A. Mendes Corrêa. Pp. 318. (Lisboa; Porto; Coimbra: Lumen Empresa Internacional Editora, 1921.) n.p.

IN this country the work of Portuguese anthropologists is not too widely known; yet it is deserving of more attention than it receives. In prehistoric archæology and somatology, investigations are being carried on which, if not considerable in bulk, are of some importance for students of European ethnology. We therefore welcome the opportunity of directing attention to this book by Prof. Mendes Corrêa, in which the most recent discoveries and hypotheses relating to the origin and descent of man are critically discussed. Each chapter deals with some one aspect of the problem, beginning with "the animal origin of man," and passing on to "evolution," the evidence of palæontology, *Pithecanthropus erectus*, the skeletal remains of prehistoric man, anthropogenesis, and a detailed exposition of the neo-monogenistic point of view. It is interesting to note that the author, in the case of the Trinil and Piltdown remains, adheres to the view in the former that the fragment of skull is simian and the femur human, and in the latter that the cranium is human and the jaw simian. A final chapter summarises the author's views, published elsewhere, on the influence of environment in the formation of races, and reviews the problems which await elucidation by further discoveries.

Sound: An Elementary Text-book for Schools and Colleges. By Dr. J. W. Capstick. (Cambridge Physical Series.) Second edition. Pp. viii + 303. (Cambridge: At the University Press, 1922.) 7*s.* 6*d.*

IN the second edition of Dr. Capstick's text-book of sound, a chapter has been added giving an outline of some of the more important applications of acoustics to military operations during the war of 1914–18. The author is not very successful in conveying in the fewest possible words a clear idea of the apparatus employed, and his descriptions would have been improved by the use of diagrams. It must, however, be pointed out that some of the diagrams in the earlier chapters are by no means perfect. In Fig. 95 the pendulum would quickly damage the mercury cup, and it is doubtful whether the Bell telephone in Fig. 99 would have been recognised by its inventor. The granular transmitter, inadequately illustrated on page 222, does not serve in this primitive form as a suitable microphone for use in a hydrophone. The author has obviously made a slip when he says that in signalling under water the sound is received by a submerged microphone similar to a *receiving* telephone. In spite of some defects the volume will serve a useful purpose as a class-book for schools.

Sewerage and Sewage Disposal: A Textbook. By L. Metcalf and H. P. Eddy. Pp. xiv + 598. (New York and London: McGraw-Hill Book Co., Inc., 1922.) 25*s.* net.

THE volume before us is the work of the authors of a three-volume treatise on "American Sewerage Practice," and is the result of a demand for a shorter book suitable for students who have not a great deal of time to devote to this subject. The early sections of the book deal with the main outlines of the problem of sewerage—the quantity of sewage to be expected, storm water, hydraulics, etc. Methods of surveying and excavating are then treated, together with the details of carrying out the work. The later sections deal with the chemical and biological characteristics of sewage and with disposal methods. There is a chapter on cost-estimating at the end of the volume. The authors are engineers whose practice brings them into intimate contact with the matters treated; this is reflected in their book, which cannot fail to be of service to students, British as well as American. The volume is profusely illustrated and is thoroughly up-to-date. There are some useful graphs, among which we note one giving the discharge of egg-shaped sewers running full depth, which is based on Kutter's formula.

Manuel de tournage du bois. Par Hippolyte Gaschet. (Bibliothèque Professionnelle.) Pp. 248. (Paris: J.-B. Baillière et Fils, 1922.) 10 francs net.

A VERY good account of the tools used and the methods employed in wood-turning is given in this little volume, which will be found to be supplementary, in some respects, to English works on the same subject. The language difficulty will probably prevent the book from reaching the hands of many young workers in this country, but manual instructors should find it useful, especially in view of the graduated series of exercises which is included at the end of the volume.

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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.*]

Periodicities.

THE recent paper by Sir William Beveridge on "Wheat Prices and Rainfall" (Journal of the Royal Statistical Society, vol. 85, pp. 412-478, 1922) raises a rather important question of principle which is involved not only in discussions over the existence of periodicities, but also over relationships between different variables.

Before Schuster's papers on the periodogram it was customary for a period to be accepted as real provided that it had an amplitude comparable with that of the original figures under analysis; and he revolutionised the treatment of the subject by showing that if the squares of the intensities of the various periodic terms are plotted in a periodogram, and if the data are those of an entirely chance distribution, then the average value of an ordinate being a, the probability that a particular ordinate will equal or exceed ka is e^{-k}. Sir William Beveridge is accordingly perfectly justified in taking Schuster's sunspot period of 11·125 years, or Brückner's 34·8 year period, and deciding that these periods probably occur in his wheat prices if the corresponding intensities are three or four times the average. But he, like many other investigators, goes a stage further, and after picking out the largest from a large number of intensities he applies the same criterion as if no selection had occurred. It is, however, clear that if we have a hundred intensities the average of which, a, is derived from a number of random figures, then the probable value of the largest of these chance intensities will not be a but will be considerably greater, and it is only when the largest amplitude actually derived materially exceeds the theoretical chance value thus obtained that reality can be inferred.

Taking the periodicities of wheat prices on pp. 457-459 between 5 years and 40 years,[1] I estimate that the "width of a line" ranges from 0·1 year for a 5 years' period, through 0·5 at 12 years to 4 years at 33 years; and accordingly that the number of independent periods between 5 years and 40 is in this case about 51. The value of a, the average intensity, being 5·898, it is easily seen that the chance of all the 51 random intensities being less than $3a$ is $(1-e^{-3})^{51}$, or 0·074, so that the chance of at least one intensity greater than $3a$ is 0·926, not e^{-3} or 0·050, as is habitually assumed. Instead of the chance of an occurrence of $3a$ "making a *prima facie* case for enquiry" (p. 424), the odds are 12 to 1 in favour of its production by mere chance. The chance of at least two intensities above $3a$ is 0·728, of three it is 0·470, of four 0·248, of five 0·109, of six 0·0403, of seven 0·0127, of nine 0·00085, and of eleven 0·00003.

Thus it is not until six intensities over $3a$ are found that the chance of production by pure luck is less than 1 in 20. It is also easily found that if the chance of all the 51 intensities being less than na is to be 19/20, n is 6·9; *i.e.* the greatest intensity for wheat price fluctuations must be 41, not 18, before the probability of its being due to luck is reduced to 1/20; and if the likelihood is to be 1/100 we must have $n=8·5$, the corresponding wheat-price intensity being 50. Of intensities greater than 41 Sir William Beveridge found four, and greater than 50 only two.

At first sight it might seem that the agreement between Sir William Beveridge's forecasted synthesis rainfall curve and the actual rainfall was too great to be explained by a few harmonic terms; but the correlation co-efficient of 0·38 (see p. 475) indicates that while 0·38 of the rainfall variations are accounted for, only $(0·38)^2$, or about a seventh, of the independent factors which control these variations have been ascertained.

As pointed out in a paper "On the Criterion for the Reality of Relationships or Periodicities," in the Indian Meteorological Memoirs (vol. 21, No. 9, 1914), the same principle is valid when discussing relationships. If we are examining the effect of rainfall on temperature and ascertain that the correlation co-efficient between the rainfall and temperature of the same month in a particular English county is four times the probable error, we may infer that the effect is highly probable. But if we work out the co-efficients of that temperature with a hundred factors taken at random, *e.g.* with the monthly rainfall of Tashkend 5·8 years previously, and pick out the largest co-efficient, it would be wrong to compare it with the average co-efficient produced by mere chance; as shown in the paper referred to, the probable value of the largest of 100 co-efficients is 4·01 times as great as the probable value of one taken at random.

GILBERT T. WALKER.

Meteorological Office, Simla, August 24.

[1] Sir William Beveridge points out on pp. 423-424 that amplitudes for periods of less than 5 years are inevitably diminished, while those above 31 are diminished by the process employed for eliminating secular trend: I calculate that the intensity at 35 years should be multiplied by $(0·87)^{-2}$ or 1·3, and that at 54 by 3·8.

DR. WALKER'S note contains, I think, a valid and valuable criticism of the procedure commonly adopted hitherto in comparing individual intensities with the average intensity in harmonic analysis. It would lead me now to modify in several ways my general discussion of the "test of intensity" (pp. 422-424 of my paper in the Journal of the Royal Statistical Society. I was particularly careful, however, in that paper to avoid laying stress on intensity as such. The net result of Dr. Walker's calculations is not to weaken but to confirm my main thesis: that a number of real periodicities exist in European wheat prices from 1550 to 1850.

According to these calculations, the chance of my getting by pure luck between five and forty years one intensity as great as $3a$ is 0·926, but the chance of my getting seven such intensities is 0·0127, and that of getting eleven is 0·00003. Actually I have, between five and forty years, fifteen intensities above $3a$ ($=17·69$); the odds are therefore 80 to 1 that at least nine of these intensities, and 33,000 to 1 that at least five of them, are not due to luck. Obviously every such intensity does, in the circumstances, present a *prima facie* case for further inquiry, the object of the inquiry being to determine which of the 15 intensities have the strongest probabilities of being due to real periods.

In that inquiry the actual height of the intensity in any case (the "test of intensity") is only one and not necessarily the most important point for consideration. As Dr. Walker shows, an intensity in my periodogram of nearly seven times the average might well be due to pure luck (the odds being only 20 to 1 against it). On the other hand, a much lower intensity might represent a true and perfectly regular but weak periodicity, just as a quite small correlation co-efficient may prove a real though weak connexion, if the number of cases compared is very large. Indication of the same period in each half of a sequence when analysed separately (the "test of continuity ") and in independent sequences (the "test of agreement with other records") are often more important criteria of reality than is the height of the intensity itself. The former test, at least, should never be neglected; it has led me to relegate to my fourth class as merely "possible," several periods, such as those near 11, 17, and 24 years, indicated by high intensities in the whole sequence, but failing in either the first or the second half.

Ultimately, of my fifteen intensities between 5 and 40 years, I have treated only nine (at 5·100, 5·671, 5·960, 8·050, 9·750, 12·840, 15·225, 19·900, and 35·500 years respectively) as certainly or probably due to real periodicities, because they show in all cases perfect or fair continuity and in most an agreement with other records. The smallest of these fifteen intensities (21·72 at 7·417 years) in fact equals not $3a$ but $3{\cdot}683a$. If with this revised figure, the probabilities are calculated in the way suggested by Dr. Walker, the odds that at least nine of the fifteen intensities are not due to luck work out at more than 2000 to 1, while the odds in favour of seven at least are 14,000 to 1.

This remarkable result, which seems to establish beyond all reasonable doubt the reign of periodicities in wheat prices, is not affected by the fact that of the fifteen intensities only four are so high that any one of the four, if it occurred alone and had to be judged by height alone, would have odds of more than 20 to 1 in its favour. Each intensity does not occur alone. Every period, moreover, to which I attach importance rests on more evidence than mere height in my periodogram.

With reference to the last paragraph but one of Dr. Walker's note, on the relation of my synthetic curve and the rainfall, I should like to emphasise the point made in my paper (pp. 449-450) that the synthetic curve as now drawn represents only a first approximation of the roughest possible character; the correlation co-efficient of 0·38 between it and the rainfall from 1850 to 1921 is sufficient to demonstrate some connexion between the wheat price cycles and the rainfall, but is in no sense to be treated as a measure of the degree of connexion. In constructing the synthetic curve, for instance, the periodicities have all been treated as of equal importance; inspection shows that weighting according to the intensities would almost certainly give a better fit and so a higher co-efficient of correlation. In many other ways a more accurate determination of the cycles is required. How high a correlation might ultimately be obtained as the result of this, it is impossible now to say, but it might easily prove to be very high indeed. Unfortunately, I have no resources for carrying my own investigations further for the present; I can only hope that others may be better placed. W. H. Beveridge.

One Possible Cause for Atmospheric Electric Phenomena.—A Query.

May I ask Sir Arthur Schuster or Dr. Chree or some other authority whether there is any serious objection to an idea like the following:

The sun being radio-active emits not only gamma rays, which ionise the atmosphere, but also alpha and beta particles. The alpha particles will be stopped by the upper layers of atmosphere, charging them positively, while the beta particles will be more penetrating, and might even reach the ground, charging it negatively; though I admit that thirty inches of mercury is a serious obstruction. But, as Arrhenius showed, the beta particles would be magnetically inveigled towards the poles, where they might descend with down currents: whereas the alpha particles—most numerous near the tropics—would be sustained by up currents; and thereafter the separated charges would reunite with familiar dielectric disruption. Oliver Lodge.

Normanton, Lake, Salisbury, Sept. 29.

School Instruction in Botany.

In the article on "School Instruction in Botany" in Nature of September 2, p. 329, the report on the botany gardens of the James Allen's Girls' School, recently published by the Board of Education, was reviewed. As I am not only the author of the report but also the initiator and organiser of the botany gardens at Dulwich, I shall be glad if space can be afforded me to reply to the following comment at the end of the article: "No mention is made in the Report of the utilisation of the botany gardens for the observation of animal life." The omission is due to the fact that the report was written in 1915 (see prefatory note) when some of the "gardens," which are now of great help in studying animal life, were in an undeveloped condition.

For example, in 1915 the oak trees in the new wood were only from three to four years old and looked somewhat like sticks, as shown in Plate 10. Since 1915 the trees have grown so much that blackbirds, hedge sparrows, and a thrush have built nests, laid their eggs and in all cases but one reared their young in our wood. Advantage of this has been taken and many girls have visited the nests. During outdoor lessons, girls have learned to recognise birds which frequent the school garden, and have become familiar with their calls and songs.

In the spring term the awakening of the numerous frogs which hibernate in the school pond is eagerly awaited. For a short period the pond is densely populated by hundreds of croaking frogs. Later, the development of the tadpoles through all the stages is watched with the keenest interest by girls of all ages. Observation of animal life in the pond includes the study of the life-histories of china mark moths, dragon flies, newts, great water beetles, water boatmen, and water snails. On one occasion last term many girls watched the various stages in the emergence of a china mark moth from its chrysalis.

In these and in other ways the botany gardens at the James Allen's Girls' School are utilised for the observation of animal life. Lilian J. Clarke.

James Allen's Girls' School,
East Dulwich Grove, S.E.22, September 28.

Transcription of Russian Names.

In his further letter (Nature, July 15, p. 78) Lord Gleichen refers to the Royal Geographical Society's System (II.) for the transcription of foreign alphabets into English. A copy of this system has just reached us and impresses us with its completeness and utility, especially for rendering place-names into English.

With regard to the transcription of Russian names we agree with Lord Gleichen that French, German, and hybrid transcriptions are unsatisfactory, but we would advocate, with Prof. Brauner, an international system, and for this purpose the Czech transcriptions have much to recommend them.

In the first place, the Serbian alphabet contains fewer letters than the Russian, and is thus inadequate to allow of accurate transcription from Russian by the Serbo-Croatian rules. Czech transcription has the advantage of being complete.

The following examples may serve to make this clear. Russian а has only one sound, as in "master." It has the same sound in Czech, but the English *a* has several sounds. If ж is rendered by *j* it is liable to mispronunciation; if transcribed to the Czech ž this liability does not arise. Russian у is always pronounced like the Czech *u* (like *oo* in the English word "hook"). Russian х can be correctly rendered by the Czech *ch*.

"Hard mute" and "soft mute" (ъ and ь) can only be transcribed into Czech, using the hook ˇ after the consonant. Russian ы has no other European sound except the Czech *y*. The different pronunciation of the Russian е, ѣ, э cannot be easily expressed in English, but this becomes easy by using the Czech ě for the first two, especially the second.

It may be pointed out that the Czech transcription is already employed in the International Catalogue of Scientific Literature, and for some years German journals (*e.g. Zeitschr. f. anorg. Chem.*) have employed letters with diacritical marks in their transcription of Russian names (*e.g.* "Žemczuznyj," which in Czech is "Žemčužný").

The objection, urged by Lord Gleichen, to the use of diacritical marks exists, but is relatively small. Most scientific journals already have such type, which is indeed necessary if Czech names are to be printed correctly. Newspapers naturally lag behind such a journal as NATURE in matters of this kind, but in time these too will doubtless find it necessary to have letters with diacritical marks in their founts.

Lord Gleichen also asks how many English people can correctly pronounce Czech letters like č. It is regrettable, but nevertheless true, that the correct pronunciation of foreign words is not a great characteristic of the British people, but it is as easy to learn how to pronounce Czech words as it is those of other languages. The example which was chosen by Lord Gleichen is poor, because the sound "č" exactly corresponds to the English sound "ch" (*e.g.* "church").

J. G. F. DRUCE.

Bled, Carniola, Jougo-Slavia.

A. GLAZUNOV
(formerly docent at
Petrograd Polytechnic).

Prague, Král. Vinohrady, Wenzigova 21,
Czecho-Slovakia,
August 5.

Colour Vision and Syntony.

IN NATURE of September 9, p. 357, Prof. E. H. Barton has shown how a syntonic hypothesis of colour vision may be made to represent the trichromatic theory of colour vision. There are numerous facts which are quite inconsistent with any form of the trichromatic theory. These are given in detail in my recent book on the "Physiology of Vision" and subsequent papers, and no attempt has been made to answer any one of them. Every fact points to the visual purple being the visual substance which, sensitising the liquid surrounding the cones, sets up a visual impulse in the cones when decomposed by light. Houstoun's explanation of the physical processes is in complete accordance with the facts, and so far as I am aware no valid objection to it has been found.

Any theory of vision must explain the movement of the positive after-image in the retina. For example, if the positive after-image of a small white triangle on black velvet be obtained with one eye, on moving the head with a jerk, both eyes being covered, an irregular white figure will be seen some little distance away from the clearly cut black triangle, the negative after-image in the original position which is seen when a small amount of light is allowed to enter the eye through the lids. Another very simple method of seeing this movement of the positive after-image is to look at three windows on awaking, which are separated by walls; on closing and covering the eyes, well defined positive after-images of the windows separated by black spaces corresponding to the walls are seen. On covering the eyes and moving the head from side to side the after-images all blend into one, the black spaces being obliterated.

Let us compare the model given by Prof. Barton with the known facts of vision. For any particular light the three vibrators acting together should give the luminosity curve for that light. Barton has placed the red vibrator at about $\lambda 760\ \mu\mu$; here the red has very little luminosity, whereas a driver of the length of the vibrator at this point will produce most effect. Again, drivers corresponding to the infra-red or ultra-violet will affect the red or violet vibrators respectively, whereas these regions are invisible.

When we come to colour blindness the trichromatic theory fails completely. How on this theory can the fact that more than fifty per cent. of dangerously colour blind people can pass the wool test be explained? The fact that a dichromic may have a luminosity curve similar to the normal, that the trichromic have only three colour sensations and designate the yellow region as red-green, and the other degrees of colour and light perception, has to be explained.

F. W. EDRIDGE-GREEN.

London, September 19.

The Green Ray at Sunset and Sunrise.

THE review by Sir Arthur Schuster of Mulder's book on the green ray or green flash at rising and setting of the sun, in NATURE of September 16, p. 370, leads me to make the following remarks:

There are, in reality, two distinct phenomena which go under the name of the green flash. The first, probably the one most usually seen and the only one to which the epithet properly applies, is certainly an after-image in an eye fatigued by the red light of the sun. I have seen it many times, only at sunset, and in many localities—on the Red Sea (twice in one evening owing to the sun being occluded by a narrow bank of cloud prior to its actual setting), in Devonshire, and even in London as the sun set behind University College Hospital.

This phenomenon can be reproduced quite easily in the laboratory by means of an artificial red sun, as I demonstrated a few years ago at a meeting of the Physical Society of London.

The second phenomenon, which I have never been successful in seeing and of which I can say little, is evidently due to atmospheric dispersion; and, from the published accounts, I should judge that it should be called the blue sun or multicoloured sun or spectrum flash. It would seem to be much more rare, as I gather from Sir Arthur Schuster's previously made descriptions that it requires rather special conditions.

If this subject should get into elementary text-books, as recommended, at least let the account of it be complete.

ALFRED W. PORTER.

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Photography of Bullets in Flight.

By Philip P. Quayle, Assistant Physicist, National Bureau of Standards, U.S.A.

Instantaneous photography by means of an electric spark provides the investigator of high-speed phenomena with a most valuable source of data. Such photographs are of the shadow variety, the bullet shadow being projected upon a photographic plate by a spark of great intensity and short duration. If the bullet is moving with a speed equal to or greater than that of sound, it propagates from both its nose and base

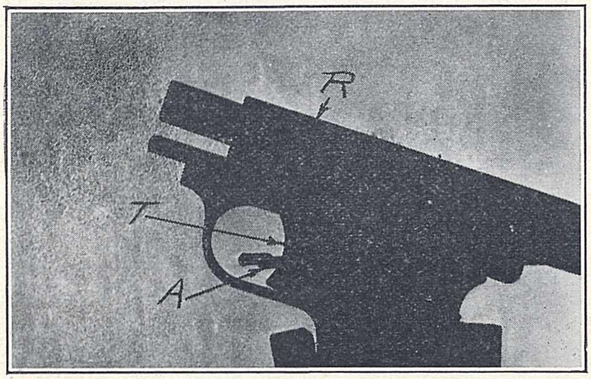

Fig. 1.—Automatic pistol in position of extreme recoil, empty cartridge case not yet ejected.
T=trigger; R=receiver; A=arm operating trigger.

a compressional wave. Light from the photographing spark in passing through the denser atmosphere of the compressional wave is refracted as by a lens, so that the wave front is also projected upon the photographic plate with the bullet. The method lends itself readily to the investigation of a projectile's stability at various points along its trajectory and to many allied problems of exterior ballistics. Instructive photographs of the recoil and shell ejection of automatic rifles, pistols, and machine guns may also be obtained in this manner.

Among the most important of the early contributions in this field of research are the admirable spark photographs by Prof. C. V. Boys (Nature, Vol. 47, pp. 415 and 440), who greatly simplified the elaborate apparatus of Prof. E. Mach. In Prof. Boys's apparatus the bullet was employed to close the spark circuit, and this method has been followed in experiments which have been carried on since that time, so far as the present writer is aware.

In the method described in this article the setting-off or triggering of the electric spark by which the photographs are taken is controlled by the compressional wave produced by the flight of the bullet, so that no wires or other portions of the apparatus need appear on the plates. Since the sound wave is used to trigger the photographing spark, the position of the rifle firing the bullet may be varied at will without affecting the functioning of the apparatus, the only requirement being that the bullet shall have a speed greater than that of sound. When the speed of the bullet is less than that of sound the muzzle blast may be used to trigger the spark. In such cases the rifle must not be moved.

In Prof. Boys's type of apparatus the photographing spark is set off by the closing of a secondary gap by the bullet itself. In the present apparatus a much more powerful spark may be used than would otherwise be possible, because the potential available for the photographing spark is not limited by the dielectric strength of some trigger gap of fixed and small dimensions.

The regulation of the potential of the spark is essential, however, since great irregularities in time occur when the apparatus is not operated at the same potential, the spark occurring earlier or later than the transit of the bullet across the plate. This, of course, precludes satisfactory records when working with modern high-speed bullets. When the proper potential has been attained a signal light is automatically turned on.

No lens system is employed in the apparatus. An arrangement which has been found very satisfactory places all of the photographic apparatus, except the trigger, inside a small light-tight house.

The trigger itself is located outside the house and near the trajectory. This trigger is an interrupter of the type used by the French in connexion with the Joly chronograph. The use of this instrument and the type of springs used in the photographing-spark-switch were suggested by Dr. D. C. Miller, of the Case School of Applied Science, where the apparatus was developed. The trigger consists of a metal diaphragm about 2 inches in diameter enclosed in a circular metal box. The diaphragm forms one side of an air-tight enclosure, and on the inside face of the diaphragm is attached a circuit-breaking mechanism. This circuit-breaker functions when the crack wave emanating from the bullet strikes the diaphragm, which in turn throws back a small hammer, thus interrupting the circuit and

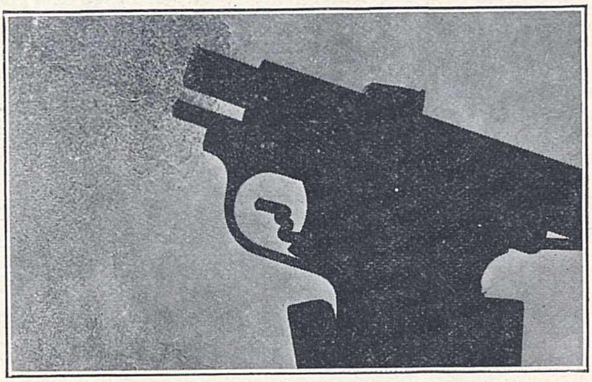

Fig. 2.—Automatic pistol; empty cartridge case just emerging from the receiver.

tripping the photographing-spark-switch, with which it is connected in series.

The essential parts of the photographic apparatus consist of a large Leyden jar battery charged by a static machine which is motor driven, the control switch for the motor being mounted on the table with the rifle. A potential regulator which is connected across the battery functions when the proper potential has been reached, and trips a switch which disconnects the battery from the charging machine and short-circuits the terminals of the latter. The switch when tripped turns on a signal light located outside the apparatus house as a signal to the rifle operator to fire.

When operating the apparatus the general sequence of events is as follows:

The photographing-spark-switch and battery-switch inside the apparatus house are set, the lights turned out, and the slide of the plateholder drawn. The operator then leaves the apparatus house by means of a light-tight passage and starts the static-machine motor by closing the table switch. He then makes any necessary

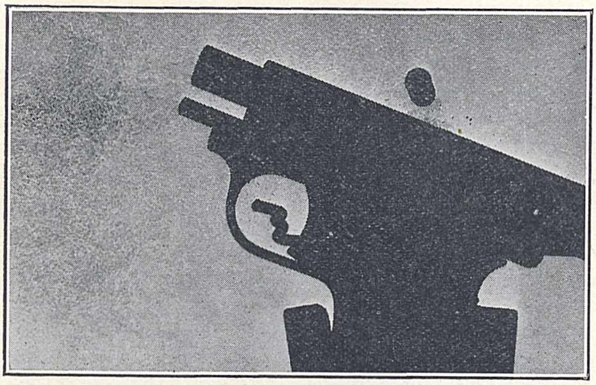

FIG. 3.—Automatic pistol; empty cartridge case ejected from receiver.

correction to the aiming and fires when the signal light appears. The bullet leaves the rifle and on its way to the apparatus house passes the trigger upon the diaphragm of which the sound wave impinges. This immediately trips the photographing-spark-switch and it starts to close the trigger gap in the spark circuit. The bullet continues on past the trigger, entering the apparatus house through a sheet of thin paper, used to shut out the light, and arrives in front of the photographic plate, upon which it is then projected by the photographing spark. The motor switch is then opened and the slide replaced in the plateholder, which may then be taken to the dark room and developed.

In case the speed of the bullets to be photographed is not known, a piece of paper or wire screen is placed in the path of the bullet in front of the photographic plate, and if a puncture in the screen is shown when the plate is developed, evidently the bullet had gone past the plate before the spark occurred. The trigger must then be moved back from the plate and the process repeated. Continuing in this manner the position of the bullet when the spark occurs will soon be bracketed within limits sufficiently small, so that an observer inside the apparatus house may see the bullet as the spark illuminates it. Visual adjustment only is then used until most of the bullets are seen in the desired locality when the spark occurs.

The apparatus is provided with two light gaps, one horizontal and the other vertical. This arrangement facilitates the taking of two photographs of the same bullet, a plan and elevation view. This is particularly useful in investigating a projectile of an unstable character having a tendency to tumble, since from the two views its actual position in space may be constructed.

The two coaxial waves which the bullet propagates from its nose and base appear on the photograph (Fig. 4) to have different slopes. This arises from the projection, for while the axis of the wave is parallel to the photographic plate, and therefore projected in proportion to its length, the radius of the projected wave is somewhat inclined to the plate and causes the distortion. The true angle of the conical sound wave in air may, however, be readily computed, from which the speed of the bullet producing the wave may be determined.[1]

In obtaining the photographs of the Colt automatic 25-calibre pistol, reproduced in Figs. 1, 2, and 3, the interrupter trigger was removed from the circuit and a timing device substituted, which consists of two electromagnets connected in series and adjustable in height, their function being to drop two steel balls at the same time when the key opening their circuit was depressed. One of these balls fell on a lever which pulled the trigger T of the automatic pistol by exerting tension on the arm A (see Fig. 1). The other ball, released from a greater height at the same time as the first, impinged on a device setting off the photographing spark. By this means any reasonable lag or lead in the firing of the pistol with respect to the occurrence of the photographing spark could be obtained. The firing apparatus is obviously not a precision instrument and could, of course, be replaced by an accurate timing device should the investigator require information of such a character.

The turbulent gases of the propelling charge are clearly shown in Figs. 1, 2, and 3. All these photographs of the automatic pistol represent a stage in the recoil relatively long after the ejection of the bullet from the muzzle, since it will be seen that the receiver R has reached the position of extreme recoil and the empty cartridge case is being ejected in Figs. 2 and 3.

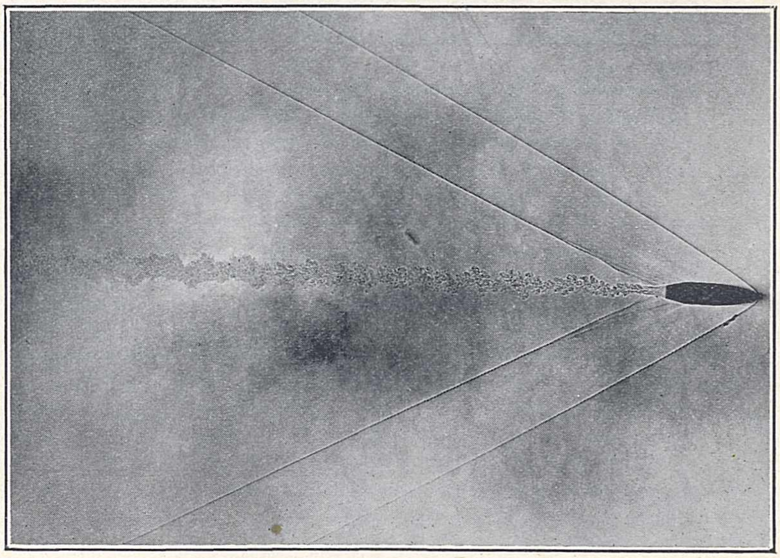

FIG. 4.—30 Calibre boat-tailed bullet, approximate speed 2600 feet per second.

If the height of the ball which triggers the spark is changed progressively by some small known amount, a series of photographs of such an automatic pistol at slightly different calculable time intervals could be secured. From the data obtainable from such photographs a pressure time curve could be computed.

[1] Journal of the Franklin Institute, May 1922.

The Study of Man.[1]

By H. J. E. PEAKE.

A CHANGE has been creeping over our science. Twelve years ago anthropologists were devoting their energies to the tracing out of the evolution of customs and material culture, assuming that, where similarities were found in different parts of the world, they were due to independent origins. It was assumed that the workings of the human mind were everywhere similar, and that, given similar conditions, similar customs would originate. The evolution of civilisation was looked upon as a single line of advance, conditioned by the unalterable nature of the human mind, and that barbarian and savage cultures were but forms of arrested development, and indicated very closely past stages of civilised communities.

But a fresh school of thought has come into prominence. According to this new view discoveries are made but once, and when resemblances are found between the cultures of different communities, even though widely separated, this is due to some connexion between them. According to the new school, the development of civilisation has been proceeding by many different paths, in response to as many types of environment, but these various advances have frequently met, and from the clash of two cultures has arisen another, often different, more complex, and usually more highly developed than either of its parents.

The old school looked upon the advance of culture as a single highway, along which different groups had been wandering at varying paces, so that, while some had traversed long distances, others had progressed but a short way. The new school, on the other hand, conceives of each group as traversing its own particular way, but that the paths frequently meet, cross, or coalesce, and that where the greatest number of paths have joined, there the pace has been quickest.

The older school, basing its views of the development of civilisation upon the doctrine of Evolution, has called itself the Evolutionary School. The newer, while believing no less in Evolution, feels it a duty to trace the various stages through which each type of civilisation has passed, rather than to assume that these stages have followed the succession observable elsewhere; thus, as historical factors form a large part of its inquiry, it has been termed the Historical School.[2]

The first note announcing the coming change was sounded from this chair eleven years ago,[3] and during the interval which has elapsed the new school has gained many adherents. All will not subscribe to the dictum that no discovery has been made twice; nevertheless there is a tendency not to assume an independent origin for any custom until it has been proved that such could not have been introduced from some other area.

These tendencies have led the anthropologist to inquire into the history of the peoples whose civilisation he is studying, and to note, too, minute points in their environment. At the same time geography began to take special note of man and his doings. This anthropogeography concerned itself with inquiring into the reactions between man and his environment, and though at first the environment was the main object of the geographer's attention, he is now inclined to pay more attention to its effect upon man. Thus anthropology and geography have been drawing closer, and as the latter is a recognised subject in our schools, no small amount of anthropological knowledge has been instilled into the minds of our boys and girls.

It might have been expected that the historians before the geographers would have been attracted to the anthropological approach, but recent events have up to now engrossed their attention. Signs have not been lacking, however, that the study of peoples and their customs, rather than of kings and politicians, is gaining ground, and we may look with confidence towards closer relations between the studies of history and anthropology.

Again, we may notice an increasing interest in our subject among sociologists and economists. These have focussed their attention upon the social organisation and economic well-being of civilised communities, with the view of presenting an orderly array of facts and principles before the political leaders. There has, however, been a tendency to trace these modern conditions back into the past, and to use for comparison examples drawn from the social organisation or economic conditions of communities living under simpler conditions. While these studies overlap those of the anthropologist, the methods used are different. We are working from the simple to the complex; they begin with highly developed conditions and thence work back to the primitive.

Lastly, we must not forget the students of the classical languages. In spite of many advantages which they possess at schools and universities, they have been losing in popularity, and the reason is not far to seek. So long as there were fresh works to be studied and imperfect texts to be emended, there was no lack of devotees to classical literature. Later, comparative philology gave fresh life to such studies, and certain views current among mid-nineteenth-century philologists gave also an impetus to the re-study of Greek mythology. But about 1890 such studies became unfashionable, and many classical scholars turned to anthropology with great advantage both to themselves and to us.

It is doubtless as a result of these converging movements that the general public is taking an interest in anthropological studies, and that works of a general nature, summing up the state of knowledge in its different branches, are in great request. The educated public wish to know more of the science of man, yet I fear they are too often perplexed by the discordant utterances of anthropologists, many of whom seem to be far from certain as to the message they have to deliver.

In their turn not a few anthropologists feel a like uncertainty as to the ultimate purpose of their studies, and are not clear as to how the results of their investigations can be of any benefit to humanity. These are points well worthy of consideration; for, as we were reminded from this chair two years ago,[4] anthropology, if it is to do its duty, must be useful to the State,

[1] From the presidential address delivered to Section H (Anthropology) of the British Association at Hull on September 7.

[2] Rivers, W. H. R., "History and Ethnology," *History*, v. 65-7, London (1920).

[3] Rivers, W. H. R., "The Ethnological Analysis of Culture," Report of Brit. Assoc., 1911, 490-2.

[4] Karl Pearson: Address to the Anthropological Section, Brit. Assoc. Report, 1920, 140-1.

or to humanity in general. Even the scope of the science is by no means clear to all, and would be differently defined by various students. It may not be out of place, therefore, to consider in detail the scope and content of anthropology, then its aims and the services it may render to mankind.

To the outside world anthropology seems to consist of the study of flint implements, skeletons, and the ways of savage men, and to many students of the subject its boundaries are scarcely more extensive. Yet civilised people also are men, and anthropology should include these within its survey. That other scientific workers, historians, geographers, sociologists, and economists, study civilised man is no reason why the anthropologist should fail to take him into account, for his point of view differs in many respects from theirs. I would suggest, therefore, that all types of men, from the most civilised to the most primitive, in all times and in all places, come within the scope of anthropology.

Anthropology is the study of man, but we need a more accurate definition. A former occupant of this chair has declared that "anthropology is the whole history of man as fired by the idea of evolution. Man in evolution—that is the subject in its full reach." He adds: "Anthropology studies man as he occurs at all known times. It studies him as he occurs in all known parts of the world. It studies him body and soul together."[5]

Anthropology may, therefore, be defined as the study of the origin and evolution of man and his works. What, then, separates anthropology from the other studies which are concerned with man is, that the anthropologist studies him from all points of view—that his is a synthetic study; above all, that evolution is his watchword; that his study is, in fact, not static but dynamic.

If, then, we grant that anthropology is the synthetic study of the evolution of man and his manifold activities, we are dealing with a subject so vast that some subdivision becomes necessary if we are to realise what the study involves. Such divisions or classification must be arbitrary, but we may consider the subject as divided primarily into two main categories: "man" and "his works."

But man himself cannot be considered from one aspect only, and it seems fitting that the anthropologist should consider that man consists of body and mind; the study of these is the special province of the anatomist, the physical anthropologist, and the psychologist. Here, again, it may be asserted that anatomy and psychology are distinct sciences, but anatomy, in so far as it helps us to understand the evolution of man, and again as it helps us to trace the variations in the human frame, is and always has been reckoned a branch of anthropology. Again, in the case of psychology, there is much which is not, strictly speaking, anthropological. On the other hand, in so far as psychology enables us to trace the development of the human mind from that of the animal, and in so far, too, as it can interpret the causes which have led to various forms of human activity, it is a branch of our science. If, too, it can help us to ascertain whether certain fundamental mental traits are normally associated with certain physical types, psychology will provide anthropologists with a means of interpreting many of the phenomena which they have noted but cannot fully explain.

The works of man are so varied that it is no easy task to classify them. We may, however, first distinguish the work of man's hands, his material culture, from his other activities. Under this heading we should include his tools, weapons, pottery, and textiles; his dwellings, tombs, and temples; his architecture and his art.

Next, we have the problems concerned with language, which we may consider as dealing with the means whereby men hold intercourse with one another. This heading might well include gesture at one end and writing at the other. Hitherto anthropologists have confined their attention too exclusively to the tongues of backward tribes, and left the speech of more advanced peoples to the philologists. I would plead, however, that language is such an essential element in human culture that comparative philologists might well consider themselves as anthropologists.

Lastly, we have social organisation and all that may be included under the terms "customs" and "institutions," a varied group, leading to the study of law and religion. Here, again, we come in contact with other studies—those of the lawyer, political economist, and theologian; but though the anthropologist is studying the same facts, his range is wider and his outlook more dynamic.

Thus it will be seen that in the three divisions of man's work, as well as in the two aspects of man himself, the anthropologist finds other workers in the field. But whereas these other sciences are concerned only with some part of man and his works, and are limited frequently to recent times and civilised communities, it is the province of the anthropologist to review them as a whole, in all times and in all places, and to trace their evolution from the simplest to the most complex.

If we accept the views of the historical school, anthropology becomes a new method of treating historical material. It is, in fact, the history of man and his civilisation, drawn not so much from written documents as from actual remains, whether of material objects or of customs and beliefs. It is concerned with wars only so far as these have produced a change in the population or language of a region. It is interested in kings only when these functionaries have retained customs indicative either of priesthood or divinity. It is interested less in legal enactments than in customary institutions, less in official theology than in the beliefs of the people; the acts of politicians concern it not so much as do the habits of humbler folk.

From some points of view anthropology may be considered as a department of zoology. A century ago zoologists were engaged in studying the higher animals, and for a time neglected the "radiate mob." Then all interest was focussed upon lowly forms, and the protozoa occupied a disproportionate part of their attention. Lately, again, their work has been more evenly distributed over the whole field. This choice of groups for special study was not due to mere caprice. The more obvious forms of life were first studied; then attention was focussed upon the simpler organisms; for, from the study of these, the zoologist was able to grasp

[5] Marett, R. R., "Anthropology," p. 1.

the underlying principles of life. These lessons learnt, he was able to attack the problems affecting the welfare of mankind.

So with the student of man. For many centuries historians, philosophers, and theologians have been studying the ways of civilised humanity, though not by the methods of the anthropologist. For, just as they were attracted by the higher groups of men, so were they fascinated by the more conspicuous individuals. During the nineteenth century, students were attracted towards the backward types of humanity, partly because of their very unlikeness to ourselves, and of recent years because they felt that the customs of these peoples were fast disappearing. But from a scientific point of view, the paramount reason was because it was felt that in such simple societies we should find the germ from which human civilisation had begun.

Much of the force of this last argument is disappearing as the evolutionary school gives place to the historical. We are becoming aware that the civilisation of backward peoples is more complex than was at first believed. We are giving up the belief that such people have preserved our ancestral types alive to the present day, for we are realising that they represent not so much our ancestors as our poor relations.

Though we must abandon the ancestral view, and cease to believe that these backward communities represent to-day the conditions under which we dwelt in the past, the institutions of these folk are in many respects less complex than our own, and it is possible to study them from every aspect with far greater ease than we could do in the case of one of the higher civilisations. Since it is the function of anthropology to study man synthetically, this is a great advantage. When dealing with these simpler problems we can evolve a method and a discipline to be applied in more complicated cases. Again, the backward peoples have no written history, and we are forced in this case to restore their past by other means. This has led to the development of fresh methods of attacking the problems of the past, which may prove of value in the case of more advanced communities.

For these reasons the study of backward peoples still has great value for the anthropologist. He has not yet solved all the problems concerned with the dawn of civilisation, nor has he yet perfected his methods and discipline. More workers and expert workers are needed in this field, and so it is that our universities devote the greater part of their energies to training students for this purpose. There are many students, however, who cannot visit wild lands to study the ways of their inhabitants. Some of these, it is true, may sift the material collected by their colleagues, though they will be at considerable disadvantage if they have had no personal experience of the people with which their material deals.

The time seems to have arrived when anthropologists should not concentrate so exclusively upon these lowly cultures, but might carry on their researches into those civilisations which have advanced further in their evolution. Not that I wish to deprecate in any way the study of backward peoples, or to discourage students from researches in that direction; but I would suggest that some anthropologists might initiate a closer inquiry into the conditions of more civilised peoples, in addition to the studies already described.

We have in the Old World three great centres of culture, each of which has been in the van of progress, and each of which has contributed to the advance of the others. These are the civilisations of China, Hindustan, and what I will call the European Region.

Though our relations with China and Japan have been intimate for several generations, and many of our compatriots are familiar with both countries, it is surprising how little we know of either of these people from the anthropological point of view. This is the more to be regretted since for more than half a century Japan has been adopting features from Western civilisation, while there are signs that the same movement is beginning in China. So far those who have made themselves familiar with the languages of the Far East have studied the art, literature, philosophy, and religion of these regions, rather than those aspects which more properly belong to our subject.

What concerns us more nearly in this country is the Indian Region. Here we have a well-defined province, peopled by successive waves of different races, speaking different languages, and with different customs and beliefs—an apparently inextricable tangle of diverse elements in various stages of cultural evolution. A vast amount of material has been gathered in the past, though such collecting has not been proceeding so fast during the last generation; but basic problems are still unsolved, and seem at times well-nigh insoluble. Perhaps it is this superabundance of material, or it may be the apparent hopelessness of the task, which has diminished the interest taken in these studies during the past few years. This attitude is regrettable, and the only redeeming feature is the extremely active and intelligent interest in these problems now taken by various groups of Indian students, especially in the University of Calcutta.

I have suggested that perhaps the lack of interest in such matters among Anglo-Indians, and especially among members of the Indian Civil Service, may be due to the apparent hopelessness of reaching a solution of any of the problems involved. It may also be due to the fact that they are sent out from this country to govern a population with different cultures and beliefs, and traditions wholly unlike those of this continent, without having received in most cases any preparation which will enable them to study, appreciate, or understand an alien civilisation. Thus they misunderstand those among whom they are sent, and are in turn misunderstood. Guiltless of any evil intent, they offend the susceptibilities of those among whom their lot is cast, and acts are put down to indifference which are only the product of ignorance. After making their initial mistakes the more intelligent set to work to study the people committed to their charge, but faced with problems of extreme intricacy, and without any previous training, more often than not they give up the attempt as hopeless.

That candidates for the Indian Civil Service should receive a full training in anthropology before leaving this country has been pleaded time after time by this Section and by the Anthropological Institute, and though I repeat the plea, which will probably be as useless as its predecessors, I would add more. The problems confronting the anthropologist and the administrator in India are of such extreme complexity that it needs a very considerable amount of combined action and research even to lay down the method and the lines along which future inquiries should be made. Such a school of thought, such a nucleus around which further research may be grouped, does not yet exist; the materials out of which it can be formed can scarcely yet be found. Yet until such a nucleus has been created, and has gathered around it a devoted band of researchers, no true understanding will be found of the problems which daily confront both peoples, and the East and the West will remain apart, subject to mutual recriminations, the natural outcome of mutual misunderstanding.

One solution only do I see to this dilemma. For many years past there have been institutions at Athens and Rome, where carefully chosen students have spent several years studying the ancient and modern conditions of those cities and their people. By this means a group of Englishmen have returned to this country well informed, not only as to the ancient but the modern conditions of Greece and Italy. Besides this we have had in each of the capitals of those two States an institution which has acted as a centre or focus of research into the civilisation of those countries. Although the main objects in both cases have been the true understanding of the cultures of the distant past, the constant intercourse of students of both nationalities working for a common end has resulted in a better understanding on the part of each of the aims and ideals of the other. I have no hesitation in saying that the existence of the British Schools at Athens and Rome has been of enormous value in bringing about and preserving friendly relations between the people of this country and those of Greece and Italy.

I cannot help feeling that a similar institution in India, served by a sympathetic and well-trained staff, to which carefully selected university men might go for a few years of post-graduate study, would go far towards removing many of the misunderstandings which are causing friction between the British and Indian peoples. Such a British School in India, if it is to be a success, should not be a Government institution, but should be founded and endowed by private benefactors of both nationalities. It would be a centre around which would gather all anthropological work in the peninsula, while it would enable the British students to arrive at a truer understanding of Indian ideals and help Indians to grasp more fully the relations subsisting between the Indian and European civilisations.

Lastly, we come to the European Region, extending southward to the Sahara, and eastwards to Mesopotamia. Throughout this region the racial basis of the population is similar, though the proportion of the elements varies. Also throughout the region there has been, from the earliest days, free communication and no great barriers to trade and migration.

Until the last fifteen hundred years the civilisation of this area was fairly uniform, though its highest and earliest developments were in the south-east, while the northern zones lagged behind and were on the outer fringe. Nevertheless it formed from palæolithic times one cultural region, and this became more marked and homogeneous during the days of the Roman Empire. Two forces from without destroyed that mighty empire and divided the region into two halves; and as each of these forces adopted different religious views, the European cultural region became divided into two. We have, therefore, to treat the European cultural region as two, the civilisations of Islam and Christendom.

Though the separation of these two halves is relatively recent, their ideals have grown divergent, while the inhabitants of both zones are no nearer to a true understanding of one another. Political difficulties in the Near East are the natural result of such misunderstandings, and the remedy here is to achieve a truer appreciation of other points of view. A more thorough knowledge of the anthropological factors of the case seems to be a necessary preliminary to such mutual understanding, and since the League of Nations and the Versailles Treaty have seen fit to add to our responsibilities in this area, it is an urgent necessity that some of our anthropologists should pay closer attention to the problems of the Near East.

And now with regard to Christendom. Are we to consider that our duties as anthropologists end with alien cultures? Is Christendom so united that misunderstandings cannot arise within its borders? At the close of a great war we can scarcely claim that there is no room for our studies.

There has been a tendency hitherto to regard anthropology as a science dealing with backward peoples, and it has been felt that to apply its principles to neighbouring peoples might be looked upon as an insult. If, however, we agree that all mankind are fit material for the anthropologist's investigations, we need have no hesitation in studying their material culture, social organisation, and religious beliefs, just as already, for practical purposes, we study their languages. There is not a country in Europe in which we may not find features of an anthropological nature which separate its population from the inhabitants of other areas. It is these differences which come to the front when trouble is brewing, and these are the factors which we need to understand if we are to avoid giving offence in moments of national irritation. Constant travel by people alive to the importance of such inquiries will in time so influence the public opinion of many of the nations of Europe that misunderstandings will be less frequent, and national sensitiveness less prone to take offence at words and actions which are not intended to provoke.

But it is not only foreign countries and their inhabitants which the anthropologist needs to study. In every country there are different strata in the population which have different customs and a different outlook. The British Isles are no exception to this rule; history records the successive arrivals of Romans, Saxons, Danes, and Normans, and the study of prehistoric remains shows us that these invasions have been preceded by a greater number in earlier days. Just as the physical type of the Briton is far from uniform, so are his mental outlook and his ideals and beliefs. Quite apart from the differences observable in the different countries which compose our group of islands, we find also that the population insensibly divides itself into classes, differing but slightly except in name from what we know in India as castes. These classes in the British

Isles have had their origin in the successive waves of conquest which these islands have suffered. Individuals have freely passed from one class to another, but though the individuals have changed the classes have remained. Owing to the constant interchange in blood the physical characters of the different classes are much alike, as are their fundamental mental traits, but in material culture, language, social organisation, and to some extent religious beliefs, they differ widely. Here then again, in our own country, there is work for the anthropologist who never leaves these shores.

Turning now to the aims of anthropology and to the means whereby it may become of service to the State and to mankind in general, we see that it is of the utmost importance that those who are sent to govern or administer areas and districts mainly occupied by backward peoples should have received sufficient training in the science to enable them, in the shortest possible space of time, and consequently with the fewest possible initial mistakes, to govern a people whose customs, traditions, and beliefs are very different from their own, without offending the susceptibilities of their subjects.

We are an Imperial people, and during the last few centuries we have taken upon ourselves a lion's share of the white man's self-imposed burden, and the lives and well-being of millions of our backward brethren have been entrusted to our charge. Recent events have, by means of mandates, added largely to our responsibilities in this respect. We, of all nations, cannot disregard this fundamental duty of despatching our proconsuls fitted to undertake these great responsibilities.

But the burden we have undertaken extends not only to backward peoples ; we have been called upon to govern or to advise the governments of peoples who have a civilisation little, if at all, inferior to our own, and to whom at one time we have been indebted for much of the culture that we now enjoy. The civilisations of these regions are infinitely more complex, and the people are not homogeneous, but are divided into numerous sections, differing in language, religion, and social customs. In these regions we meet with anthropological problems of infinite difficulty and complexity, on the solution of which depend the peace and well-being of the population. Yet our representatives go to take up their duties in these lands with little or no previous training, and it is only a marvel that errors of tact, due to ignorance, are not more common.

In these civilised regions race consciousness has been growing fast during the last half-century, and errors of tact and manners, which were submitted to in former times, though not with a good grace, are now actively resented, and the old methods of government are discredited. It may not yet be too late to remedy this evil, if no time is lost in giving a full anthropological training to those who are sent to administer these regions.

But we are not only an Imperial people, governing and administering regions with alien populations ; we are also a wandering and adventurous people. The nomadic spirit of our ancestors is still alive within us ; our ships, like those of the Vikings of old, are to be seen in every sea. So it comes that our people will be found in all lands and all climates from the Arctic circle to the Equator.

All these wandering Britons come in contact with the inhabitants of the lands they visit, creating various impressions, sometimes good, more often bad. Had they a fuller knowledge of the customs and opinions of the people they visit, or even a truer appreciation of the fact that diverse customs and opinions exist and should be respected, we should not have to record the creation of so many bad impressions. Luckily our people, as a rule, have much common sense, and often a desire to please, so this trouble is thus to some extent mitigated ; but the difficulties that have arisen from ignorance of the ways of others, from too insular an outlook, in fact, from a lack of appreciation of the anthropological standpoint, are making us and our government heartily disliked in nearly every quarter of the globe. It is to remedy these difficulties, and the danger to the peace of the world which is threatened thereby, that I would advocate an increased study of anthropology by all sections of the community. Herein lies one of the chief means by which our science may become of service to mankind.

It is not my business to draft a scheme for the furtherance of anthropological studies. Two of our universities offer degrees in this subject, and others a diploma ; courses of instruction on some sections of the subject are given there and elsewhere. Many teachers of geography are introducing much anthropological matter into their curricula, and there are signs that some historical teachers may follow suit, so that the subject-matter, if not the name, is not unknown in some of our schools. But we have much lost time to make up and the matter is urgent.

We cannot, of course, expect all our people to be trained anthropologists and to understand fully all the ways of the people they may chance to meet in their wanderings. What matters far more is that they should appreciate the fact that different peoples have had different pasts and so act differently in response to the same stimuli. Further, that all this diversity has its value ; that we cannot be sure that one culture is in all respects superior to another, still less that ours is the best and the only one which is of consequence. It is not so much the facts that matter as the spirit of anthropology ; we need not so much that our people should have anthropological knowledge as that they should learn to think anthropologically.

It is needless for me to remind you that the world is in a state of very unstable equilibrium—that the crust is, so to speak, cracked in many places, and that the fissures are becoming wider and deeper, and that fresh fissures are constantly appearing, not only in distant lands but nearer home. Again, this crust, if I may continue the geological metaphor, is stratified, and there are horizontal as well as vertical cleavages, which are daily becoming more marked. It is to the interest of humanity that these breaches should be healed and the cracks stopped, or we may find the civilisation of the world, which has grown up through long millennia at the cost of enormous struggles, break up into a thousand fragments. Such a break in the culture of the European Region followed the dissolution of the Roman Empire, and more than a thousand years were needed to heal it ; nay, some of the cracks then made have never yet been closed.

Anything that may help to avert such a disaster is important to the human race, and there is no greater danger at present than the alienation of the peoples of Asia and the Near East. Much of the ill-feeling engendered in India, Egypt, and elsewhere is the product of misunderstandings, due to a lack of appreciation on both sides of the opinions and views of the other party, and there seems to be no better method of removing such misunderstandings than a sympathetic study of one another's culture; to this end anthropology offers the most hopeful approach.

Obituary.

DR. DAVID SHARP, F.R.S.

DR. DAVID SHARP, whose name, it has been well said, is a household word wherever the science of entomology is pursued, died on August 27 at his home at Brockenhurst. His love of entomology, the great and continuing enthusiasm of his life, dated from his early childhood. Born in 1840 at Towcester, Northamptonshire, his early years were passed at Whittlebury, Northants, and at Stony Stratford. His parents later moved to London, and it was at Loudoun Road, St. John's Wood, that Herbert Spencer was an inmate of Sharp's father's house, as Spencer himself has related in his autobiography. Sharp himself said that his youthful intimacy with Spencer had influenced him considerably, and throughout his life he retained in Spencer's work an interest which found expression in the publication in 1904 of an article on "the place of Herbert Spencer in biology."

Sharp was destined by his father for a business career, but, finding this uncongenial, he studied medicine in London and afterwards at Edinburgh University, where he graduated in 1866 with the degrees M.B. and C.M. Specialising in the treatment of mental illnesses, he resided for some years at Thornhill in Dumfriesshire. He left Scotland in 1884 and lived at Shirley Warren, Southampton, and afterwards at Wilmington, near Dartford, Kent. Early in 1890 he was appointed curator of the insect collections of the University Museum of Zoology, Cambridge, a post which he resigned early in 1909. He then retired to Brockenhurst, where he passed the rest of his days.

Most of his multitudinous writings are systematic works on the Coleoptera, to which he devoted the greater part of his life, but many deal with other insects or with life-histories, or have a still wider bearing, for his learning extended to a wonderful degree over the whole field of entomology. He had an unrivalled knowledge of the British Coleoptera, and already in 1869 had published a monograph of nearly 200 pages on the obscure genus Homalota. His list of the Coleoptera of Scotland appeared in the early volumes of the *Scottish Naturalist*, and he published two catalogues of the Coleopterous fauna of Britain, the second in collaboration with Canon W. W. Fowler. His numerous other studies of British beetles form a series of papers continuing to the last years of his life.

Sharp's biggest works on foreign Coleoptera are the monograph of water-beetles (Dytiscidae) published by the Royal Dublin Society in 1882, and his contributions to the "Biologia Centrali-Americana." In the latter he wrote the whole of the volume on Adephaga and Staphylinidae, more than 800 pages, the greater part of the volume on Clavicorns, and three other important sections. He also published in 1876 a paper of nearly 400 pages on the Staphylinidae of the Amazons. On New Zealand beetles, a fauna in which he was specially interested, he produced a long series of memoirs. One can barely allude to his papers on the beetles of Japan, an important series, and to others on those of Ceylon, Southern India, the White Nile, etc., with many more, far too numerous to mention. Systematists, knowing the work required for the production of a single careful description, will appreciate the immense amount of toil needed to achieve these results. Special mention must be made of Sharp's work on the faunas of islands. A series of earlier papers on Hawaiian beetles was but the prelude to his labours as secretary of the committee appointed in 1890 to investigate that fauna, and as editor of the three large volumes of the "Fauna Hawaiiensis," of which he himself wrote several considerable parts. He was moreover a member of the committee appointed in 1888 to examine the flora and fauna of the West Indies.

Of his more general writings undoubtedly the best known are the two volumes on insects in the "Cambridge Natural History," published in 1895 and 1899 respectively, which at once became standard works. His memoir (1912) written in collaboration with Mr. F. Muir on "the comparative anatomy of the male genital tube in Coleoptera" is a masterly treatise, on the production of which the breadth of his learning was brought to bear. In 1873 appeared his pamphlet on "the object and method of zoological nomenclature," in which he elaborated the view that nomenclature requires, for the maintenance of continuity of knowledge, fixed names for the species of animals, while changing ideas as to classification need shifting names for their expression. He advocated that the two names, generic and trivial, originally given to an animal should always be preserved intact, even though it may subsequently be placed in several different genera at different periods. He held also that the analytic system of Linnaeus, in which species are treated as fractions of genera, broke down almost at once, and that only by a synthetic system could progress be made; that species must first be rightly understood, and then grouped into genera. These ideas he carried into practice in his monograph of the water-beetles, but in his later works he did not adhere strictly to the system of naming there used. In the introduction to that monograph he also expressed some of his views on the origin of species, an example of his cautiousness with regard to accepted ideas. He also discussed the phylogeny of insects in the proceedings of the Congress of Zoology held at Cambridge in 1898; and the senses, especially the sight, of insects in his retiring presidential address to the Entomological Society (1888). To him are due the articles on "Termites" and "Insects" in the volumes of the "Encyclopædia Britannica" issued in 1902, as is also (in part) that on "Hexapoda" in the later edition (1910).

Perhaps Dr. Sharp's greatest service to zoology was in connexion with the "Zoological Record." Of this he became general editor in 1892, and he only laid the work down a few weeks before his death. Throughout this period he was also recorder of all the literature on insects. He improved the volumes immensely, and raised the classified subject-index to a wonderful degree of efficiency.

So far allusion has been made only to his writings, but he also excelled as a field-worker and collector. Ever laying great stress on the importance of the collection and permanent preservation of material, he published several articles on these points. His collection of British Coleoptera is as fine as any, and he also made a very large foreign beetle collection, the greater part of which, consisting of some 150,000 specimens, was acquired by the British Museum in 1905. During his time at Cambridge he amassed a large amount of material for that Museum. His fine library was recently purchased by the Cawthron Institute at Nelson, New Zealand.

Dr. Sharp was a wide reader, and though of rather slight bodily frame he had, even to an advanced age, great powers of endurance as a field-worker, and an almost unlimited capacity for mental work. No time was ever lost in picking up the threads of his work, so that even short intervals were used to the full. He was Hon. M.A. of Cambridge; elected F.R.S. in 1890; fellow, and former councillor of the Zoological Society. He joined the Entomological Society in 1862 and was president in 1887 and 1888, besides holding lesser offices on several occasions. He was also an honorary or corresponding member of the New Zealand Institute and of the principal entomological societies of the world.

H. S.

DR. WILLIAM KELLNER.

DR. WILLIAM KELLNER, who died at Charlton, on September 12, in his eighty-third year, was born at Frankfort in 1839, and received his scientific training under Prof. Wöhler at Göttingen, finally obtaining his Ph.D. degree in that university. He became a Fellow of the Institute of Chemistry in 1878 and served on the Council from 1895 to 1898. In 1862 he came to England as assistant to Sir Henry Roscoe, at Owens College, Manchester, whence, in 1864, he went to Woolwich and joined the staff of the War Department chemist (Sir Frederick Abel). In his early years at Woolwich Dr. Kellner was engaged in the varied general work of the chemical department. Later his main work became investigatory and experimental, both in connexion with explosives, as also to meet the requirements of the various Commissions and Committees on which the War Department chemist was a prominent member; of these the "Royal Commission on Accidents in Mines" and "The Explosives Committee" (appointed in 1889 to produce a smokeless powder for the Service) may be mentioned.

Dr. Kellner also devoted much work to the production of an apparatus for determination of the flashing point in oils, and was largely responsible for the Abel flash point apparatus, eventually perfected; in collaboration with Sir Boverton Redwood he carried out an exhaustive series of tests with this apparatus.

As a scientific worker Dr. Kellner was painstaking and methodical, displaying much skill in devising experiments to assist in elucidating the various problems confronting him in the course of his work. As regards practical results his most important work was in connexion with the evolution of cordite, much of the more difficult research and experimental work leading to the production of this explosive being carried out by him in the chemical department at Woolwich Arsenal; in spite of the numerous smokeless powders which have been brought into use since, the fact that, after a period of thirty years, cordite still remains the British Service propellant for army and navy use, is perhaps the best testimonial to the thoroughness of his work in this direction.

In 1892 Dr. Kellner succeeded Sir Frederick Abel as chemist to the War Department, and in addition to the duties of this office, served as an associate member of the Ordnance Board and as consulting chemist to the Royal Gunpowder Factory at Waltham Abbey; he retired from the service in 1904.

WE much regret to announce the death on October 2, at fifty-eight years of age, of Col. E. H. Grove-Hills, F.R.S., formerly head of the Topographical Department of the War Office and the author of a number of papers on astronomical subjects.

Current Topics and Events.

H.R.H. THE PRINCE OF WALES has graciously accepted an invitation to be present at a joint dinner of the Institution of Mining Engineers (representing coal-mining engineering) and the Institution of Mining and Metallurgy (representing the mining of minerals other than coal) to be held on Thursday, November 16. The dinner will be held at the Guildhall by permission of the Corporation of the City of London.

IN his presidential address to the British Association at Edinburgh last year, Sir Edward Thorpe referred to the difficulty which is encountered by many workers in science of being unable to obtain all the scientific books they require owing to lack of means. Sir Robert Hadfield has now generously offered to contribute a sum of 50*l.* per annum for three years, to be expended in supplies of books to those who are engaged in scientific pursuits and are unable to purchase for themselves. The council of the British Association has at present under consideration the best means of allocating this gift.

AMONG many important accessions of manuscripts to the Library of Congress (Washington) noted in the librarian's report for 1921, we observe the papers and correspondence of the late Major-General W. C. Gorgas, and the diaries and note-books of Jean Nicholas Nicollet, the explorer of the upper Mississippi, Missouri, Red, and Arkansas rivers in the first half of the nineteenth century. The division of maps has received many rarities. An increase of receipts from the Central Powers is noted. "A large number of these were theses of German universities and institutes of technology, which goes to show that the work of these institutions was carried on during the war without interruption."

ACCORDING to letters received by the last mail, the International Congress of Americanists at Rio de Janeiro has been a very great success. An enormous mass of papers was presented, all of which the Government proposes to print in full. At the close of the meeting the majority of the members took advantage of the delightful excursions which had been arranged for their benefit. After some discussion it was decided to hold the twenty-first session of the congress in 1924 in Holland by invitation of the Dutch Government, and in 1925 at Gothenburg, Sweden, by invitation of that town, where the museum is in charge of Mr. Erland Nordenskiöld, the well-known authority on South America. In 1926 the congress will meet in Philadelphia.

THERE are welcome indications that the work of investigating our national antiquities, interrupted by the outbreak of the war, is now being revived. The Congress of Archæological Societies, in union with the Society of Antiquaries, London, has just issued the first number, for 1921, of "The Year's Work in Archæology." This useful publication gives lists, arranged in the three kingdoms and their counties, of the progress of exploration. In a valuable supplement we have a list of the more important papers on the subject published by the local societies, and though a large number of these societies are affiliated to the Congress, there is still room for the association of local workers in this important enterprise. The Congress makes an appeal for contributions in order to effect the purchase of Cissbury Ring, near Worthing. As this pamphlet shows, there are still considerable vandalism and destruction of important monuments; the Congress protests specially against the destruction of a portion of the Middlesex Grim's Dyke at Pinner Green, and other examples are quoted in the Report. Much important work is being done in connexion with the Archæological Survey, and the president, Sir Hercules Read, remarks that there are many signs that we are at last becoming a civilised nation, as is shown by the Ancient Monuments Act and the appointment of the Congress Secretary, Mr. Crawford, to the newly created post of Archæology Officer at the Ordnance Survey.

THE *Toronto Star* of July 6 last has a note on a method of marking trails leading to springs of water which is practised by Indians of Western Texas. Two heaps of rock roughly heaped together, one about three feet high, the second a little lower, are placed beside the track, usually on an elevation commanding a view of the country for some five miles or more. A sight is taken from behind the larger heap, over the smaller, to some object on the horizon, such as a tree or clump of bushes. Near this object will be found a second pair of heaps of rock sighting on a second objective. This process is continued until the spring is reached. This primitive method of sighting a trail is of interest in connexion with the suggestions put forward by Mr. Alfred Watkins in his "Ancient British Trackways," recently noticed in these columns. He argued that many of the older roads in this country could be assigned to pre-Roman times on the evidence of what it was presumed were sighting marks, which must have been used in much the same way as the Indians are said to make use of these heaps of rocks. Mr. Watkin's theory, as was pointed out when it was under notice, undoubtedly holds good in many cases, especially in connexion with natural objects; in others, particularly in the case of mounds, moats, churches, etc., it appears more open to criticism.

THE Fifth Annual Report of the Imperial War Museum has recently been issued by H.M. Stationery Office, price 9*d.* (post free 10½*d.*). It is typewritten on 8 folio pages and reproduced by a multicopier. This at any rate shows a desire for economy, calculated to appease the public. The work of the museum during the year 1921–22 consisted in a complete survey of the whole collection, elimination of items of no technical value or historical interest, and the compression and concentration of the more valuable exhibits under definite headings and groupings. This was particularly the case with the Munitions and Air Force exhibits. Stress is laid in this report on the technical value of the collections and on the fact that many objects of our everyday life during the War have been preserved in this museum while they have disappeared elsewhere. Allusion is made to the proposal to utilise two galleries at present occupied by the Science Museum and certain galleries now occupied by the Imperial Institute. These proposals have, it will be remembered, evoked a great deal of opposition. The committee appointed to investigate on them has reported to the Cabinet, but no decision has yet been reached.

DR. DAVID STARR JORDAN proposes that the International Commission on Zoological Nomenclature should reject the following works from consideration under the Law of Priority:—Gronow, 1763, "Museum Ichthyologicum"; Commerson (as footnotes in Lacépède, "Hist. nat. des poissons," mostly 1803); "Gesellschaft Schauplatz," 1775–1781, an anonymous dictionary accepting the pre-Linnaean genera of Klein; Catesby, 1771, "Natural History of Carolina, Florida, and the Bahamas" (1731–1750), revised reprint by Edwards; Browne, 1789, revised reprint of "Civil and Natural History of Jamaica"; Valmont de Bomare, 1768–1775, "Dict. raisonnée universelle d'hist. nat." (several names accidentally binomial). By this all systematic names published as new in those works will be rejected as of the dates in question, but will remain available as of the dates when they were adopted by later authors of unquestioned status. It is hoped that the proposed action will extricate zoologists from an impasse into which they have been led by a divergence of views respecting the terms "binary" and "binomial." Zoologists who may have opinions on this proposal, which they desire to lay before the Commission, are invited to communicate them in writing to any member of it, so that they may reach the Secretary at Washington, D.C., U.S.A., before September 1, 1923. They would do well first to consult Opinions Nos. 13, 20, 21, 23, and 24 issued by the Commission.

THOSE who are familiar with the history of the elements will know, and those who are not familiar can easily inform themselves of the fact, that Lavoisier included among the elements both light and heat, which he classified along with oxygen, nitrogen, and hydrogen. A more detailed study of his "Traité élémentaire de chimie" will show that before discussing the compounds of oxygen, nitrogen, etc., with other elements, he devoted a brief chapter to observations on the compounds of light and heat with different substances. The rapid development of chemistry soon led to the abandonment of these imponderable elements, which came to be regarded as different manifestations of energy. It is, therefore, of interest to read in the *Pharmaceutical Journal* of August 12 a letter in which Mr. Carol A. Cofman Nicoresti, B. ès Sc. et Lettr., announces, as a final conclusion of his investigation of gaseous volume and pressure, "that heat and light are both material substances, that they enter into chemical combination with other elements, and that they are *thrown out* by *chemical reaction*." It is perhaps a compliment to Lavoisier that even his untenable hypotheses should thus undergo resurrection; but that they should be put forward as original can only be taken as a sign of imperfect chemical education. In one other respect Mr. Nicoresti's growth as a student of chemistry appears to have been arrested at a period more than a century earlier than Lavoisier, since he asserts that after careful consideration he is driven to the conclusion "that there are no such things as *gases*, but that there is only *one* gas in nature. That explains why the gaseous laws *are so uniform*." In this respect he apparently adopts the views of Boyle and Mayow, and his chemical education appears to have been carried forward but little further than the period of Agricola, who "hinted that the gases in mines were manifestations of malignant imps."

IN the will of Prince Albert of Monaco, who died on June 26 last, there are noteworthy gifts for scientific purposes. His farm at Sainte Suzanne is left to the French Academy of Agriculture, and the wish is expressed that the estate should remain a place for agricultural experiments, to demonstrate what science and determination can obtain from sterile lands. Dr. Jules Richard will receive 600,000 francs to enable him to complete literary and scientific works in progress, including the results of the oceanographic cruises and the preparation of the Bathymetric Chart of the Oceans. The proceeds of the sale of the yacht *Hirondelle*, all books and publications of a scientific nature, as well as certain personal effects, will go to the Oceanographic Institute at Paris and Monaco, while the Institute of Human Palæontology in Paris is to receive any personal effects relating to the work carried on there. The Paris Academy of Sciences will receive a million francs, the income of which is to provide a prize to be awarded every two years, the nature of the prize to be indicated by the Academy, according to the needs of the moment; a like sum is bequeathed to the Academy of Medicine for a similar prize.

WE learn from the *British Medical Journal* that the Carnegie Hero Fund trustees have awarded a medallion and an annuity of 130*l*. to Dr. John Spence of Edinburgh, in recognition of his valuable and heroic work in radiology. Dr. Spence was among the first in Scotland to take up research in X-rays and medical electricity, and as a result of radiological experiments he sustained serious damage to both hands, necessitating amputation of the right forearm. Dr. Spence is still carrying on his work as radiologist at Leith Hospital and Craigleith Hospital, Edinburgh.

H.R.H. THE DUKE OF CONNAUGHT has consented to unveil the roll of honour which has been erected at the Institution of Civil Engineers to the memory of its members and students who lost their lives in the war. The ceremony will take place at 4 P.M. on Friday, October 27.

AT the next ordinary scientific meeting of the Chemical Society on October 19, Prof. T. M. Lowry will read a paper entitled "The Polarity of Double Bonds. An Extension of the Theories of Lapworth and Robinson," and it is hoped that a general discussion will take place. On Thursday, October 26, at 8 P.M., a lecture entitled "The Significance of Crystal Structure" will be delivered by Sir William H. Bragg, in conjunction with Prof. W. L. Bragg. This meeting will be held in the lecture hall of the Institution of Mechanical Engineers, Storey's Gate, S.W.1.

WEATHER reports from Captain Amundsen's arctic expedition will be sent from the ship *Maud* and included in the collective message broadcasted by wireless from the Eiffel Tower daily at 11 h. 30 m. G.M.T. These observations, according to the *Meteorological Magazine*, will commence on October 15.

IT was announced at a meeting of the Chemical Society on October 5 that Prof. J. F. Thorpe had been nominated to fill, until the next Annual General Meeting, the office of treasurer, rendered vacant by the resignation of Dr. M. O. Forster, recently appointed Director of the Indian Institute of Science at Bangalore. Dr. J. T. Hewitt was nominated to fill the vacancy in the list of vice-presidents caused by Prof. Thorpe's appointment.

FROM the Report of the Castle Museum Committee to the Town Council of Norwich for 1921, just received, we learn that the Norwich Education Committee has appointed a special demonstrator to conduct round the museum organised parties of about 25 pupils accompanied by teachers. During the year 19,801 attendances were recorded, each class attending the complete series of demonstrations in sixteen weekly visits. The first lecture dealt with the purpose and methods of a museum, the next thirteen with various forms of animal life, the fifteenth with the early history of man, and the last with the story of the rocks and fossils. We understand that other Education Committees think of following this excellent example.

MR. H. E. STONE, of Sidcup, Kent, has forwarded to us a photograph of a specimen of *Datura Stramonium* which has attained a height of 28 inches with a foliage span of 58 × 24 inches, and bears 25 well-developed seed-pods. The plant is undoubtedly a fine specimen, although not unusually large. The largest plants are often found on rubbish-heaps made up of garden refuse, and also as weeds in cultivated ground. Such plants benefit by their isolation as much as by rich food material. Cultivated plants are often allowed to stand too close together to be able to develop to their full extent, while they usually lack the rich food material available in the case of isolated plants, and particularly those that have sprung up as weeds.

THE London agency of the Smithsonian Institution, Washington, which, since 1871, has been carried on by Messrs. William Wesley and Son, 28 Essex Street, Strand, London, has been removed to the premises of the new firm of Messrs. Wheldon and Wesley, Ltd. (incorporating William Wesley and Son), at 2, 3, and 4 Arthur Street, New Oxford Street, W.C.2. The large number of societies, museums, and institutions which forward their publications for transmission to their American correspondents through the International Exchange System of the Smithsonian Institution are requested to forward their consignments in the future to 2, 3, 4 Arthur Street, New Oxford Street, W.C.2.

Our Astronomical Column.

THE SUNSPOT PERIODICITY.—Many attempts have been made to correlate the 11 year period of spot variation with the 11·86 year period of Jupiter's revolution. The latter, as it stands, differs too widely, and it is necessary to combine it with some other period. Prof. T. J. J. See, in a special number of *Astr. Nachr.*, vol. 216, attempts to combine it with 9·93 years, which is the period in which Jupiter gains a semi-revolution upon Saturn. He weights these two periods in the ratio 1·828 to 1, this ratio being the square root of that of Jupiter's mass to Saturn's mass. The result is 11·18 years, which is close to the sunspot period. But it is to be noted that while the 11·86 year period depends wholly on Jupiter, that of 9·93 years depends on both planets, so that the appropriateness of the above ratio is far from clear; apart from this the resulting period of two wave motions does not depend on the ratio of their amplitudes, but on the time that one takes to gain a revolution on the other. For example, the period from spring tides to spring tides is a semi-lunation, and this would not be altered by an alteration in the relative heights of solar and lunar tides.

It will be remembered that Prof. E. W. Brown also endeavoured to get the sunspot period from Jupiter and Saturn, though in a different manner. He was successful in predicting that the 1907 maximum would be a late one. Mr. E. W. Maunder directed attention to the cyclical shift of the spots in solar latitude synchronously with the variation in activity, which seems to indicate an internal rather than an external origin.

FLAMSTEED'S LETTERS TO RICHARD TOWNELEY.—This very interesting packet of letters was recently found at the Royal Society. Dr. Dreyer contributes a long article to the *Observatory* for September describing their principal contents. A few points may be mentioned here. Flamsteed was prompt in accepting Roemer's explanation of the annual inequality of Jupiter's satellites, due to the finite velocity of light. He studied refraction at low altitudes by measuring the change in the apparent vertical diameter of the sun.

We find from his notes on the great comet of 1680 that he was at that time still a believer in the vortices of Descartes, though he makes a note on Newton's different opinion. By 1686 Flamsteed had apparently become convinced of the overthrow of the system of vortices; after alluding to the progress in the printing of the "Principia" he expresses his satisfaction in the immense gain that the new system will afford in the study of the planetary motions, "so that in the room of mourning I congratulate my own happiness."

It is rather melancholy to note how his opinion of Halley gradually changed from admiration to jealousy and suspicion. This seems to have been largely due to the association of Halley with Hooke, whom Flamsteed considered an enemy.

We share Dr. Dreyer's hope that the letters will be published in full.

PERTURBATIONS OF WOLF'S COMET.—Allusion was lately made in these notes to the work of M. Kamensky on this comet from its discovery in 1884 to the present time, and to the large changes in its orbit likely to arise from the very near approach to Jupiter this year. He has now calculated these changes, and gives the results in *Astr. Journ.* No. 807. The least distance occurred on September 26, when it was one-eighth of a unit, so that Jupiter's direct action was $1\frac{1}{2}$ times that of the sun, and the assumption of elliptical motion ceases to be the smallest approximation to the truth. On the other hand, a remarkable approximation may be obtained by assuming the motion to be in a hyperbola about Jupiter, which is equivalent to treating the action of the sun on the two bodies as identical during the time of near approach. Incidentally this gives an opportunity for using the equations for hyperbolic motion, which are given in the text-books but very seldom employed. The results obtained by this simple method are quite close to those of the more rigorous investigation. A curious point is that the present perturbations are about equal in size but opposite in direction to those at the approach of 1875, so that the comet now returns very nearly to its 1875 orbit. The period is increased from $6\frac{3}{4}$ to $8\frac{1}{4}$ years, and the perihelion distance from 1·53 to 2·40. It fortunately happens that at the next perihelion passage, 1925, Oct. 28.4, the comet will be almost in opposition, so that the distance from the earth will attain its minimum value, 1·40. Prof. Kamensky hopes that it may not be beyond visual or photographic reach with large instruments: if it should be found, most of the credit will belong to him; if not seen then it will almost certainly be permanently lost.

Research Items.

THE ROMAN BALANCE IN SOUTH AMERICA.—Mr. Erland Nordenskiöld has reprinted from the journal of the Société des Américanistes de Paris (N.S. vol. xiii., 1921) an article sub-entitled "Emploi de la balance romaine en Amérique du Sud avant la conquête." He produces evidence, with a full bibliography of authorities, to show that this invention was not confined to the Old World, but was found in the New World before the discovery of America.

ANTHROPOLOGY IN THE CHILTERN HILLS.—In the Journal of the Royal Anthropological Institute (vol. lii. Part 1), Mr. W. Bradbrooks and Prof. F. G. Parsons publish an elaborate memoir, with a long series of measurements of skull form, on the population of the Chiltern Hills, in which they arrive at the following conclusions: in this comparatively isolated area about half the working-class male people can trace their ancestry back to three generations in some part of the area; the hair colour is rather darker than Beddoe found in the Eastern and East Midland Counties, and the proportion is higher than in any other part of Great Britain, except the South-western Counties and Wales; the eye colour is identical with that of London and the East Midlands; the average cephalic index, 777, is practically that of the modern working man in London, and the average height, 5 ft. 7 in., is that of the black-haired individuals. Thus, the present-day inhabitants of the North Chiltern area, who are not recent immigrants, are distinctly darker haired than those surrounding them, and this darkness appears to be due to the survival of a great proportion of Neolithic or Mediterranean blood in the district.

DISTRIBUTION OF FUTURE WHITE SETTLEMENT.—The problem of the potentiality of the world for white settlement is attacked quantitatively by Dr. Griffith Taylor in the *Geographical Review* for July. The world is divided into economic regions which coincide in the main with Herbertson's natural regions. The areas of these regions are determined by planimeter measurements. The factors influencing human settlement are grouped under four headings which comprise the dominant controls—temperature, rainfall, location, and coal reserves. Fisheries have local rather than general importance and are ignored. From the values of each of these four controls a quadrilateral graph, the econograph, is constructed for each region, and the area of the graph is found to represent approximately the habitability of the region concerned. The econograph is a rectangular figure formed on four axes which represent, respectively, the average annual temperature, the average annual rainfall, the average elevation, and the estimated total coal reserve of the region. In what Dr. Taylor believes to be the ideal region these values would be 55° F., 50 in., sea-level, and 200×10^4 tons per square mile. The comparative value of these controls was apparently reached by assuming various values and testing them against the actual population map of Europe. By this means Dr. Taylor decided to give the temperature control double the weight of the rainfall and allow the coal factor, if large, to have equal weight with optimum temperature and rainfall combined. The ideal econograph represents 1000 units. All the seventy-four regions of the world have values below this ideal. The last step was to plot on a map of the world the numbers representing the areas and draw lines of habitability, called isoiketes. This map is of great interest as a partially successful attempt to forecast the future growth of white settlement.

MOSQUITO INVESTIGATIONS.—Since the statement was made by Messrs. Carter and Blacklock that *Anopheles plumbeus* is a potential carrier of malaria in this country, it having been experimentally infected by them, considerable interest has been taken in the habits and distribution of the species in Britain. Following studies made by these authors in the Liverpool district and in the Isle of Man, an inquiry was instituted by the mosquito investigation committee of the South-Eastern Union of Scientific Societies, acting on behalf of the Ministry of Health. The committee now announces that this special inquiry is concluded, and that *A. plumbeus* has been shown to be exclusively sylvan in habits, and to be widely distributed in England, occurring, when searched for, in almost any area in which are found beech, sycamore, chestnut, or other trees with water-containing rot-holes. The committee is now turning its attention to the mating and egg-laying habits of *A. plumbeus* and other species, which are still imperfectly known, and invites co-operation from observers in all parts of the country in elucidating these matters.

MUSCARINE.—In the Journal of the Chemical Society for September, Dr. Harold King, of the National Institute for Medical Research, records the isolation of muscarine, the highly potent and toxic principle of *Amanita muscaria*, the Fly Agaric, a common fungus of our birch woods. Muscarine has been the fertile subject of controversy among chemists and pharmacologists for more than fifty years, and it is now shown that the pure material differs essentially from the original claims as to its properties and constitution made by Harnack, upon whose work the whole of the subsequent edifice has been erected. There is no evidence that muscarine is related to choline or is a quaternary base. More than ordinary interest is attached to muscarine owing to its extreme specificity of localisation in the mammalian body and its complete antagonism by atropine.

A NEW SPECTRO-POLARIMETER.—Messrs. L. Bellingham and F. Stanley, Ltd., of 71 Hornsey Rise, have designed and provisionally protected a polarising prism which can be used either in the visible or ultra-violet region of the spectrum. The prism is constructed from one solid piece of Iceland spar cut in such a manner with respect to the crystallographic axis, and of such a length of side, that the extraordinary ray only is transmitted while the ordinary ray is absorbed at the sides. Two such prisms are placed side by side in a suitable mounting. Before being placed in contact the sides of each prism are ground away to give the required length of dividing line between the halves and also to produce the necessary half shadow angle. To provide a sharp face edge one of the prisms is allowed to project in front of the other, and the two are then bound together. It is claimed that such an arrangement is absolutely permanent and that the extinction is perfect. The entire absence of cement relieves the prism of all strain, and eliminates the possibility of light being diffused from particles in the cement or from scratches on the cemented surface. By employing such a polarising prism Messrs. Bellingham and Stanley have been able to construct a polarimeter which can be used either for visual observation, in conjunction with a mercury lamp, or for photographing the entire spectrum between wave-lengths 230 $\mu\mu$ and 800 $\mu\mu$ at one exposure.

The Fauna of the Sea-Bottom.[1]

By Dr. C. G. JOH. PETERSEN, Director of the Biological Station, Copenhagen.

STUDIES of the fauna of the sea-bottom are of essential zoological significance, and many scientific questions as well as important fishery interests depend upon them. The subject, however, is so extensive that I must confine myself mainly to the different methods adopted for the investigation of the fauna of the sea-bottom.

Since 1883 I have investigated Danish waters by means of the dredge; it was my task then to give on charts the distribution, especially in the Kattegat, of every single species of marine animal, to understand the laws ruling the distribution of the animals on the sea-bottom (the cruises of the gunboat *Hauch*). Different specialists had each a group of animals to work out, and a great number of charts were printed, but I did not feel quite content with my first publication, although something was cleared off by that method. The method was, and is still, the usual one for such investigations.

Many years later the question was put before me: Why does the plaice in the western Limfjord grow very slowly, but very quickly in the middle of the Limfjord? The answer required first of all a quantitative investigation of the amount of plaice-food in both places. A small bottom-sampler on a pole, long enough to reach the bottom in the shallow fjord was made in the 'nineties of last century and proved that much food was to be found in both places; the difference in growth-rate of the plaice was found later on to depend not only upon the amount of food on the bottom, but also upon the different number of plaice living there on each square mile. The idea of overcrowding for sea-fishes was introduced for the first time.

Many years later I constructed a new bottom-sampler fastened to a wire; this I have used everywhere in Scandinavian waters down to a depth of 300 fathoms. It was my idea at first to compare the amount of fish-food per sq. metre in the Limfjord with the amount of fish-food per sq. metre in our remaining waters by means of the bottom-sampler; but I soon found it difficult to compare the animals from one water with those of another; in some places the animals were small and of great value for fishes, in others the animals were bigger and built up of carbonate of lime (chalk) mainly, and with a great content of water; chalk and water being of course of little importance as food in the sea for other animals, I realised that I should compare, first of all, the amount of food in places with the same kind of animal population, and I had to map out these places.

The bottom-sampler taught me that we have about eight such different animal communities in Danish waters from 0 to 300 fathoms, characterised by numerous large and characteristic animals. They may be echinoderms, bivalves, crustacea, etc., but are all animals living mainly on detritus, not rapacious animals. These last named are necessarily always scarcer than the more peacefully living animals, as the grass-feeding animals on the dry land are more common than tigers and lions.

One thing puzzled me in the beginning very much; the bottom-sampler showed in many hauls the most uniform content in the sieves in the same animal community, then suddenly it came up filled with quite different animals, *Modiola modiolus*, Trophonia, *Ophiopholis aculeata*, etc., without any corresponding difference in the depth or in the nature of the bottom. How is this to be explained?

[1] Opening of a discussion held in Section D (Zoology) of the British Association at Hull on Sept. 7.

All these new organisms were animals living not in the bottom like ordinary animals, but above the bottom, originally fixed to a small stone or a shell, as on a heath we may find lichens on stones, not heather, or as in a beech-wood, on stones we find mosses, not flowers; strong currents may help to nourish such an *epi-fauna* with its often enormously rich animal life. Every object on the sea-bottom, a stone, a shell, a wreck, living plants, may give rise to such epi-faunas; within the same community on the level sea-bottom there is the same epi-fauna, but in different communities different epi-faunas may be found. The epi-fauna is, as a rule, scattered over the bottom in spots, and it is not always easy, in single cases, to say what is the reason for its existence; it is therefore not possible to give its distribution on a chart; you may give it on the spots where you have found it, but you never will be able to give all the spots existing on the bottom. On rocky coasts the epi-faunas are dominating; the coral reefs are a kind of epi-fauna, built up mainly of chalk and water; they are of very little importance as fish-food.

In contradistinction to the distribution of the epi-faunas the communities of the level sea-bottom are of a very uniform distribution, in such localities as in Danish waters and in the North Sea. Their distribution may be easily mapped out, and their content of fish-food and other animals quantitatively determined. We have taken thousands of samples, each of $\frac{1}{10}$ sq. metre, with the bottom-sampler in Denmark, and they have nearly always shown several animals, worms, bivalves, Ophiuridæ, etc., in each; only one or two samples of them have shown no animal content.

By means of the bottom-sampler we may, therefore, using the most frequently occurring organisms, easily map out the communities of the level sea-bottom, and determine its content of fish-food.

The theory of probability will indicate the degree of accuracy; many samples will give, as a rule, more and more exactitude. We may determine how the number of organisms varies at different seasons and in different years. If we examine what the fishes eat of these organisms we may determine whether they are good or bad areas for this or that species of fish, and may get a fair idea of the productivity of the sea-bottom as a whole, not forgetting that all the small, fast-growing, short-living animals are often to be reckoned as yearly production, whereas the bigger, longer living animals must be reckoned by means of another method. We may get an idea of the whole metabolism of the sea—but I must not go too far in mentioning these problems.

With a good steamer I could in one month map out the whole of the North Sea as to its animal communities. I would take between 500 and 1000 samples spread over the whole of the North Sea, out to the 100-fathom line, about one or two per hour. Using a bottom-sampler of 0·2 sq. m. I should then have taken up only the animals of an area at 100-200 sq. m., but I am sure that I should get all the species of the common uniformly-distributed animals of the whole area, and I should be able to give a rough-sketched map of the animal communities. If we used a bottom-sampler on a heath only once, we should catch heather, and so in the sea, I should not catch many rare animals, but I do not care for rare animals; the main thing is to know the animals that make up the great bulk of the bottom population, to know their distribution and their weight per square mile. If you wish for greater exactitude than this first trip could give, you may take more stations and investigate smaller areas more carefully.

I am glad to be able to say that in 1921 Dr. Russell, on the English steamer *John Bligh*, made the first trip across the North Sea with my bottom-sampler, guided by my assistant, Dr. H. Blegvad; they found some of the same communities between Lowestoft and Esbjerg as we know from the Kattegat.

Thanks to the bottom-sampler we can now speak about areas with a Venus mussel community, an *Amphiura filiformis* community, a *Brissopsis Amphiura chiajei* community, and so on, as we on land speak about a heath, a beech-wood, a meadow, etc.; we are also able to get a quantitative idea of the amount of animals on the sea-bottom, and are able to follow seasonal or other variations therein.

A dredge will sometimes give us, when well used, a bagful of animals, belonging to the epi-fauna as well as to the ordinary communities, and taken up from all the communities it has been towed over. The dredge is inclined, moreover, to take all animals *on*, not *in*, the bottom, and its content is therefore not a true illustration of what is living *in* or *on* the bottom, but a mixture mostly of epi-fauna from different communities, without giving the slightest idea of quantity per square metre. The content of a dredge and a bottom-sampler used on the same station will very often give quite different collections of animals.

The dredge has given excellent information to zoologists wishing to collect rare animals for preservation in alcohol, and for dredging oysters, and so on, but a true illustration of the fauna on the sea bottom it never has given and never will give.

I admit one thing: it is easy for me to speak and write about the bottom-sampler work, but it never will be well understood without seeing the work going on on board ship; many men of science from Europe have seen how quickly the sampler may be used, like an ordinary sounding machine, and how well it works. I should be glad to welcome many more visitors at the Danish Biological Station, not only to see the bottom-sampler working, but also to be able to discuss with them the problems which have arisen in my mind while using this method during the last 10 to 12 years.

It was a Dane, O. Fr. Müller, who first introduced the dredge in northern Europe for scientific use, and it will always be used by zoologists and for special purposes, but only the bottom-sampler is able to give a true and quantitative representative illustration of the bottom fauna.

Finally, I wish to say that to have a bottom-sampler and to use it is not enough to become a great marine biologist; it depends much upon the possession of working ideas. The bottom-sampler is not able to solve every question; it cannot, *e.g.*, take animals living very deep in a hard bottom, and the apparatus must be modified for special work, according to the size of the ship used, the depth at which you are working, etc., and it is necessary to supplement the investigation by means of other apparatus, fishing-gear, dredges, etc. But without quantitative work it is not possible to understand the principal features of the fauna of the sea-bottom.

It would be a matter of great scientific interest to have a bottom-sampler used down the slope of the continent at all depths, out on the very ocean floor, to determine all the communities living here, and to prove how barren the ocean floor really is. It would also be of great interest to follow our European communities from the North Pole down to Cape Town, to study their geographical distribution, to determine the perfectly unknown Arctic communities, and the unknown tropical communities. I have given a hypothetical chart in my Report No. 22, but it has to be verified. I am too old to do that, and my steamer too small. I hope other men will do it. I am sure the geologists would be glad to know something about these communities, based upon the common animals. I am certain that, like me, they care much more for common characteristic species and their distribution than for "rare" animals.

The productivity of the bottom fauna in European waters is by no means unlimited; it is, therefore, a matter of the greatest importance for some of the greatest fishery questions to know as much as possible about this productivity. The English fishermen are, as I often have heard, the backbone of the English navy; they depend upon the fishes, and these in turn depend upon the fish-food. Careful investigation of the latter is, therefore, a matter of great importance—particularly for Great Britain.

Adhesives.

By EMIL HATSCHEK.

THE treatise of Theophilus Presbyter, entitled "Diversarum Artium Schedula," and well known to all students of the history of painting, gives directions for the preparation and use of glues from leather and deers' antlers, of plum- and cherry-gums, and of mixtures of cheese and lime described as "cheese glues." This list of adhesives familiar to craftsmen at the end of the eleventh century covers practically all the types in use at the beginning of the twentieth century. A similar degree of old empirical perfection is shown by many arts employing colloidal material, and the student of colloid chemistry anxious to magnify his office is perpetually confronted with the task of explaining the *rationale* of traditional procedure and of suggesting improvements based on theoretical grounds.

The difficulties of this task are well illustrated by the first report of the Adhesives Research Committee.[1] Towards the end of the war a shortage of glue and of the chief substitute, casein, threatened to limit the output of aircraft, and the labours of the committee were accordingly directed, on one hand, to a close study of glue, and, on the other, to the discovery of possible substitutes other than casein. The report contains much interesting and novel matter under both heads.

The difficulties in the way of a rational study of glue seem to be twofold. The first is that the only criterion of its value as adhesive is a mechanical test of a glued joint between wooden test pieces of specified nature and size. The report describes the conditions of such a test, as finally adopted, and sets forth the possible sources of error. Both on theoretical and on practical grounds (about five days have to elapse from the soaking of the glue to the actual breaking test), it is desirable to find some easily measured constant which shows a simple quantitative relation with the breaking strength. No such constant is yet known, although empirically the setting time of the glue sol, the melting point of the gel and its "strength," *i.e.* roughly speaking, its modulus of elasticity, furnish some indication of its quality.

The second difficulty is of a more fundamental nature. It is known that pure gelatin is not a good

[1] Department of Scientific and Industrial Research. "First Report of the Adhesives Research Committee," pp. iv+129. Price 4s.

adhesive, so that the superiority of glue must be due, directly or indirectly, to the presence of other substances of which, so far, little is known. Investigations on this point are proceeding; in the meantime the committee have evolved a novel and highly promising test, that for "diffusible nitrogen." A gel of standard composition is immersed in a known volume of water, and after a fixed time the nitrogen content of the latter is determined by Kjeldahl's method. This is, of course, due to compounds of much lower molecular weight or aggregation than gelatin, and—apart from some exceptions—the amount of diffusible nitrogen is roughly inversely proportional to the tensile strength. While this result is of great interest, it can scarcely be said to simplify the problem stated above, namely, what factors cause the difference between pure gelatin and glue. Speaking, however, quite generally, we know of no connexion between constitution and adhesive properties; the striking fact is how sparingly the latter are distributed between a very few materials even among highly hydrated colloids.

Lack of space forbids detailed reference to the very interesting investigations on the extraction of gelatin from various raw materials, but the committee's successful attempt to find a strong vegetable adhesive must be mentioned. A protein was prepared from castor bean residues—which are poisonous and therefore useless as cattle food—and this protein forms a strong adhesive with calcium hydroxide and alkaline salts in various proportions. From the data given regarding the solubility of this protein, it appears to be related to casein, and the mechanical properties of the adhesive prepared from it are not much inferior to those of casein glues.

The report is supplemented by an appendix—which greatly exceeds in length the report itself—giving a "Descriptive Bibliography of Gelatin." This is a very complete, lucid, and impartial summary of the vast literature, in which no paper of any interest seems to have been overlooked. Those from English sources—though important—are remarkably few in number, and this state of things suggests questions which are none the less curious for being familiar. One is whether the development of a very promising discipline is going to be left to workers of other nations as completely as was (to take an unhackneyed instance) that of the theory of functions; the other, whether such cases of neglect arise from deep-seated national tastes or idiosyncrasies in research, or merely from inadequate opportunities for tuition and experimental work.

The Decomposition of Tungsten.

THE September issue of the Journal of the American Chemical Society contains an account of the preliminary experiments made by Drs. Wendt and Irion on the decomposition of tungsten at extreme temperatures, with the production of helium, a report of which appeared in the daily press, to which reference has already been made in NATURE (April 1, 1922, vol. 109, p. 418). The authors regret the exaggerated early report, given wide publicity by the press after its oral presentation, and emphasise the preliminary character of the work. They describe fully the apparatus used for attaining temperatures above 20,000° by passing heavy currents through metal wires, and state that when tungsten wires are exploded in a vacuum at such temperatures the spectrum of helium appears in the gases produced. When the explosion is conducted in carbon dioxide, 0·713 milligram of tungsten gave rise to 1·01 c.c. of gas not absorbed by potash solution. The authors remark that their method "includes factors, both of cause and of error, analogous to those operative in the voluminous and inconclusive controversy on the evolution of helium in various types of low pressure electrical discharge tubes, extending from 1905 to 1915."

The electrical apparatus provided for currents of 40 amperes at 100,000 volts during the brief period necessary to charge the condenser, which was then discharged through a tungsten wire 0·036 mm. diameter and 4 cm. long. The wires were stretched between heavy copper terminals in a special spherical glass bulb of 300 c.c. capacity, which was capable of withstanding momentarily an enormous outward pressure, and had a small discharge tube sealed on for examination of the spectrum of any gas produced. The wire was heated to well above 2000° for 15 hours in a high vacuum before the explosion was made, and the tube before explosion showed no spectrum or fluorescence when connected with a 50,000-volt coil. No dust, smoke, or solid residue was left after the explosion. Gas was present, which showed the faint presence of the strongest green line of mercury, probably from back diffusion of the pumps, and the only other line uniformly present and positively identified was the strong yellow line of helium. It would seem that both hydrogen and neon were absent. The absence of hydrogen is of interest, since the atomic weight of tungsten is exactly 46 times that of helium, and this element would therefore not be expected to give hydrogen on disruption of its atom.

The explosion in carbon dioxide seems to have been less conclusive, as the authors do not seem to have been quite sure of the absence of unabsorbable impurities. They point out that if the entire weight of 0·713 milligram of tungsten had been converted into helium, 4 c.c. of this gas should have been obtained. The much smaller volume found would point to the production of heavier gases. Altogether the work is of very great interest, although the authors emphasise the necessity of complete analysis of the gas obtained before anything conclusive can be stated. This chemical test is to be made in the continuation of the work.

The Belt of Political Change in Europe.

IN a paper contributed to Section E (Geography) of the British Association at Hull, Prof. J. F. Unstead commented on the striking fact that the new states of Europe, or those which have gained or regained independent existence during recent years, lie in a relatively narrow belt of country extending across the whole of Europe from the Arctic Sea in the north to the Mediterranean in the south. West of this belt changes have been slight, while east of it a final settlement has not been reached. Of this belt no part has been exempt from change. It contains about 100 millions of people or about one-fifth of the inhabitants of Europe, and covers about one-fifth of the total area of the continent. The new states have been formed mainly by the break-up of three great empires, the disintegration of which was one of the results of the world war.

Prof. Unstead pointed out that the belt of change is a region caught between east and west, marginal to each and influenced by each, and he showed how this idea applies both to physical and human conditions. Western Europe, with inland seas and intricate structure and relief, provides varied resources, maritime, agricultural, and mineral. Into this region spread the civilisation of the Mediterranean region, and here communities found the physical conditions which enabled them to develop. Physical barriers and relatively small productive areas gave distinctiveness and led eventually to the growth of separate nationalities. These nations became self-governing and, broadly speaking, democratic.

Eastern Europe, on the other hand, is characterised by uniformity of structure and relief, with great belts of similar climatic conditions and natural vegetation extending through it into Asia and so facilitating human migrations and military movements, mainly east and west. From the human as well as the physical point of view this region was for many centuries an extension of Asia and had but a scanty population. The Slav languages became characteristic and the authority of the Czar dominated the greater part of the region. The Asiatic incursions which in earlier centuries swept across the eastern plains were as a rule checked when they reached the belt of change. Here they found varied conditions of life, but different from those to which they had been accustomed. Traditions and names of invading tribes have been preserved, differences of language remain, and not infrequently feelings of hostility and memories of conquest are rife. Sufficient time has not yet elapsed for a complete fusion of races in the several regions of the belt. The Asiatic elements still assert themselves: Finns, Ests, Magyars, Bulgars, and Turks stand out, contrasted in one way or another with Swedes, Germans, Slavs, Albanians, and Greeks of European descent. Moreover, two small Nordic groups, Letts and Lithuanians, have preserved their identity from early times and remain distinct from other Nordic people in language and nationality. On the other hand, the occurrence of minerals has led to the partial penetration of Western influences.

Prof. Unstead went on to show the diversity of religion and political conditions in this belt of change. The problem of minorities exists in one form or another throughout the belt, and is perhaps the greatest menace to future peace. The present political units are by no means self-sufficing, and their frontiers are frequently barriers to trade and hindrances to production. Furthermore, the attainment of political freedom has often been accompanied by a check to production, commerce, and prosperity.

University and Educational Intelligence.

ABERDEEN.—Applications are invited for the Blackwell Prize, value 30 guineas, for an essay on "The Sculptured and Inscribed Stones of the North-East and North of Scotland." The essays, bearing a motto and accompanied by a sealed envelope bearing the same motto and giving the name and address of the writer, must reach the secretary of the university on or before January 1 next.

CAMBRIDGE.—Mr. J. Walton, St. John's College, has been appointed junior demonstrator of botany. Mr. F. A. Potts, Trinity Hall, has been reappointed demonstrator of comparative anatomy. Dr. A. B. Appleton, Downing College, Mr. D. G. Reid, Trinity College, Mr. A. Hopkinson, Emmanuel College, and Mr. V. C. Pennell, Pembroke College, have been reappointed demonstrators in anatomy. Dr. Ff. Roberts, Clare College, Mr. T. R. Parsons, Sidney Sussex College, have been reappointed demonstrators in physiology. Mr. G. V. Carey, Clare College, has been appointed educational secretary to the Cambridge University Press.

A. J. Smith, Downing College, has been appointed University Frank Smart Student in Botany. The John Winbolt prize has been awarded to F. E. Smith, Sidney Sussex College.

LEEDS.—Mr. Lascelles Abercrombie, lecturer in poetry at Liverpool University, has been elected by the council of the University professor of English language and literature, in succession to Prof. Gordon, who was recently appointed to the Merton professorship of English literature at Oxford.

LONDON.—It was announced in NATURE of July 29, p. 166, that Mr. H. G. Wells had consented to offer himself as Parliamentary candidate for the University, at the invitation of the executive of the University Labour Party, upon the retirement of Sir Philip Magnus at the end of the present session of Parliament. At a general meeting of the party held on Friday, October 6, Mr. Wells was adopted as Parliamentary candidate as recommended by the executive.

IT is announced that Mr. H. M. McCreath, head of the Agricultural Department, Seale-Hayne College, Devon, has been elected principal of the East Anglian Institute of Agriculture, Chelmsford.

A SITE consisting of nearly 20 acres has been presented by Mr. T. R. Ferens at a cost of about 10,000*l.* to the education authorities of Hull for the immediate purpose of providing accommodation for advanced technical departments. It is anticipated that a university college will be developed later on the site.

THE distribution of geographical teaching in the universities of Europe is illustrated in a map which accompanies a paper by Mr. W. L. G. Joerg, in the *Geographical Review* for July, on "Recent Geographical Work in Europe." From this map it appears that more than 120 universities in Europe (excluding Russia and allied Soviet states) have provision for geography. Germany, Switzerland, and France are perhaps the best provided, but Great Britain does not fall far behind. In Balkan lands, geography is fairly well represented in Bulgaria and Yugo Slavia; Rumania has four universities offering geography, while Hungary and Czecho-Slovakia also have centres of instruction. On the whole, the new or reconstructed states of Europe show every indication of realising the importance of the subject. The only states in Europe which would appear to offer no university geography are Latvia, Lithuania, Albania, Greece, and Ireland.

DURHAM University has recently published a calendar for the year 1922–23 (price 3*s.* 6*d.* net), a useful compilation which serves as a guide to affairs in the University. The first half of the volume deals with the University as a whole; its officers, the regulations affecting conduct and degrees, as well as the subjects required for the latter and for various diplomas are given. A special section is devoted to the fellowships, scholarships, and prizes which are awarded by the University. The remainder of the calendar is divided into three sections referring to the Durham colleges, the College of Medicine, Newcastle-upon-Tyne, and Armstrong College, respectively. It should be noted that up to and including September 1923 the matriculation examination will continue to be held in Durham and Newcastle; after October 1923 the matriculation examination (Newcastle Division) will cease to be held. The new regulations for matriculation in the Newcastle colleges, which will then come into force, are given in detail. In a concluding section of the volume there is an alphabetical list of members of Durham University.

Calendar of Industrial Pioneers.

October 15, 1889. Sir Daniel Gooch died.—An eminent locomotive engineer and industrial administrator, Gooch served an apprenticeship in Stephenson's works at Newcastle, and at the age of twenty-one became locomotive superintendent to the Great Western Railway. He invented the Gooch link gear, experimented on the resistance of the atmosphere to trains in motion, designed a self-registering dynamometer, and built many fine broad-gauge engines. After resigning his position, he played an important part in the establishment of telegraphic communication between England and America, and from 1865 to 1887 was chairman of the Great Western Railway.

October 17, 1907. Gustav Adolf Zeuner died.—Born in Chemnitz, November 30, 1828, and educated at the Mining Academy at Freiberg, Zeuner as a professor of engineering did important work at Zurich, Freiburg, and Dresden, while his writings were highly valued by engineers. He founded the German journal *Zivilingenieur*, and he was widely known for his works on value gear and on technical thermodynamics.

October 18, 1903. Gordon McKay died.—The most successful inventor of boot-sewing machinery, McKay, who was born in Massachusetts in 1818, made an immense fortune which he bequeathed to Harvard University for science professorships and laboratories.

October 18, 1918. Marcel Deprez died.—For nearly forty years Deprez devoted himself to the application of electricity to industrial purposes. He solved many of the problems connected with the transmission of high-tension electricity, invented the compound winding for dynamos and devised measuring instruments. From 1890 he was professor of industrial electricity at the Conservatoire des Arts et Métiers.

October 19, 1749. William Ged died.—The inventor of stereotyping, Ged was born in 1690 and became a goldsmith in Edinburgh. In 1725 he took out a patent for developing Van de Mey's idea of substituting for movable type solid plates cast from type, and four years later he endeavoured without success to introduce his methods in London. His subsequent career was one of disappointment, and he died in poverty.

October 19, 1897. George Pullman died.—Pullman, to whom the world owes the modern railway carriage, was born in 1831 in New York State, and in 1859 settled at Chicago, where he began experimenting on the construction of sleeping-cars, his first successful car, the "Pioneer," being built in 1863 at a cost of 3000*l*.-4000*l*. The Pullman Palace Car Company was founded in 1867; extensive works were laid out in 1879, and at the time of Pullman's death more than 15,000 men were employed in them. The sleeping-car was introduced into England in 1875.

October 21, 1896. James Henry Greathead died.—Trained as a civil engineer under Barlow, Greathead devised the "Greathead" shield, which has since been extensively used for driving tunnels.

October 21, 1902. Sidney Howe Short died.—Regarded as one of the most brilliant electrical engineers of his day, Short was a native of Columbus, Ohio, where he was born, October 8, 1858. Educated at the Ohio State University, at the age of twenty he succeeded Mendenhall as professor of physics there, and two years afterwards removed to Denver, Colorado. Resigning his chair in 1885, he took up practical work and did pioneer work in connexion with electric railways. E. C. S.

Societies and Academies.

SWANSEA.

Institute of Metals, September 22.—F. L. **Brady**: The structure of eutectics. An attempt has been made to correlate the micro-structure of solidified eutectics, mainly those between metals and metallic compounds, with the physical properties of the component metals. The surface tension of the molten metal and the cohesive force acting during crystallisation seem to be the main forces influencing the final structure. The eutectics examined fall into three classes: "globular," "lamellar," and "angular." The structures agree with what would be expected from theoretical considerations of the effects of surface tension and cohesion.—M. **Cook**: The antimony-bismuth system. The two metals form an isomorphous series of alloys. The liquidus curve is perfectly smooth and the solidus is horizontal at 270° C. up to 60 per cent. of antimony, after which it rises steeply to the freezing-point of antimony. Chill-cast and slowly cooled specimens reveal duplex structures, but with prolonged annealing—550 hours at 275° C.—the alloys become homogeneous. Twin crystals and peculiar banded effects were observed in some of the annealed specimens. Possibly the twin crystals are formed during solidification of the alloy by stresses due to expansion, and grew on annealing. The nature of the "bands" has not been definitely ascertained, though they are not considered to be slipbands.—A. **Jefferson**: The cause of red stains on silver-plated work. The Sheffield Silver Trade Technical Society appointed a committee to examine this subject. It was established experimentally that the red stain is caused by the indiscriminate use of rouge in the finishing and polishing processes, through the absorption of the rouge into the open pores of the heated surface, the heat being evolved by the friction of the hand or finishing "dolly."—Q. A. **Mansuri**: Intermetallic actions. The system thallium-arsenic. By thermal and microscopic analysis it was shown that thallium and arsenic do not act chemically with each other nor do they form solid solutions; they alloy in all proportions. Arsenic dissolves in molten thallium and lowers its freezing-point until a solution of 8·01 per cent. arsenic freezes at the eutectic temperature of 215° C. Then the freezing-points of the alloys rise gradually to 240° C. All alloys containing from 13 to about 40 per cent. arsenic begin to freeze at 240° C. and are made up of two layers—the upper layer rich in arsenic while the lower rich in thallium. Beyond 40 per cent. arsenic, to nearly pure arsenic, the solution is uniform and the two layers disappear. By heating such substances in evacuated, sealed glass tubes and applying the hot junction of the couple in close contact with the outside of the glass tube, the couple is almost as sensitive as when dipped in the molten substance.—F. **Johnson** and W. **Grantley Jones**: New forms of apparatus for determining the linear shrinkage and for bottom-pouring of cast metals and alloys, accompanied by data on the shrinkage and hardness of cast copper-zinc alloys. The shrinkage values of chill-cast copper-zinc alloys were higher in general than those obtained for sand-cast bars by previous investigators. Pure electrolytic metals were used, and most of the alloys were poured at a temperature interval of approximately 115° C. above their liquidi, the mould being kept at a constant temperature by a jacket of water maintained at the boiling-point. The bottom-pouring apparatus has the advantage of (*a*) control of pouring temperature; (*b*) facility for registering temperature of metal; (*c*) absence of delay between attainment of required pouring-temperature and release of metal into the mould; (*d*) control of rate of pouring; (*e*) exclusion of dross from stream of metal; and (*f*) mitigation of "zinc-fume." Uniformity of hardness was secured by annealing. For the annealed bars the Brinell curve showed an increase of hardness over the range 100 to 88 per cent. copper. From 88 to 72 per cent. copper hardness was constant, a slight fall setting in at about 72 per cent. copper and persisting to 63 per cent., at which point a rapid increase set in with the appearance of the β-constituent. With the exception of a small dip in the curve, between 53 and 50 per cent. copper, the increase is maintained to 45 per cent. copper. The changes of scleroscopic hardness with composition are similar but less pronounced. The hardening capacity of the α-brasses under cold-work increases rapidly with increase of zinc up to a maximum near 75 per cent. copper. The rolled strips, after close annealing, were re-tested for hardness; the range of uniform hardness is slightly restricted and the succeeding fall (between 70 and 63 per cent. copper) is more pronounced.—F. W. **Harris**: The hardness of the brasses, and some experiments on its measurement by means of a strainless indentation. The theories generally advanced with regard to the connexion between hardness and internal constitution have been, in the main, substantiated. A slight maximum occurs in the middle of the α-phase and a small depression in the β-phase. The "absolute" hardness for the series was compared with the Brinell hardness by means of curves.

PARIS.

Academy of Sciences, September 11.—M. L. Maquenne in the chair.—L. **Cuénot** and L. **Mercier**: The loss of the faculty of flight in parasitic Diptera. The hypothesis generally admitted is that the atrophy of the wings is the result of non-usage connected with the parasitic mode of life. The authors give the results of a series of observations directly opposed to this view.—E. **Merlin**: A mobile space attached to a network.—P. **Urysohn**: Cantorian multiplicities. D. **Riabouchinski**: The equations of motion in two dimensions, of solids in a liquid with vortices.—Henri **Villat**: Plane vortex movements in a fluid containing solid walls.—M. **Thiébaut**: The composition of the iridescent marls. These marls contain three main constituents: carbonates (dolomite and calcite), a silicate which is not a clay, approaching celadonite and bravaisite in composition, and detritic elements with abundance of white mica and quartz.—W. J. **Vernadsky**: The problem of the decomposition of kaolin by organisms. In admixture with bacteria, diatoms developed well on a nutritive medium, containing no silica except combined silica in a colloidal clay. From these results it would appear that diatoms, either alone or in association with bacteria, can decompose the kaolin structure and set free alumina.—Cam. **de Bruyne**: Idioblasts and diaphragms in the Nymphaceæ.—Marc **Romieu**: A method of selective coloration of the nervous system in some invertebrates. Details of the application of the benzidine-hydrogen peroxide reagent to the study of the nervous system of some invertebrates. The nerves are coloured blue; and the nervous system as a whole can be seen down to the smallest details.—Gabriel **Bertrand** and M. **Mokragnatz**: The presence of cobalt and nickel in plants. The ashes from twenty species of plants have been analysed, the parts utilised as food being chosen for examination. Nickel has been found in all the plants examined in quantities between 0·01 milligram and 0·2 milligram per kilogram of fresh material: cobalt (0·005 to 0·3 milligram per kilogram) was found in all cases except oats and carrot.

Diary of Societies.

MONDAY, OCTOBER 16.

FARADAY SOCIETY AND THE BRITISH COLD STORAGE AND ICE ASSOCIATION (at Institution of Civil Engineers), at 2.30, 4.45, and 7.45.—Discussion on the Present Position of the Generation and Utilisation of Cold.—Prof. H. Kamerlingh Onnes and others: Laboratory Methods of Liquefaction, and Methods of Measuring Low Temperatures.—Dr. Crommelin: Description of the Equipment of the Cryogenic Laboratory at Leyden.—M. Claude: The Industrial Manufacture of Hydrogen by the Partial Liquefaction of Water Gas.—E. A. Griffiths and others.

CHEMICAL INDUSTRY CLUB (at 2 Whitehall Court), at 8.—Annual General Meeting.

ROYAL GEOGRAPHICAL SOCIETY AND THE ALPINE CLUB (at Central Hall, Westminster), at 8.30.—Gen. Bruce, Col. Strutt, Mr. Mallory, Capt. Finch, and Major Norton: The Mount Everest Expedition, 1922.

TUESDAY, OCTOBER 17.

ROYAL HORTICULTURAL SOCIETY, at 3.—R. G. Hutton: The Control of the Fruit Tree by its Roots.

ROYAL SOCIETY OF MEDICINE, at 5.—General Meeting of Fellows.

INSTITUTE OF TRANSPORT (at Institution of Electrical Engineers), at 5.30.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 8.—Major F. C. V. Laws: The Progress of Aerial Photography.

WEDNESDAY, OCTOBER 18.

ROYAL COLLEGE OF PHYSICIANS, at 4.—Dr. A. Chaplin: Harveian Oration.

INSTITUTE OF PHYSICS (at Institution of Electrical Engineers), at 6.—C. C. Paterson: The Physicist in Electrical Engineering (Lectures on "Physics in Industry," No. 3).

ROYAL MICROSCOPICAL SOCIETY, at 8.—Prof. R. Chambers: New Apparatus and Methods for the Dissection and Injection of Living Cells.—T. F. Connolly: The Specification of a Medical Microscope.—H. J. Denham: A Micrometric Slide Rule.

THURSDAY, OCTOBER 19.

ROYAL SOCIETY OF MEDICINE (Dermatology Section), at 4.30; at 8.30.—Dr. Savatard: Epithelioma of the Skin.

ROYAL AERONAUTICAL SOCIETY (at Royal United Service Institution), at 5.30.—J. D. North: The Metal Construction of Aeroplanes.

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Dr. F. H. Hayward: Something Wrong with Intelligence Tests.

CHEMICAL SOCIETY, at 8.—Prof. T. M. Lowry: The Polarity of Double Bonds. An Extension of the Theories of Lapworth and Robinson.

SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (at Essex Hall), at 8.—Dr. Marie Stopes: The Ideals and Present Position of Constructive Birth Control (Presidential Address).

FRIDAY, OCTOBER 20.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Dr. H. S. Hele-Shaw: Presidential Address.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—G. H. Ayres: Profits from Waste Products.

INSTITUTION OF PRODUCTION ENGINEERS (at Royal Automobile Club), at 7.30.—M. R. Lawrence: Presidential Address.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 8.—G. A. Clarke: Record Work in Cloud Photography.

PUBLIC LECTURES.

SATURDAY, OCTOBER 14.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. Shaw: Flight in all Ages.

MONDAY, October 16.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. Shattock: The Anatomical Results of Inflammation.

CITY OF LONDON Y.M.C.A. (186 Aldersgate Street), at 6.—Dr. E. L. Ash: Mind and Health.

TUESDAY, OCTOBER 17.

GRESHAM COLLEGE (Basinghall Street), at 6.—A. R. Hinks: Astronomy. Succeeding Lectures on October 18, 19, 20.

WEDNESDAY, OCTOBER 18.

SCHOOL OF ORIENTAL STUDIES, at 5.—J. W. Robertson Scott: Impressions of the Japanese.

UNIVERSITY COLLEGE, at 5.30.—Sir Richard Paget, Bart.: The Nature and Reproduction of Speech Sounds.

THURSDAY, OCTOBER 19.

UNIVERSITY COLLEGE, at 4.—Dr. T. G. Pinches: Babel and its Gods.

CITY OF LONDON Y.M.C.A. (186 Aldersgate Street), at 6.—Sir D'Arcy Power: Surgery in the City of London.

FRIDAY, OCTOBER 20.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Hydrocephaly.

BEDFORD COLLEGE FOR WOMEN, at 5.30.—F. H. Marshall: The Early Civilisation of Ionia.

SATURDAY, OCTOBER 21.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: The Nile in the Life and Religion of the Ancient Egyptians.