THURSDAY, JULY 12, 1906.

PHYSICAL CHEMISTRY APPLIED TO CHEMISTRY AND BIOLOGY.

Cours de Chimie physique suivi d'Applications à la Chimie et à la Biologie. By Victor Henri. Cours libre professé à la Faculté des Sciences de Paris. Premier Fascicule. Pp. xii+336 et seq. (Paris: A. Hermann, 1906.) Price 15 francs.

THIS volume forms a portion of the first part of a treatise on physical chemistry and its applications to chemistry and biology, evidently intended for readers commencing the specialised study of physical chemistry, but possessing some considerable knowledge of chemistry and biology.

The subjects described in the thirteen chapters of this first part are as follows:—General conditions of equilibrium in solutions; electrical conductivity of solutions; ionic theory; conductivity in non-aqueous solutions; osmosis and osmotic pressure; diffusion; cryoscopy; vapour pressure and boiling-point of solutions; absorption and solution; solubility and coefficient of distribution in solution; surface tension and viscosity of solutions; optical properties of solutions; electrical phenomena in solutions, study of galvanic and concentration cells (incomplete).

The general scheme of treatment which the author outlines in his preface consists in describing in each case (1) the methods of measurement used in studying the particular phenomenon under consideration, (2) the experimental results obtained, and (3) the hypotheses and general theories which make it possible to connect together the experimental results and also others obtained by different experimental methods. This method of presenting experimental results apart from the theory which may have given birth to the observations, or have formed a connecting link for correlating them with other known facts, may be most philosophical, and occasionally most desirable, in order to impress upon the mind of the student that the observed facts exist apart from any theory, as has been most ably done by the present author, for example, in chapters i., ii., and iii. of his treatise. At the same time it can and does become a most cumbrous and space-robbing form of description, and much beauty is lost by not placing the facts at once in the appropriate setting of the theory which lead the mind to the planning of the experimental work which established the facts.

It is no doubt quite possible that a mathematical treatise might be written without the use of any symbols or any conventions of any type, or that a treatise on chemistry might be written consisting of bare, dry experimental facts without any reference to the atomic theory. Such treatises would be most interesting as monuments of human perseverance and industry, and would be literary curiosities of the highest order; but it is questionable if they would be very intelligible, and certainly they would be very lengthy, and most unstimulating to the student or worker, who could not proceed a step further with their aid alone in the way of advance, but would at once have to proceed to formulate a theory if it were desired to carry out an experiment differing in type from any in such a non-theoretical treatise. Without a theory in advance there can be no such thing a intelligent experimentation; after experimentation, the theory must be adapted where necessary to experimental results, or, if necessary, a new theory formulated which will lead to further experimentation.

It is therefore a relief to find that after the first three chapters the author somewhat alters his plan, accepts the ionic theory, and speaks boldly of ions. Some of the aspects in which the ionic theory, as at present held, fails to account for experimental facts are pointed out in the book, and those many experimental observations which are accounted for, and correlated, by the theory are justly held up for well-deserved admiration.

The author is also to be congratulated upon not having too thoroughly carried out the intention expressed in his preface of making the mathematics of physical chemistry problems easy for the non-mathematical reader.

The authors who invent and perpetuate this style of mathematics made easy surely forget that a reader who has not a rudimentary notion of how to apply the calculus probably has not learnt his more elementary mathematics well enough to follow the solution of their long and involved series and equations, and if he ever did has probably forgotten it long ago, and therefore skips the proof and accepts the conclusion much as he would have done had the proof been given in the shorter way.

As stated above, anything which can be put or proven in mathematical symbols could also be equally put or proven in ordinary words, provided patience and perseverance could be provided on the part of the author to write it, and of the reader laboriously to wade through it; but when there is a better method, surely it is much better for the non-mathematical reader to accept his mathematics ready made for him, or, if he objects to doing this, take up the study of mathematics a little longer and then turn to its applications.

It is accordingly a relief to find that the author does not carry his threat of making mathematics easy too far, and employs the calculus where necessary.

Regarding the subjects treated in the first part so far as they are contained in the present volume, it may be said that on the whole the style of treatment is most interesting, and the information usually full and carried well up to the present date.

Occasionally it would have been well, as the work is obviously intended specially for biological students interested in physical chemistry, if the biological aspects had been treated at greater length, as, for example, in the section on the theory of indicators on p. 110, and that on the study of the fluids of the organism, p. 114; but it is possible that the author may intend to return to these subjects at a later part of the work.

The descriptions of how to carry out experimental work given in the volume are clearly intended to enable the student to carry on experiments, for the

precautions to prevent experimental errors are often given in considerable detail, as, for example, in regard to freezing-point determinations and conductivity measurements; yet if this be the intention of these descriptions they are singularly incomplete in other respects. For example, in describing the determination of the freezing point the only thing said about the thermometer to be used is that it may have either a fixed or a variable zero. We venture to think that some description of the Beckmann thermometer and the method of using it would have been of service here.

BENJAMIN MOORE.

THE MAKING OF ROCKS.

Petrogenesis. By Dr. C. Doelter. Pp. xii+262. (Brunswick: Vieweg und Sohn, 1906.) Price 7 marks.

IN this work, which would be valued highly for its references to current literature alone, the author brings together what is known as to the origin of various types of rocks. Its outlook is that of the mineralogist and not of the physical geographer; but this enables the author, though far too modestly, to bring his researches on the construction of minerals and rocks to bear upon broad geological problems. As a treatise, the book is elementary and yet satisfying; in the series of which it forms a part, "Sammlung naturwissenschaftlicher und mathematischer Monographien," it exactly fills its place as an exposition of prevalent, if not necessarily established, views. Very often these views are subjected to criticism that shows how far we are from finality and conclusions; but the lucidity of discussion and absence of bias displayed by Dr. Doelter make us grateful to him as a guide. The history of the struggle for the Rhine in no way affects his scientific judgment; and once again we feel that Austria holds the balance in the geological controversies of our time.

When we say that the book is elementary, we mean this in the best of senses. It goes to the root of a question, and compels the reader to understand it. As an example of the large amount of valuable matter that may be compressed into one paragraph, we may take the following (p. 80), from a discussion on differentiation in igneous magmas:—

"Attempts have been made, as we have seen, to connect differentiation fundamentally with the existence of magmas which will not mix with one another. But this is an improbable supposition, since every magma can dissolve any other, as I have shown experimentally. The solubility of one mineral in another depends only on the temperature; and at a temperature varying with each case, the critical temperature of solution, the products of fusion are soluble in one another. Experiment also proves to us that no separation takes place in the fluids so long as they are stirred; it occurs first as cooling goes on; where there is no movement, separation can take place according to specific gravity, even in the fluid state."

The book opens with a discussion of the causes of fluidity of magmas within the earth, and their occasional appearance at the surface is attributed primarily to tectonic movements. When relief from pressure comes, the magma becomes fluid, and corrodes the surrounding rocks. The gases contained in it operate "like a blowpipe-flame." The results of such corrosion are treated later (p. 116, &c.), and Dr. Doelter remarks, following Daly's recent papers, that basic lavas, coming quickly up broad cracks, reach us in a state of greater purity than acid ones, which move more slowly, and have greater opportunities for affecting the walls that bound them. The acid masses "exhibit traces of the country-rocks, but not necessarily near the contact-zone, since, in the case of deep-seated rocks, the absorbed fragments may become distributed in the interior of the mass."

The author's remarks on the potency of mineralising agents during the consolidation of igneous rocks are based upon his own well-known experiments. Mica thus seems always to require the presence of fluorine. While water is the greatest mineraliser, we are reminded that we are not dealing with pure water in the earth, but with water containing chlorides, hydrochloric acid, boric acid, and so forth (p. 24). Certain minerals decompose in their own products of fusion, and give rise to other minerals, or mere glass, on consolidation. In such cases, the crystalline condition remains stable only at a lower temperature than that of fusion, and the function of a mineraliser or "crystalliser" is to reduce the temperature at which the substance crystallises out again. If the right point is reached, the original mineral is recovered in its crystalline form. Thus, in the much-debated case of quartz, the mineral, at ordinary pressure, will not separate from its product of fusion at temperatures above 950°. Below this temperature its crystals are stable. Above it they are unstable, although their melting-point is not reached until 1600° or 1700°. The common minerals that require the help of mineralisers for their formation are albite, orthoclase, quartz, garnet, haüyne, epidote, wollastonite, hornblende, and mica. Hence an acid crystalline rock cannot arise without mineralisers, and the frequent presence of tourmaline, fluorspar, scheelite, and so forth, in granite, indicating boric acid, fluorine, tungstic acid, chlorides, &c., bears out in nature the results of synthetic laboratory work.

On p. 65 it is interestingly pointed out that the different items in the chemical analysis of a rock, as written down, possess very different values, and that too large deductions must not be based on small differences in the quantities of magnesia, soda, or potash stated to be present. Exactitude in these determinations is not obtainable with the same degree of success as in the case of silica and alumina, and the alkalies, unfortunately, usually appear as small numbers, in which the second place of decimals becomes of importance for comparison. The American school, by the by, has made such headway that the word "salisch" slips in naturally on p. 44.

We cannot dwell on all the important considerations here put forward as to the processes that go on during the cooling of igneous rocks. Among these, the description of "Unterkühlung" on p. 137 strikes us as of especial interest. The retention of

a mineral in a state of fusion below its ordinary melting-point may allow of the previous crystallisation of another, which cannot sustain such conditions, and thus the normal order of crystallisation may be reversed. This fact is used to explain the crystallisation of augite before the felspar in basic rocks, which, in normal circumstances, so frequently show ophitic structure.

All through the book the influence of personal experiment remains manifest, and we must not complain if the genesis of the sedimentary rocks is treated in a somewhat rapid fashion. Flints thus receive far less than their due (p. 232), considering how much they have been discussed. Guppy's observations on silicified corals in the Fiji Islands raise, for instance, new questions in themselves. But references to recent work, such as Linck's on the separation of calcium carbonate from sea-water, will lead the reader forward; and we turn back contentedly from these scantier pages to the fine account of the problems of contact-metamorphism, and thank the author again and again for his clear and stimulating treatise.

As is natural in so wide a field, we miss mention of some memorable work, such as that of Harker on mixed rocks in the Inner Hebrides; on the other hand, we hail with delight the name of MacGregory (p. 31), who appears to be Prof. J. W. Gregory in the glory of a Scottish title. GRENVILLE A. J. COLE.

STRUCTURES AND MATERIALS.

Theory of Structures and Strength of Materials. By Prof. Henry T. Bovey. Fourth edition. Pp. xiii + 968. (New York: John Wiley and Sons; London: Chapman and Hall, 1905.) Price 1*l.* 11*s.* 6*d.* net.

THIS well-known text-book has been largely rewritten and enlarged for the present fourth edition. In the preface Prof. Bovey states that a number of fresh examples, mostly drawn from actual practice, have been added to the various chapters, and that all tables of strengths, elasticities, and weights of materials have been brought up to date.

In chap. i. a description of Bow's method of notation is given, and the author has now adopted this system throughout the book when dealing with stresses developed in framed structures. The treatment of the three-hinged braced arch for station roofs and for sheds of wide span is a new piece of work in this chapter. In chap. ii. there is a new series of paragraphs dealing with the graphical determination of the maximum bending moment at any point of an arbitrarily loaded girder, and several examples illustrating the author's methods are worked out in full. Chap. iii. of the older editions has wisely been broken up into two chapters, one (chap. iii.) dealing with momentum, energy, and balancing, and the other (chap. iv.) with stress, strain, and elasticity. In the older editions this chapter was a very difficult one for the student to follow, and the author, in rewriting and dividing it, has brought the various steps of the work into their true relation one with the other. The whole of the material in chap. x. of the older editions, which dealt with thick-walled, hollow cylinders, has now been incorporated into chap. v., which treats of the more difficult work on stress and strain, and undoubtedly it follows more naturally in this position after the discussion of the general equations of stress.

In chap. vii., in dealing with the relation of the neutral plane to the stress at any point in a beam, Prof. Bovey has incorporated the results of his own experimental work, which was carried out with the view of determining within the limits of elasticity the changes of fibre length at different depths of a beam when loaded transversely. In this chapter there are also additional paragraphs dealing with the design of reinforced concrete beams, the position of the neutral axis, and the strength of such beams; additional graphical methods are given for determining the slope and deflection in loaded beams, and in connection with the theory of continuous girders fresh matter has been introduced.

In chap. viii., which deals with the theory and the bending of struts, the results of the most recent experiments have been incorporated, and, as the chapter has been rearranged, it is now much more useful to engineers engaged in the difficult problem of strut design. In chap. ix. the stresses in non-circular shafts are discussed, and there is also much new matter in the paragraphs on the efficiency of shafting and the whirling of shafting, and open coil springs are dealt with, as well as the ordinary helical springs. Chap. x., which is devoted to bridges, has been entirely rewritten and greatly improved. Graphical methods are used throughout for the determination of stresses in the piers, and the most recent types of bridges are discussed and explained. Excellent tables are given of the loads upon, and the weights of, bridges, and several examples of fairly large bridges are worked out in complete detail. This chapter is now a most valuable one for those who are concerned with the design of bridges of all classes, and the examples have been made thoroughly practical. We have no hesitation in saying that Prof. Bovey in thus practically rewriting his book has considerably improved its value both to the engineering student and to the civil engineer engaged in the design of all classes of structures in steel and iron.

T. H. B.

RATIONAL DAIRYING.

Dairy Chemistry. By Harry Snyder. Pp. x + 190. (London: Macmillan and Co., Ltd.; New York: The Macmillan Co., 1906.) Price 4*s.* 6*d.* net.

PROF. SNYDER'S work as agricultural chemist in the University of Minnesota is well known. This State, with a population less than that of Kent and Essex, possesses a University Agricultural Department in which are 800 students most of whom are attending a three years' course. The majority are students who during the summer months have to work for a living, and at the close of their academic training return to rural employment. Thus Min-

nesota, in common with other States of the Middle West, is year by year producing an army of workers who have learnt to base their work on scientific principles and to look to the results of scientific research for the future development of their industry.

The success of the American agricultural colleges in turning out trained craftsmen (they are not, perhaps, equally successful in producing highly-trained scientific experts) is to be traced to the intimate association of the practical and the scientific teaching. On the one hand science is taught, but the mind of the student is constantly being directed to its industrial applications; on the other hand the industry is taught, but with constant reference to underlying scientific principles. Prof. Snyder's book is a capital example of the method of industrial teaching. It is a text-book of dairying, but there is no rule-of-thumb; an appeal is made to reason; processes are advocated because found by experiment to be sound; the impression left on the student's mind is, "This is the best to-day; there may be a better to-morrow."

To take from the book two examples of the effect of this method of training on industrial development:—The advantages of the cold curing of Cheddar cheese were established by Babcock and Russell at the Wisconsin Experiment Station. It is a rational process based on recent investigations on the action of the natural enzymes in milk. The results were only published in 1901, but already cold-curing factories have risen throughout Ontario and the cheese-producing States of the Union, showing a readiness to accept the results of scientific investigation, although involving a large capital outlay, to which it is difficult to find a parallel in British agriculture. As the second illustration, take the percentage of fat and total solids in milk, 3½ and 12 respectively, enforced as the legal standard in Minnesota. To obtain such milk, cattle must be bred up to this high standard. The agricultural community is far-sighted enough to see that, although it may involve hardship on individuals, the high standard is an advantage to a State where butter and cheese production is an important industry.

The book should prove almost as useful to dairymen in this country as in America. There are few Americanisms either in spelling or phraseology, and throughout there is an insistence on the importance of proper hygienic conditions in dairying, with several useful suggestions as to how cleanliness can be secured, which should be invaluable, for it is on account of the neglect of such conditions in this country that dairymen's troubles are generally due. The method of calculating dividends in dairying is also worthy of particular attention here. There are, unfortunately, a few misprints and inaccuracies, together with curious repetitions of the same statements, suggesting that the book has been edited from lecture notes compiled in card-catalogue form. As usual in American works, the whole of the nitrogen compounds in foods are considered as proteids. The bibliography containing references to American, German, and British scientific papers is an excellent feature. T. S. D.

OUR BOOK SHELF.

Gedanken über Vererbung. Dr. Alexander Petrunkewitsch. Pp. 83. (Freiburg, i. B.: Speyer and Kaerner, 1904.) Price 1.80 marks.

THE author thinks that clearness is gained if we regard the organism as a continually changing mechanical system with a life-cycle extending from the arbitrarily chosen moment of oogenesis to the post-mortem death of the last scrap of decaying tissue. An acquired character is the result of a reaction of the system to external influences, and presupposes a definite heritable structure capable of reacting, so that there is no sharp boundary between acquired and inherited characters. What is called a heritable character may be due to a coincidence of successive reactions. The concept of heredity strictly applies only to the germ-cells; it is simply "the process which leads to the formation of germ-cells whose structure is the same as or like the parental germ-cells." Development is the expression of this structure, and the formative causes of development lie in the relation between the system and its environment. An animate system can only exist in definite conditions, which can only oscillate within definite limits. Life is an adjustment between the amplitudes of variation in the animate system and in the environment, and involves a progressive limitation of the organismal variability. Those variations the causes of which lie in the oscillations of the germ-cell structure may be called gametogenous or endogenous as contrasted with exogenous variations (modifications) which are acquired in the course of life. This distinction will hold even if we abandon the theory of the continuity of the germ-plasm, and simply suppose that the germ-cells are those cells which through chemical reactions have attained the same structure as the parental germ-cells. When this sameness is not attained variations result, the amplitude of which may be trivial or fatal, or it may be that a new pattern of system results which we call a mutation. So far as we can see, the author simply re-states familiar facts and ideas in a slightly novel way, and we do not share his confidence that clearness is gained by so doing.

J. A. T.

Giordano Bruno. In Memoriam of the 17th February, 1600. By Alois Riehl. Translated by Agnes Fry. Pp. 112. (Edinburgh and London: T. N. Foulis, 1905.) Price 2*s.* 6*d.* net.

THE life of Giordano Bruno is not altogether unfamiliar to readers of reviews in NATURE. A larger volume on this subject was reviewed about two years ago (March 31, 1904, vol. lxix., p. 505). Still earlier, in May, 1900, the original of the present translation was reviewed, and the reviewer expressed the wish that Prof. Alois Riehl's essay could be presented in English. This suggestion has led to the appearance of the present volume.

The first account of Giordano Bruno coming from the pen of Prof. Alois Riehl dates from 1889, the year in which the present monument was erected to Bruno on the site of his martyrdom. The tercentenary of Bruno's death on February 17, 1900, formed the occasion for a second edition, in which the account of Bruno's philosophy was revised. Without entering into minute detail, the present translation bears the impress of being a good one, and when the small size of the book is taken into account the description of Bruno's life will be found to be as full and complete as could be possibly expected.

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.]*

Geological Survey of Canada.

IN the issue of NATURE of June 21 is a letter from Mr. A. P. Low. This communication is liable to be misleading, and I shall be greatly obliged if you will allow me to correct the misstatement which it contain, namely, that "at the same time, Dr. R. Bell simply returned to his former position of assistant-director and chief geologist, to which he had been appointed in 1892."

I was not appointed chief geologist in 1892. This office did not then exist. It was created on March 27 last, and I was appointed to it by a formal Order-in-Council on that date, a large increase being made to my salary at the same time. ROBERT BELL.

Office of the Canadian High Commissioner, London, July 9.

I HAVE taken some trouble to inquire into the extraordinary appointment to the Geological Survey of Canada concerning which you published a paragraph on April 26 (vol. lxxiii., p. 613) and a letter on June 21 (p. 175). I send you my results in case you would care to continue the correspondence.

Report states that the Premier informed Dr. Bell that the Government, for its own reasons, was going to make certain changes in the administration of the department, but that wishing Dr. Bell to be quite contented with these changes, he asked him to state the conditions which would be agreeable to him. I have also learned that the Premier transferred Dr. Bell's letter for action to the Minister of the Interior, who is at the head of the Geological Survey Department. Owing to the great pressure of the business of the session of Parliament, the matter has not yet been considered, and further changes are probable, but for the present Dr. Bell has been promoted to be chief geologist of Canada, and allowed to devote his time entirely to scientific matters. He attains at least equal rank, and receives a substantial addition to his salary, with a promise of further increase in the near future. In connection with the above change, Sir Wilfrid Laurier spoke in Parliament in the highest terms of Dr. Bell's ability and of the great scientific services he had already rendered the Dominion.

If these are facts, then Mr. Low's letter (p. 175) appears to be inaccurate. The office of chief geologist was, it seems, newly created for Dr. Bell last March, and he was not appointed to it, as Mr. Low asserts, in 1892.

Mr. Low, I find, is quite unknown in the geological world, whereas Dr. Robert Bell's name has long been familiar throughout Europe and America. He is now in his fiftieth year of service to the Government of Canada in connection with its Geological Survey, and as practical head of that department for the last five years he has maintained its high reputation and administered all its affairs with credit. He is a Fellow of the Royal Society of London, a Doctor of Science of Cambridge, a Doctor of Medicine of McGill, a Doctor of Laws, &c., and has been honoured by the King with the companionship of the Imperial Service Order.

During his administration of the business affairs of the Canadian Survey, it is generally recognised that he has improved its efficiency in many ways, and has increased the number of its officers, the extent of its operations, the Government grant, the library, the extent of its premises, &c. He has sent to the field an average of more than thirty parties every year, as compared with less than half that number in the time of his various predecessors. Surely this is a good record, for the sooner a country is surveyed the better it is for all economic purposes.

The above matters and many others are clearly described by Dr. Bell in his annual summary reports of the survey for the past five years. He had previously caused to be carried on very extensive topographical surveys in all sections of the vast Dominion, taking the leading part himself in this work. It was for these valuable services to geography that the Royal Geographical Society this year awarded him the patron's gold medal, with the approval of the King.

It is clear, I think, that although the interests of science have not been wholly sacrificed, party politics and not geology have been in question in regard to Mr. Low's appointment. F. R. S.

July 7.

Osmotic Pressure.

THE gravamen of our criticism of Prof. Kahlenberg's paper is directed against his statement that "indirect measurements of osmotic pressures involve the assumption that the gas laws hold for solutions." In vol. lxxvii., Proc. Roy. Soc., we deduce a relation between the osmotic and vapour pressures of a solution which is independent of the gas laws "holding for solutions." Prof. Kahlenberg, in his recent letter, does not attempt to show that this relation is unsound; we may therefore take it that he accepts the theory, but is dissatisfied with the experimental evidence which we adduced to corroborate it. Perhaps the following will help to convince him.

In a paper read before the Royal Society, June 7, we give the results of the direct and indirect measurements of the osmotic pressures of some aqueous solutions of cane sugar.

Concentration	Direct O.P. at 0° C.	Indirect O.P. (from V.P. at 0° C.)
540 grs. per lit. sol.	67·51	69·4
660 ,, ,,	100·78	101·9
750 ,, ,,	133·74	136·0

Since reading this paper we have found that aqueous solutions of dextrose and galactose give similarly concordant results. As regards the last paragraph of Prof. Kahlenberg's letter (p. 222), we would point out that he gives no experimental evidence for the assumption that the sugar that had passed through the rubber membrane was sugar from which, so to speak, the solvent had been filtered off. Until such evidence is forthcoming, it seems to us that the criticism we levelled at his work is legitimate, and suggests a simple explanation of the low results he obtained. BERKELEY.

Foxcombe, near Oxford. E. G. J. HARTLEY.

Family Diseases and Temperaments.

MAY I appeal through your columns to those of your readers who are interested in the tendency of certain diseases and temperaments to run in particular families to aid me in an investigation I am at present making? The schedules now being issued contain space for a great deal of information, but it is rare for any single recorder to be able to supply all of it. What is wanted is a perfectly frank statement of what the recorder knows or can find out without much trouble. The only request made is that if the recorder feels unable to state certain facts not to the family credit, as well as those which indicate a sound, successful stock, no attempt should be made to fill in the schedule. At the same time, *no names are required*, the recorder may select any family he pleases for record, and the name of the recorder is only required in case it is needful to ask for explanation of any entry, and as a general sign of good faith.

I am fully aware of the labour involved in giving a fairly full family record, and my gratitude for aid in the matter is very great. At the same time, it is, I think, not unjustifiable to hope that among the readers of NATURE there will be some ready to help in an inquiry which if completed will be of considerable scientific value. There exists at present no ample data from which we can determine the inter-relationship of disease, temperament, and success in life. We know comparatively little the extent to which these factors are associated together or persist in certain families. After some considerable labour, about 200 records have been obtained, some of them very full and excellent, and the majority of considerable value. But the

number must be extended, if possible to 1000, before the work of reduction is begun. May I ask for further aid in the matter? I shall be glad to send two or more schedules to anyone who will help to get a faithful record.

KARL PEARSON.

University College, London, W.C.

Thermodynamics of Diffusion.

IN applying the principles of thermodynamics to diffusion of gases, several pitfalls have to be guarded against.

In the first place, if we adopt the old definition of entropy in terms of integrals of the form $\int dQ/T$, we are almost certain to go wrong when we come to deal with diffusion. If we imagine diffusion to take place between two of the ideal "perfect gases" of our text-books at constant pressure, volume and temperature, and without gain or loss of heat, no quantity of the nature of dQ appears to be associated with the phenomenon, and it is easy to rush to the conclusion that no change of entropy takes place. This danger is avoided if we adopt Mr. Swinburne's plan of defining entropy in terms of "waste" or unavailable energy relative to an assumed auxiliary medium. By "auxiliary medium" is here meant a medium at uniform temperature T_0 which can be used indefinitely as a refrigerator in thermodynamic operations, and any change in the amount of *unavailable* energy under such conditions, when divided by the temperature T_0, gives the corresponding change of entropy.

If this definition is adopted we see that the phenomenon of mixing the gases does not in itself suffice to determine the changes of entropy associated with it. The matter can only be decided by an appeal to experience as to the means whereby the gases can be separated or mixed reversibly. The case of an ideal "perfect gas" forms no exception to this statement.

The proper inference is, not that the diffusion involves no change of entropy, but that the change of entropy, if it exist, cannot be expressed as a sum of differentials of the form dQ/T.

The second pitfall occurs when we take the well-known expression for the entropy of a perfect gas in terms of pressure (or volume) and temperature, and try by this means to connect the entropy of the mixture with the entropies of the components. Where we are likely to get into trouble is by ignoring the integration constants in the expressions for the entropy. There is no evidence from mere thermodynamic reasoning that the constant does not change in the process of diffusion. All we can infer is that the change of entropy associated with the mixing of gases at uniform pressure and temperature is constant, *i.e.* independent of pressure and temperature.

To sum up, then, even when we have defined an ideal perfect gas in the ordinary way, and assumed the property that two such gases can mix in a closed vessel without change of pressure and temperature, thermodynamical considerations still give us no information whatever as to the change of entropy accompanying diffusion, and on this point a further appeal to experience is necessary.

This amounts to saying that our definition of perfect gases is still incomplete. What further property shall we assume in order to complete it? If we regard a "perfect gas" as a mere invention on paper, the most *useful* plan is to take some simple property which is approximately satisfied in the case of actual gases and assume that this property is accurately satisfied by our perfect gases. Now, actual gases may be separated and re-mixed either by diffusion through a membrane or by liquefying, or, if preferred, freezing one of the constituents.

Taking either of these processes, and making suitable assumptions which would render that process perfectly reversible, we are led to the inference that the whole entropy of a mixture of perfect gases should be taken to be equal to the sum of the whole entropies of its components at the same temperature and partial pressure, *i.e.* if each component occupied the same volume as the final mixture.

According to this view, when diffusion takes place at constant temperature and *pressure*, there is a gain of entropy and a loss of available energy equal in amount to that which would be incurred if each of the constituents were to expand by rushing into a vacuum until it occupied the same volume as the final mixture.

There is another way of partially separating the constituents of a gas mixture. If the mixture be introduced into a field of force such as that due to the earth's attraction, or if we imagine it to be whirled in a centrifuge, the denser gases will predominate in the lower parts of the atmosphere or where the potential is greatest, and the lighter gases will predominate in the upper regions or where the potential is least. In this case the partial separation is effected at the expense of work done by the field of force.

This note does not purport to deal in full detail with the thermodynamics of diffusion, but merely to direct attention to certain points which are easily overlooked. One of the most important of these points is that the possibility of producing mechanical work by the diffusion of gases through a membrane at constant temperature is not necessarily inconsistent with the principles of thermodynamics or the ordinary definitions of a perfect gas.

If any physicist should claim to have discovered Maxwell's demons in connection with the diffusion of gases, the first questions we should ask him are:—

(1) Can he, without the performance of external work, separate the gases in a mixture in such a way that the temperature is the same at the end as at the beginning, and the separated constituents each occupy volumes smaller than that of the original mixture?

(2) Can he obtain external work by the mixing of two gases without change of temperature if the initial volume of each gas is not less than the final volume of the mixture?

(3) Are his claims based on new experimental evidence?

G. H. BRYAN.

Early Meteors of the Perseid Shower.

THE moon being new on July 21 this year renders the conditions favourable for observing the earlier members of the great Perseid display. A few of these are usually visible on July 15, and probably just before that night, and it would be interesting if multiple observations of supposed Perseids could be obtained so that their radiants might be definitely assigned without the risk of error.

A single record of a meteor-flight only permits an assumption to be made as to the apparent radiant, and mistakes frequently result. For example, if a streak-leaving meteor, seen at the July–August epoch, happens to be directed from the northern part of Perseus it will certainly be attributed to the Perseid swarm, though it may quite possibly have had its origin in a different shower from Cassiopeia, Andromeda, Aries, Camelopardus or Auriga. To avoid such errors of allocation it is proposed to maintain simultaneous watches this year between July 15 and 28 from 10 to 12 p.m., and the writer would be glad to hear particulars of any observations for comparison with similar results obtained at Bristol.

The mean height of the Perseid meteors has already been satisfactorily deduced, but it seems desirable further to investigate the position and motion of the radiant, especially during the last half of July. Such meteors as appear amongst the stars of Perseus or bordering constellations are the best for indicating the exact place of the radiant, and bright meteors should always be carefully registered, as they are very likely to have been noticed elsewhere. The centre of radiation travels from near ϕ Andromedæ at the middle of July to a few degrees south of the star-cluster at χ Persei at the end, the ephemeris places (*Monthly Notices*, lxii., 169) being as under:—

Date	R.A.	Dec.	Date	R.A.	Dec.
July 15	15°·3	+48°·9	July 25	24°·9	+52°·5
,, 17	17°·1	+49°·7	,, 27	27°·1	+53°·2
,, 19	18°·0	+50°·5	,, 29	29°·3	+53°·8
,, 21	20°·8	+51°·1	,, 31	31°·6	+54°·4
,, 23	22°·8	+51°·8	Aug. 2	33°·9	+55°·0

Bishopston, Bristol. W. F. DENNING.

WESTERN AND CENTRAL ABYSSINIA.

IT is with no desire to depreciate the work under review, or any other of the books published on the subject of Abyssinia since the great work of James Bruce (more than a hundred years ago), if the present reviewer ventures to remark that no modern work on the subject of Abyssinia has yet been written which is at all commensurate with the importance of that marvellously interesting African State. Possibly such a work might have been finally compiled had Baron Carlo von Erlanger lived to write it. In his posthumous "Forschungsreise dürch Süd-Schoa, Galla und die Somali-Länder," he treats of a fragment of Abyssinia in a way which, if it had been applied to the whole of that region, would have illustrated effectively for the first time to the man of science, as well as to the more general reader, the most interesting part of Africa.

A little reflection will convince those who have not thought on the subject that Abyssinia *is* from every point of view the most interesting portion of the Dark Continent. Here the fauna and flora of the Mediterranean region meet those of tropical Africa. Here the lofty, snow-capped mountains retain a wild goat (the most southerly occurrence of the Caprine subfamily in the African continent). Here also is a peculiar and aberrant dog—*Canis simensis*. In the western lowlands of Abyssinia there is a true wild boar—*Sus sennaarensis*. Several of the antelopes and two or three species of monkeys are peculiar to Abyssinia in their range, as are numerous birds, a few fish, two or three reptiles, and a great many plants. Some of the fish are closely related to species in North Africa or Syria. The human races are of varied types and widely different origins, speaking a variety of languages, some of which are unclassified. In the extreme south-west of Abyssinia there are Negro types which have been classified as Bantu, and others which resemble either the Congo or the Bushman pygmies. In the south-east and south, and thence almost to the centre of the country, the population is mainly of the handsome Gala-Hamitic type or of the kindred Somali stock. In the west there are Nilotic Negroes, and in the north, centre, and east races that are compounded of Hamite and Semite, with traces here and there of ancient Greek or Egyptian colonies, while there are dark-skinned Jews whose origin would seem to antedate by many centuries the destruction of Jerusalem.

In this country has been developed the strangest and most debased type of Christianity, and there are forms of devil worship or belief in demoniac possession of great interest to the student of religions. Abyssinia has a history, more or less credible, going back to a thousand years before Christ, while its records from the first impact of the Portuguese in the sixteenth century down to the present day have been part of the world's history, linked on to the records of civilised Europe, Asia, and North Africa. Whereas nearly all Africa south of the Sahara, with the exception of the Upper Niger and a narrow fringe along the west and east coasts, only came within the domain of written history a hundred years ago, Abyssinia has as much formed part of the record of Caucasian civilisation as Britain or Morocco.

The author of the book under review gives within the compass of 315 pages an excellent general description of western and central Abyssinia, and the book contains a number of good photographic illustrations. In his preface, and in one or two passages in the body of the book, the author hints with some ominousness at future trouble which is coming on the Sudan from the direction of Abyssinia. It would be out of place in NATURE to discuss international politics, nor do the readers of this Journal tend to take the point of view that what is quite permissible to Great Britain in the way of political pushfulness is almost criminal when forming part of the policy of a sister European or American nation. But apart from the warnings which are given by Mr. Hayes as to the growth of German or American influence in

FIG. 1.—Market day at Zegi. From "The Source of the Blue Nile.

[1] "The Source of the Blue Nile. A Record of a Journey through the Sudan to Lake Tsana in Western Abyssinia, and of the Return to Egypt by the Valley of the Atbara, with a note on the Religion, Customs, &c., of Abyssinia." By Arthur J. Hayes; and an Entomological Appendix by Prof. E. B. Poulton, F.R.S. Pp. xi+315. (London: Smith, Elder and Co., 1905.) Price 10*s.* 6*d.* net.

Abyssinia, he seems to indicate, and with much more probability, political dangers from the effervescence of the Abyssinians themselves. Before long the adjacent regions of the Egyptian Sudan promise to become exceedingly prosperous with their fertile soil and accessibility through British-made railroads or river navigation. Mr. Hayes seems to anticipate that this coming prosperity may be a source of temptation to the reckless mountaineers of western Abyssinia, who can reach the Sudan so much more easily than the Sudan can vanquish Abyssinia.

In his desire to give an accurate picture of Abyssinia, both at the present day and at previous periods, the author quotes extensively from earlier writers, with acknowledgment, and, where the works are recent, by direct permission. These extracts, coupled with his own shrewd and accurate observations, make up a most readable and, perhaps it may be said, valuable description of Abyssinia. There is a good deal of new information about Abyssinian Christianity, coupled with some admirable photographs of frescoes in the interior of churches. The author's remarks on pp. 56 and 59 on the soil created by the work of the white ant, and the washing of this soil down from the highlands of Abyssinia to the lowlands of Egypt and the Sudan, are distinctly interesting. There are one or two trifling mistakes which should be corrected; for instance, in the text and illustration on p. 184, a fine specimen of a reedbuck antelope is described as a "hartebeest." It is interesting to note that, so far north as the valley of the Atbara, such a typical specimen of the reedbuck should be found.

The author and the authorities whom he quotes somewhat extensively give an interesting description of the Falashas, the so-called black Jews of central Abyssinia, the region round Lake Tsana. The Falashas are undoubtedly Jews in religion, and have been for many centuries; but great caution should be exercised by people who desire to write with scientific accuracy in identifying these people of Semitic origin with the ancient Israelites of Palestine. It is alleged that the traditions of these Falashas would make them the descendants of a branch of the Jewish people which had never known Palestine, but had migrated to Abyssinia direct from Egypt. Such theories as this are hardly worth discussing by the scientific ethnologist. The Children of Israel were undoubtedly an Arab tribe that originated in the region between Syria and Egypt. Their monotheistic religion spread far and wide through the centuries into Arabia, Abyssinia, and North Africa; and, elsewhere, in the form of Christianity. The Jewish people that were expelled from Palestine by the Romans were a very composite race, containing a good deal of Armenian blood. It is possible that the Falashas, like other tribes of "black Jews" elsewhere, adopted the Jewish religion at some period before the spread of Christianity or of Islam, but are not directly descended from any section of the original Jews.

H. H. JOHNSTON.

OPSONINS AND TUBERCULOSIS.[1]

WHEN the scientific researches of Durham, working in Gruber's laboratory, revealed in 1895 the presence of agglutinins in the blood, the discovery was soon put to practical use in clinical medicine by Widal and Grünbaum, who showed what valuable aids these substances were in the diagnosis of typhoid fever; further, and this does not seem to have been so generally recognised, they have been shown to be of service in the prognosis of that disease. A similar and no less important practical use in the diagnosis of tubercular infections was made by Wright and Douglas (Proc. Roy. Soc., vol. lxxiv.), and is here further developed by the former in conjunction with Staff-surgeon Reid. The method employed is the estimation of the opsonic power of the serum; and the technique is that described by Drs. Wright and Douglas in a previous paper (Proc. Roy. Soc., vol. lxxii.). This briefly consists in incubating for fifteen minutes at body temperature a mixture of equal volumes of washed blood corpuscles, bacterial suspension, and the serum under investigation. Blood films of this mixture are prepared and appropriately stained, and the phagocytic count is estimated and compared with the result attained by conducting the same experiment with normal serum, such serum being obtained by pooling the blood of a number of healthy individuals. The phagocytic count of the experiment conducted with normal serum is taken as unity, and the result of the other count as compared with this gives the opsonic index of the serum under investigation.

In the recent paper the authors first give the result of a large number of blood examinations in generalised and localised tubercular infections. Two very important facts are the outcome of this work:—

(*a*) That in localised tubercular infections the opsonic index is uniformly low.

(*b*) That in cases of tuberculosis associated with constitutional disturbances the index is continually varying, the patient living a "life of alternating negative and positive phases," that is to say, the resistance of the blood is reduced as an immediate effect of the bacterial poison and then increased above the normal in response to the infection.

Further, ample evidence has accumulated substantiating the fact already enunciated that normal sera do not vary more than ten per cent. on either side of unity.

Applying these principles to the practical diagnosis of tubercular infections, it will be obvious that much value will accrue from a series of examinations of the blood, and to a less extent from a single examination. Where a series of measurements of the opsonic power of the blood reveals a persistently low opsonic power with respect to the tubercle bacillus, it may be inferred, in the case when there is evidence of a localised bacterial infection which suggests tuberculosis, that the infection in question is tubercular in character. A continually fluctuating index would point to a tuberculous infection associated with constitutional disturbances, whilst an index which never varied on either side of the normal to a greater extent than ten per cent. would be taken as evidence against a tubercular infection.

If only one examination of the blood is possible and the index is found to be low, then according to the evidence in the case under investigation of a local bacterial infection or of constitutional disturbances, it may be inferred with probability that the infection is of a tuberculous nature. A high index would be taken as evidence of a systemic tuberculous infection which is active or has recently been active. But no inference at all, either positive or negative, is warranted if on a single occasion the tuberculo-opsonic index be found to be within normal limits. In this case, however, it is possible by employing a further test to arrive at a diagnosis. This consists in repeating the experiment after having heated the serum for

[1] "On the Diagnosis of Tubercle by the Examination of the Blood, and on Spontaneous Phagocytosis." By Dr. A. E. Wright and Staff-Surgeon Reid, R.N. (Proc. Roy. Soc., B., vol. lxxvii., 1906.)

"On Spontaneous Phagocytosis, and on the Phagocytosis which is obtained with the Heated Serum of Patients who have responded to Tubercular Infection, or, as the case may be, to the Inoculation of a Tubercle Vaccine." (*Ibid.*)

ten minutes at 60° C. This method of testing is based upon the fact that if normal serum is heated it no longer incites phagocytosis, whilst in cases suffering from tuberculous infection "incitor elements" have been elaborated in the organism in response to the infection, and the serum is found, after heating, to retain a considerable measure of its power of inciting phagocytosis. In a series of experiments with normal heated sera the index varied between 0·00 and 0·125; whilst in experiments conducted with the heated sera of patients with tubercular infections the index ranged from 0·09 to 1·7. These figures are obtained by comparison of their phagocytic count with that obtained with unheated pooled blood of healthy men.

In a previous paper (Roy. Soc. Proc., vol. lxxiv., p. 157), Dr. Wright suggested that the fact that the actual focus of infection had a lowered "bacteriotropic pressure" as regards the offending micro-organism might be employed in the diagnosis of abscesses or effusions of a doubtful nature, the inference being that the fluid has washed over these bacteria at the site of infection, and has thus been deprived of its antibacterial substances. In this paper an interesting and convincing series of cases is given showing the practical value of this method of diagnosis of tubercle. Further justification for this would seem to be furnished in the proof of the "specificity" of opsonins for given bacteria as demonstrated by Dr. Bulloch in a recent number of the Proceedings of the Royal Society.

The same number of the Proceedings of the Royal Society contains a further paper by the same authors on "Spontaneous Phagocytosis," and on the phagocytosis which is obtained with the heated serum of patients who have responded to tubercular infection. Under the first heading the authors investigate the question of the phagocytosis which occurs in the absence of serum; under the second, the question as to the nature of the "incitor element" referred to above as being present in the heated blood derived from patients who have responded to the tubercular infection, or, as the case may be, to the inoculation of a tubercle vaccine.

As the result of searching experiments, the authors conclude that the "incitor element" is not a "stimulin" which affects the white blood corpuscles, but an opsonin which enters into combination with bacteria. They further conclude in this matter, in agreement with the previous work of Dr. Dean (Proc. Roy. Soc., B., vol. lxxvi.), that the substance in question does not differ with respect to its resistance to heat and sunlight from that which is found in the unheated normal serum.

That the opsonins are eminently heliolabile is also of great practical import, for a blood allowed to lie in the sunlight preparatory to its examination for opsonins is entirely spoilt, as is shown by experiment in the present paper.

As regards spontaneous phagocytosis an important fact was arrived at, namely, that it is in the lowest salt concentrations (0·6 per cent. NaCl) that phagocytic activity is greatest, whilst it is practically abolished by a concentration of more than 1·2 per cent.

Another experiment of practical moment is worthy of mention. When dealing with heated sera, which, as we saw above, may be used as aids to diagnosis, it is very important that the same conditions should exist in every case, for the phagocytosis occurring after the serum had been exposed to various temperatures for varying periods was found to differ considerably. Thus a fixed temperature (60° C.) for a fixed period (10 minutes) should always be employed in the exploitation of this method of diagnosis.

NOTES.

THE Mackinnon studentships for the year 1906-1907 have been awarded by the Royal Society to Mr. W. G. Duffield, "for the study of arc spectra of metals under high pressures"; and to Dr. F. H. Scott, "for the continuation of studies on the nature of the process of excitation of nerve cells."

THE arrangements for the international celebration of the jubilee of the coal-tar industry to which attention has been directed in these columns are now well advanced, and a very representative gathering of foreign chemists will assemble in London on July 26–27 in honour of Dr. Perkin and his work. As might have been expected in view of the great development of the industry in Germany, that country will send a very strong body of delegates. Among those who have already accepted invitations are Prof. Emil Fischer, representing the German Chemical Society; Drs. Duisberg and Delbrück, representing the "Verein Deutscher Chemiker"; Drs. Böttinger (Elberfeld), H. Caro (Mannheim), Ehrhardt (Badische Co.), Kallé (Biebrich), Klingemann (Cassella and Co.), H. Erdmann (Charlottenburg Technical High School), Kremers, Lepsius (Griesheim), Raschig (Ludwigshafen), Möhlau (Dresden), Gustav Schultz (Münich); and Drs. Bablich, Liebert, de Ridder, Albrecht Schmidt, and Ullrich, representing the Höchst colour works. It is probable that Prof. Liebermann and Drs. v. Martius and Bernthsen will also be present. From France, M. Gautier, president of the Chemical Society of Paris, and Prof. Haller will represent their society. Profs. Étard, Moureu, and Guyot will also attend as representatives of France. Holland will be represented by Profs. Holleman and van Romburgh, Austria by Prof. Friedländer, and Switzerland by Prof. Hans Rupe. America, as already announced, proposes to have an independent celebration in the autumn, but will also participate in the general international movement. The American delegates have not yet been nominated. At the banquet on July 26 all the foreign delegates will be present as guests, and it is hoped that the chemists of this country will attend in large numbers. At the meeting at the Royal Institution on July 26 Dr. Perkin will receive the Hofmann medal of the German Chemical Society and the Lavoisier medal of the Chemical Society of Paris, besides numerous addresses from the learned and technical societies. Among the names of officials and public men who have so far responded to the invitation to attend the banquet are Lords Kelvin, Rayleigh, and Alverstone, the German Ambassador, the Right Hon. R. B. Haldane, Mr. Justice Buckley, Sir Wm. Broadbent and Sir Arthur Rücker. All applications for tickets for the dinner and other functions should be addressed to Dr. J. C. Cain, 28 Pembury Road, Clapton, N.E. As the gathering is expected to be a very large one, it is desirable that those proposing to be present should communicate at once with Dr. Cain so that the necessary arrangements for their accommodation may be made.

THERE are now on exhibition at the London Hippodrome three microcephalic girls stated to have come from Mexico, like the famous Maximo and Bartola, who toured the world some fifty years ago and were described to the Ethnological Society by Sir Richard Owen. The present specimens are said to be members of an almost extinct race closely allied to simians; but microcephaly is not associated with any particular race, and the information was probably suggested by the statements made as to the origin of the earlier pair. Although they are often monkey-like, the microcephalics are not technically simian in their characteristics; in some cases they have a small vocabulary, in others they

are mute so far as real language is concerned. The skull capacity has been known to fall as low as 270 cm., but the present immature specimens are said to have brains only one-seventh the normal size.

IN connection with the third International Colliery Exhibition recently held at the Royal Agricultural Hall, a representative gathering of delegates from mining and allied institutions in different parts of the world was entertained at luncheon by Mr. H. Greville Montgomery, M.P. It was unanimously resolved by the assembly to hold an International Mining Conference in connection with the fourth International Colliery Exhibition in 1908. An organising committee was elected, and among its members are:—Mr. J. C. Cadman, Prof. S. Herbert Cox, Mr. W. Cullen, Prof. Dunstan, F.R.S., Mr. W. B. Esson, Prof. W. Gowland, Mr. E. M. Hann, Mr. T. H. Holland, F.R.S., Mr. J. H. Marr, Mr. T. W. Mitchell, Mr. W. H. Patchell, Mr. H. M. Ridge, Mr. W. Rowley, and Mr. W. Russell, C.B., with Mr. H. Greville Montgomery, M.P., as chairman, and Mr. Allan Greenwell as secretary. All communications should be addressed to the secretary at the offices (provisional) of the conference, 30–31 Furnival Street, Holborn, London, E.C.

THE committee of bibliography and of astronomical sciences of the Royal Observatory of Belgium has undertaken to publish a list of the observatories and astronomers of the whole world. A request for information, in the form of a list of questions, with a model reply relating to the astronomical service at the Uccle Observatory, Belgium, has been addressed to directors of observatories. In addition, the list will include such astronomers (university professors, amateurs, &c.) who are not attached to any observatory, but are nevertheless actively engaged in astronomical research. The information already sent will enable the committee to draw up, not only a list of observatories, with their geographical coordinates and the members of the staff, but also a table showing the astronomical activity of the whole world, based upon the information given as to the instruments at the disposal of each institution, the researches undertaken, and the papers published. Directors of observatories who have not received the question-form, or have not yet forwarded a reply, as well as unattached astronomers, are requested to send the information desired, or to repair any omissions, as soon as possible to the chairman of the committee, Prof. P. Stroobant, astronomer at the Royal Observatory of Belgium, Uccle, Belgium.

THROUGH the death of Prof. H. A. Ward, who was struck down by a motor car on July 5 in Buffalo, U.S.A., a figure well known to every museum and mineral dealer in Europe and America has passed away. Prof. Ward was born at Rochester, N.Y., in 1834. For a short period he assisted Prof. Agassiz at Harvard Scientific School; in 1855 he went to Paris for a course of study, and travelled thence widely over Europe; from 1860 to 1865 he was professor of natural science in Rochester University. From that period until his death, most of his time was spent in travelling for the purpose of forming collections of mineralogical and geological specimens, which are well known as "Ward's Cabinets." To geological literature Prof. Ward contributed little of importance, but as a collector he did valuable service. He had built up the most complete private collection of meteorites in existence; in extending it he spared neither time nor money; though more than seventy years of age, he passed through London last year on his way to cross Europe, searching for new specimens with the ardour of a boy.

WITH the Earl of Grey, G.C.M.G., Governor-General of Canada, as patron, and Sir L. A. Jetté, Lieutenant-Governor of Quebec, as honorary president, the fifteenth International Congress of Americanists will meet at Quebec from Monday, September 10, to Saturday, September 15. The work of the congress will have reference to:—(1) The native races of America, their origin, geographical distribution, history, physical characters, languages, civilisation, mythology, religions, morals and habits. (2) The indigenous monuments and the archæology of America. (3) The history of the discovery and European occupancy of the New World. The committee of organisation is as follows:—President: Dr. Robert Bell, F.R.S., director of the Geological Survey of Canada, Ottawa. Vice-Presidents: Mgr. J. C. K. Laflamme, Dean of the Faculty of Arts, Laval University, Quebec; Hon. R. A. Pyne, Minister of Education of the Province of Ontario, Toronto; Dr. D. Boyle, Department of Education, Toronto. General Secretary: Dr. N. E. Dionne, librarian, Legislative Assembly. Treasurer: Mr. Alp. Gagnon, Department of Public Works, Quebec.

IN a long and interesting article in the *Times* of July 9 on the commercial application of wireless telegraphy, the writer deals very fully with the history of wireless telegraphy and with the various systems now being worked on a commercial basis. The claims of the various systems are clearly put forward, and should prove of interest to the non-technical readers who are mostly inclined to the opinion that the words "wireless telegraphy" and "Marconi" are synonymous. Among the many systems which have been developed since Mr. Marconi achieved success, may there not be one or more which is entitled to an equal consideration by the authorities? This is one of the chief points raised by the *Times* correspondent, and it is one which in the interests of the nation should be fully recognised. So long as one company is granted a monopoly, the cost for commercial use is likely to remain high, and any improvements which might be made through fair competition are unlikely to be developed in the same proportion. In Germany a combination of the various systems has been made, and any new improvement brought out is thus welcomed and given the fullest consideration. In this manner the highest efficiency is obtained, and if some similar arrangement could be arrived at in this country it would surely be to the benefit of the country at large. As to whether it would be more to the interests of the nation for the Government to own and work the wireless telegraph stations, when, by a fair trial, the best system or combinations of systems has been established, is a matter which wants the fullest consideration, and before any further licences are granted to any company or companies, this aspect of the situation should be one of the first points to be decided by the authorities in whose charge the welfare of the country is placed.

PROF. HÖNNANN, professor of mining in the Berlin Technical High School, died on June 30 in his seventy-first year.

THE twenty-third annual congress of the Royal Sanitary Institute was opened at Bristol on Monday under the presidency of Sir Edward Fry, F.R.S.

PROF. WALTHER VON LINGELSHEIM, director of the hygiene station in Beuthen, Upper Silesia, has been appointed director of the newly founded hygiene institute in the same town.

DR. WILHELM BODE, departmental director of the Emperor Frederick Museum in Berlin, has been appointed

Director-General of the Berlin Royal Museums, with the rank of Wirklicher Geheimer Oberregierungsrath.

THE Berufsgenossenschaft der chemischen Industrie held its twenty-second ordinary meeting in Detmold on June 28, and sanctioned the spending of half a million marks for the erection of the society's business premises.

DR. THEODOR MEYER, whose work on the commercial preparation of sulphuric acid has given him a high place among technical chemists, has been appointed director of the installations bureau for the German chemical industry, in Berlin, Kurfürstendamm 139, in succession to the late Dr. H. H. Niedenführ.

PROF. HUGO VON GILM died in Vienna on June 21, in his seventy-sixth year. Born in Innsbruck, he studied at the university under Prof. Hlasiwetz, whose assistant and co-worker in several pieces of research in organic chemistry he subsequently became. From 1863 to 1895 he was first lecturer, and ultimately professor of chemistry and chemical technology in the Vienna Landesoberreal- und höheren Gewerbeschule.

PROF. EMIL JACOBSEN celebrated his seventieth birthday on July 3 in Charlottenburg, where he has lived for many years. He was born in Danzig, and studied as a pharmaceutical student in Breslau and Berlin. In 1862 he opened an analytical laboratory in Berlin, in which he made a number of valuable observations and discoveries. Dr. Jacobson is the originator and editor of several successful periodicals. From 1862 to 1903 he issued an annual publication under the title of the *Chemisch-technisches Repertorium*, and from 1864 to 1894 the weekly paper *Industrie Blätter*, while from 1878 to 1895 he was the director of the *Chemische Industrie*.

AN earthquake shock was felt at Manstrae, Alva, and Blairlogie, in Perthshire, about 3.45 on July 4. The tremor, which passed from west to east, lasted about two seconds, and was accompanied by sounds as of distant explosions.

THE annual exhibition of antiquities connected with the Institute of Archæology, University of Liverpool, will be held in the Lord Derby Museum, Public Museums, Liverpool, from July 11 to July 26 inclusive. The exhibits include prehistoric remains from Hierakonpolis; examples of provincial art from Esna, of Hyksos period and later; scarabs, ornaments, and inscriptions from Abydos, of 2000 to 1200 B.C.; pottery and other remains of primitive man, from Kostamneh in Nubia, recently discovered by Mr. John Garstang and Mr. E. Harold Jones.

FROM the ashes of the monthly magazine of current scientific investigation, *Science Progress*, which came to an end in 1898 through lack of support, has arisen a quarterly review under the same title, edited, with the assistance of a strong advisory committee, by Dr. N. H. Alcock and Mr. W. G. Freeman, and published by Mr. John Murray. The periodical has much the same appearance as its predecessor, and the contributions to it are of the same character. There are twelve articles in which methods and results of work in several departments of science are described by writers actively engaged in scientific investigation. The contributions are thus trustworthy statements of the position and progress of important subjects of scientific study, the biological sciences being given particular attention. In the first number the endeavour of the new periodical is stated to be "to present summaries, as far as possible of a non-technical character, of important recent work in any branch of science, to show the progress achieved, and if possible to indicate something of the line along which further advance is to be made towards the desired end. The chemist, to take an example, will describe for the botanist recent advances in chemistry, the botanist will do the same service for the chemist, often, it is hoped, to the advantage and assistance of both." These intentions are, of course, admirable, and the only difficulty to be anticipated is in their application. Scientific work is so minutely specialised that the vocabulary common to all investigators is somewhat limited; and the greatest trouble the editors will have will be to obtain authoritative articles on subjects of prime importance written in a style that can be read with ease and interest by the world of science in general, while at the same time they appeal to the wants of students of special branches of scientific inquiry. We trust that the new review will be successful in its attempt to provide a common meeting-ground for men of science, where workers in biological and physical sciences can lead one another to appreciate the significance of progress made in their respective departments of natural knowledge.

WE have received a copy of an illustrated prospectus of the new edition of the "Systematisches Conchylien-Cabinet" of Martini and Chemnitz, now in course of issue by Messrs. Bauer and Raspe, of Nürnberg, under the editorship of Dr. W. Kobelt.

FROM the University of Wisconsin we have just received a copy of No. 115 of the Bulletin of that institution bearing the date of September, 1905. It is devoted to a review of the rise and progress of the study of anatomy in the United States, drawn up by Prof. C. R. Bardeen, and delivered as an inaugural address on his assumption of the chair of anatomy in the University. The discourse includes a reference to the early history of anatomy. In the University of Wisconsin a special department has been recently established for the study of human and comparative anatomy, neurology, histology, and embryology.

"NOTES on Malayan Pigs" is the title of an illustrated paper by Mr. G. S. Miller forming No. 1466 of the Proceedings of the U.S. National Museum. As the author has had the advantage of studying large series of specimens in the museums of Washington, London, Berlin, Leyden, and Berne, it may be hoped that this communication will do much towards settling the vexed question as to the number of distinguishable representatives of the genus Sus inhabiting the Malay area, although it is possible that what Mr. Miller regards as "groups" other naturalists may consider "species." Several new forms are named.

No. 1468 of the Proceedings of the U.S. National Museum is devoted to a collection of fishes from Ecuador and Peru, the new forms described by the author, Mr. E. C. Starks, including several cat-fishes (Siluridæ). In No. 1476 of the same serial Messrs. Jordan and Snyder describe two giant bass from Japan, namely, *Stereolypis ischinagi* and *Erilepis zonifer*, both of which have been long known to science, although imperfectly represented in collections. Despite the fact of both being commonly known as "bass," the two species are referable to distinct families. One example of the former was about 6 feet in length, while a specimen of the latter measured 57 inches, and other specimens are stated to weigh as much as 200lb.

BOTANY is the main subject in the June number of the *American Naturalist*, the "notes" being entirely devoted to that subject, while Dr. K. M. Wieland discourses at considerable length on the causes of the pressure and flow of sap in the maple. Osmosis from one living cell to another is, in Dr. Wieland's opinion, the only *vera causa* for the latter phenomenon. "Only by flow through the cell from one reservoir to another, due to the unequal

osmotic permeability at the two ends, does it seem possible to obtain pressure by this method. . . . The pith-ray cells seem the only ones in the wood in position to fulfil the above requirements. The most probable explanation at present is that the pith-ray cells, stimulated by the rising temperature, become unequally permeable, thus setting up a current and accompanying pressure from the pith towards the bark." Two shorter articles, one by Mr. R. C. Osburn and the other by Mr. A. S. Pearse, respectively deal with the existence of dragon-fly larvæ in brackish water and with the reactions to chemical and other stimuli of the hydroid polyps of the genus Tubularia.

THE June issue (vol. vii., No. 3) of the Journal of the Marine Biological Association of the United Kingdom opens with an obituary notice of the late Prof. Weldon, who was one of the oldest workers at the laboratories, and one of the most earnest and enthusiastic supporters of that institution. This is followed by an illustrated paper on certain British nudibranchiate molluscs. A report is appended on the work of the council in connection with the International Fishery Investigations. In order to carry out efficiently the work in the North Sea, it was found advisable to establish a laboratory at Lowestoft. The experiments with marked plaice have proved the occurrence of extensive migrations on the part of that species. Very noteworthy are some of the hydrographical results, especially in relation to the fact that the waters of the North Sea and the English Channel have, respectively, different origins, according to the season of the year. It would appear, for instance, that during the summer and early autumn of 1903, the Channel waters were largely derived from the Irish Sea, while during the remainder of the year they were chiefly drawn from the Bay of Biscay, as indicated by their excessive saltness. The issue closes with the report of the working of the laboratory, &c., during 1904-5.

AN important communication on the morphology of fishes appears in the June issue of the *Quarterly Journal of Microscopical Science*, in which Mr. E. S. Goodrich discusses the development, structure, and origin of the median and paired fins. It is shown that the mode of development of the dorsal fins is essentially the same as that of the paired fins, both arising as longitudinal folds, into which grow buds from the myotomes, these being subsequently affected by concentration and fusion. The careful and detailed observations of the author practically give the death-blow to the theory that the paired fins of fishes (and consequently the limbs of vertebrates generally) are derived from modified gill-arches, for, as is mentioned in the text, that theory gives no explanation of this remarkable structural resemblance of the paired to the median fins. On such a theory the resemblance is in truth absolutely inexplicable, whereas on the lateral (and median) fold-theory such a resemblance is not only easy of explanation, but is precisely what we should expect to occur. Mr. Goodrich has done good service in brushing aside collateral issues and putting the *crux* of the problem plainly before his readers, and it may be hoped that his efforts will result in the general acceptance of the lateral fold-theory. The contents of the above-named issue of the *Quarterly Journal of Microscopical Science* also include a continuation of Dr. Woodcock's review of the hæmoflagellates, and a preliminary account, by Miss R. M. Harrison, of a newly-discovered organ (consisting of a glandular body between the fifth and sixth abdominal ganglia) in the cockroach.

NOT for the first time American botanists are extending their sphere of operations to British colonies in undertaking an investigation of plants in the Bahama Islands. The collections gathered hitherto by various American botanists have been of a somewhat meagre character, so that Drs. N. L. Britton and C. F. Millspaugh, with the consent of the British botanists concerned, have planned a botanical survey of the group. Under the title "Prænunciæ Bahamenses," Dr. Millspaugh, in vol. ii., No. 3, of the botanical series of the Publications of the Field Columbian Museum, Chicago, treats the orders Amarantaceæ, Euphorbiaceæ, Rubiaceæ, and Verbenaceæ. Under the Verbenaceæ two new genera, Nashia, allied to Lantana, and Pseudocarpidium, allied to Vitex, are founded.

THE systematic articles in the recent part of the Kew Bulletin, No. 4, include a decade of new orchids described by Mr. R. A. Rolfe, and a series of "Diagnoses Africanæ" contributed by Mr. N. E. Brown, among which are several plants collected by the Hon. Mrs. E. Cecil in Rhodesia and Portuguese East Africa. The nature and uses of Chinese wood oil, generally known as t'ung oil, are discussed by Mr. J. M. Hillier, and the tree yielding it is referred by Mr. Botting Hemsley to *Aleurites Fordii*. A number of new species of Indian fungi are recorded by Mr. Massee, who also writes a note wherein he advances arguments proving that potato-disease and potato leaf-curl are more often perpetuated by hibernating mycelium than by diffusion of spores.

THE exhibit organised by the Meteorological Office for the International Exhibition, Christchurch, N.Z., 1906–7, was, by permission of Dr. Shaw, viewed on July 6 by many persons interested in meteorology. The exhibits were intended to illustrate the methods adopted by the Office and by the institutions associated with it, and the results obtained on land and sea. For this purpose instruments, published works, and specially prepared diagrams were arranged according to the branches into which the operations of the Office are divided. Perhaps the most imposing display was in connection with maritime meteorology; many beautiful specimen sheets of monthly charts for the various oceans testified to the care and skill bestowed on this important part of the work of the Office. Among the many objects of interest was a meteorological log contributed by the Prince of Wales when in command of H.M.S. *Thrush*. The details connected with the preparation of weather forecasts and the issue of storm warnings were well represented. Among the most attractive charts may be mentioned one showing the portions of the globe for which daily weather reports are published, with isobaric lines drawn for December 21, 1905, from the charts received; maps showing passages of cyclonic depressions across the British Isles and the prevalence of gales on our coasts. In the section dealing with climatological statistics maps were exhibited showing the stations under the control of the English and Scottish Meteorological Societies and the British Rainfall Organisation. Dr. Shaw contributed some carefully drawn diagrams showing the apparent relation between the yield of wheat and rainfall; meteorological sequences—dry autumn followed by wet spring and *vice versâ*—and the meteorological relations of widely distant regions. Although somewhat of a tentative character, the results were very striking, and led to the conviction that a great step in the right direction had been made in grappling with the multitudinous details at the disposal of the Office. The department dealing with automatic recording apparatus took also a prominent position in the exhibit; some excellent drawings were shown illustrating the mounting and working of the instruments at the first order observatories. Among the instruments exhibited by

some of the principal opticians was a Beckley's anemometer with Whipple's improvements, by which the direction of the vane could be read at any time by pressing the electric button of an indicator placed in any convenient room in the observer's apartments. Another interesting feature was some carefully drawn diagrams illustrating the wind circulation at the South Pole (results of the *Discovery* observations) for each month, both at the surface and in the higher regions of the atmosphere. Mr. Dines exhibited a model of a kite and a meteorograph used for the investigation of the upper air.

THE *Physikalische Zeitschrift* for June 15 contains a description by Prof. Simon, illustrated by plans and photographs, of the new buildings and equipment of the institute for applied electricity in the University of Göttingen. A historical sketch is given of the steady development of the teaching of electrotechnics at Göttingen during the past twelve years, with particulars of the funds available during this period and of the circumstances which have led to the creation of the new "institute."

AN attempt to ascertain the cause of the explosion which sometimes occurs of sealed glass tubes containing radium bromide is described by Mr. Paul L. Mercanton in No. 11 of the *Physikalische Zeitschrift*. Such an explosion might possibly be due to the pressure set up within the tube by some gas being gradually produced by the radium. A glass tube containing 15 mg. of radium bromide, which had been kept sealed during more than three years, was accordingly opened under such conditions as would permit of the measurement of any increase of pressure, and of the examination of any gas liberated from the tube. It was found, however, that no increase of pressure could be observed, nor could the presence of helium be detected.

THE fourth edition of Prof. J. E. V. Boas's "Lehrbuch der Zoologie für Studierende," which has just been published by Mr. Gustav Fischer, Jena, contains much new matter, both in the text and illustrations. There were 378 figures in the first German edition of this work, reviewed in NATURE of January 22, 1891 (vol. xliii., p. 268), and this number has now been increased to 577; while both the general and special parts of the text have been thoroughly revised by the author, with the assistance of Prof. J. W. Spengel, professor of zoology at Giessen.

A SECOND edition, revised and enlarged, of Prof. C. Moureu's "Notions fondamentales de Chimie organique" has been published by Messrs. Gauthier-Villars, Paris. The book is a synopsis of the facts and theories of organic chemistry, and is intended to be an introduction to the study of this science.

OUR ASTRONOMICAL COLUMN.

FINLAY'S COMET.—Writing to the editor of the *Astronomische Nachrichten* (No. 4102), Herr L. Schulhof states that the Jupiter perturbations of Finlay's comet bring the time of perihelion passage forward by about twelve hours, thereby making it September 7·5 instead of September 8·0 as given originally. The uncertainty of the elements is probably not greater than a quarter of a day, so that the perihelion time may now be taken as lying between September 7·25 and September 7·75. On June this comet was twice as bright as when discovered in 1886, and its apparent brightness will steadily increase until the end of August; the observation of the comet is, therefore, very probable.

THE RADIANTS OF THE PERSEID SHOWER.—From a number of observations made at Dorpat during 1901 and 1902, M. Wwedenski, under the direction of Prof. Pokrowski, has determined the following radiants of the Perseid meteors:—

Date of observation.	No. of meteors observed.	Chief radiant point. α	δ
1901 Aug. 10	23	40° ...	+57°
,, ,, 11	37	47 ...	+58
,, ,, 12	17	47 ...	+56
1902 Aug. 10	17	43 ...	+60
,, ,, 11	27	35 ...	+55

Another set of observations made on August 10 and 11, 1901, gave 40°+57° (24 meteors) and 44°+57° (43 meteors) respectively (*Astronomische Nachrichten*, No. 4098).

MAGNITUDE OBSERVATIONS OF NOVA AQUILÆ No. 2.—The magnitude of Nova Aquilæ No. 2 was observed at the Bothkamp Observatory on seventy-seven occasions between September 5 and December 10, 1905, and the results are given and discussed in No. 4098 of the *Astronomische Nachrichten*. On analysing these results, Dr. Guthnick found that the curve showing the diminution of magnitude was not a straight line, but a parabola of the following form:—

$$m = 10{\cdot}96 + 0{\cdot}0272t - 0{\cdot}000095t^2,$$

where m = the Nova's magnitude at the time of observation, 10·96 its magnitude on September 5, 1905, and t the number of days which elapsed between September 5 and the time of observation. The departure of the observed values from those computed, for the same epoch, from the curve are given in the table accompanying the results.

AN OBJECTIVE-PRISM COMPARISON SPECTROGRAPH.—In No. 5, vol. xxiii., of the *Astrophysical Journal*, Mr. de Lisle Stewart, of the Cincinnati Observatory, proposes a new form of objective-prism spectrograph which might be employed for the determination of stellar radial velocities. Instead of making two exposures with the one instrument, as has been proposed in previous suggestions to this end, Mr. Stewart proposes to employ two similar spectrographs mounted rigidly on one equatorial mounting and having the prism bases adjacent. This would bring the two spectra of each star near together on the plate, and would, presumably, eliminate, at least to some extent, the differential effects of flexure and temperature changes. Various details as to the inclination of the two tubes to each other, the inclination of the plate, the positions of auxiliary telescopes, &c., are given in the paper. Prof. Frost estimates that the probable error of radial velocities so determined would not be less than 20 km., but Mr. Stewart suggests that practical experience would remove the outstanding obstacles to more trustworthy determinations.

RUSSIAN ASTRONOMICAL OBSERVATIONS.—We have recently received five Bulletins of the St. Petersburg Imperial Academy of Sciences, each of which contains one or more papers of astronomical interest. Thus No. 5, vol. xvii. (1902), includes a paper, in French, by Prof. Brédikhine on the *rôle* of Jupiter in the formation of simple radiants, and in vol. xviii. (1903) MM. Donitch and Jaegermann have articles on the solar envelopes during the last minimum and on the production of comets' tails respectively. Vol. xix. (1903) contains several astronomical papers, including one on the observations of the chromosphere outside eclipses (M. Donitch), and another on comet forms (M. Jaegermann). Vol. xx. (1904) is largely astronomical, and includes articles on the Pulkowa spectrograph, the repulsive force of the sun, the solar activity, and the International Catalogue; whilst vol. xxi. (1904) contains papers by Prof. Belopolsky dealing with radial-velocity problems.

A NEW OBSERVATORY FOR HAMBURG.—From *Himmel und Erde* (No. 8, 1906) we learn that a new observatory is to be erected near Hamburg. The senate and council of that town have voted one million marks towards its erection and equipment. Among the other instruments which it is proposed to instal in the new building, the following are the chief:—A meridian circle of 18 cm. (7 inches) aperture, a 60 cm. (23 inches) refractor, a double telescope for photographic purposes, and a reflector having a mirror of 1 metre diameter.

STAR TRANSITS BY PHOTOGRAPHY.[1]

THE annoyance that arises from the effects of a "magnitude equation" in transit observations has led to various suggestions for its detection or removal. Screens in front of the object-glass so as to reduce the light of bright stars have been employed with advantage, and various photographic devices arranged with the view of eliminating personal peculiarities have been adopted. But while ingenuity has been active in proposing practical applications and methods, the numerical results have been few. Recently, Prof. S. Hirayama, of the astronomical observatory at Tokyo, has put in practice a contrivance similar to that employed by the Rev. Father Hagen in photographing a star in the focus of the transit telescope. In this method the exposure and occultation of a star is alternately effected by means of a bar, moved in obedience to a clock, so as to give rise to a series of dots along the star trail.

The Tokyo transit was for this purpose provided with a triple object-glass, reducing the secondary spectrum, and specially corrected for photographic rays. The aperture was 13·5 cm., and the focal length 211 cm. The range of magnitude to which the telescope was applicable depended, of course, upon the time of exposure permitted by the occulting bar. As a matter of fact, with a full second's exposure, equatorial stars of the fifth magnitude gave a measurable image. For stars of greater declination than 73° the exposure of one second was too short to divide distinctly the successive impressions from each other. The limitations of the method are thus clearly indicated. For fainter stars it seems necessary to consider the possibility of moving the photographic plate at the same rate as the star, and imprinting on the plate the image of a fixed reticule at known times. The simpler method adopted by Prof. Hirayama recommended itself to him, since the apparatus could be constructed in the workshops belonging to the observatory.

This apparatus consisted of a camera containing the reticule, occulting bar, and the dark slide, which could be inserted in the place ordinarily occupied by the wires and eye-piece. The reticule consists of seven fine lines ruled upon a microscope cover-glass, firmly cemented to a rectangular frame which carries the dark slide. These lines are interrupted for a short distance in the middle of the field so that they shall not interfere with the star images. The centre of the field is marked by two horizontal wires in the ordinary manner. The occulting bar (Fig. 1) is a

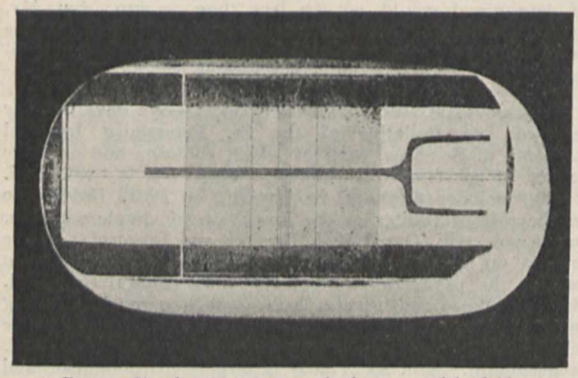

FIG. 1.—Showing the bar at rest, in the centre of the field.

thin metal slip about 8 cm. long with a square opening at one end, so as to allow the observer to see the star enter the field, and to permit him to adjust the instrument so that the transit shall take place behind the bar when in its stationary position. The end of this bar is soldered to the armature of an electromagnetic coil. Whenever the electric circuit is established the bar is lifted up and the star exposed. This circuit is made and broken automatically by contact springs in the standard sidereal clock. The bar consequently operates as an exposing shutter, permitting the cone of light from the star to fall for a longer or shorter period upon the sensitised plate, the period being decided by the contact springs.

The sensitive plate when inserted in the dark slide comes within 0·2 mm. of the lines of the reticule, so that these lines and the image of the star are practically in the same focus. Evidently this distance must be made as small as possible to reduce any error arising from photographic parallax, but the plate can be shifted in its own plane, so that five separate exposures can be made upon the same plate. The advantage thus secured of taking

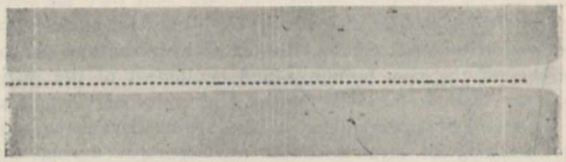

FIG. 2.—The bar removed, showing the transit of a star; slightly enlarged.

five stars on the same plate is somewhat discounted by the fact that no proper adjustment can be made for developing the plates according to the different actinic intensity of the stars.

The method of observation will be easily apprehended from the description of the apparatus and the character of the results obtained (Fig. 2). The measurement of the plates is not so simple. It is distinctly admitted that to measure a negative is more laborious than to read the fractions of a second from a chronographic sheet. Theoretically, the beginning of each "break" made by the clock is the exact point to which the reading should refer; but owing to the difficulty of measuring the edges of the dots, due to the want of sharp definition, this plan could not be adopted. The middle of the "break" to the middle of the "make" has been taken as the full second. This arrangement, or conventional rule, has probably got over the difficulty arising from the photographic spread, for it seems not impossible but that the want of definition at the edges of the dot, or the distance between two dots, is dependent upon the brightness of the star. But if this source of error is eliminated the author has to regret that the length of the dot depends upon the battery, the spring, the friction, and the moving parts of the apparatus as affected by the variable component of the force of gravity. "The weakening of the battery has been constantly provided for, but at present I see no way of escape from all the other disadvantages."

This admission seems to deprive this peculiar method of observation of much practical benefit. The question that has to be solved is not so much one of relative accuracy as it is of the possibility of eliminating systematic errors, inherent in older and more familiar methods. Looked at as a simple matter of determining the position of a star on a plate at any required moment, the results leave nothing to be desired. In an example worked out in detail it is shown that the error in a single pair of measures is ±0·017s., and the mean error of thirty-two pairs, or what may be regarded as equivalent to a complete transit, ±0·002s. The results of the measures of 140 stars, made when the plate was moved with, and against, the direction of diurnal motion, gave for the average value of personal equation +0·027s., the positive sign implying that the time of transit was longer when the plates were measured along the diurnal motion than when measured against it.

But such measures leave the question of a possible error dependent upon magnitude untouched. Unfortunately, the limited range of magnitude and the small number of observations do not permit any very definite conclusion to be drawn. The author presents a table of forty-six stars in which the photographic magnitude varies from 1·2 mag. to 5·5 mag., and gives residuals for each night and the mean residual. The latter is less than 0·05s. in all but two cases out of the forty-six. Further, when these mean residuals are arranged for each star in the order of photographic magnitude, no relation between the two is notice-

[1] "Preliminary Experiments on the Photographic Transit." By S. Hirayama. Annales de l'Observatoire astronomique de Tokyo. Tome iii., 4e fascicule. (Tokyo, 1905.)

able. Of the two errors greater than 0·05s., one is +0·072s. and the other −0·060s., and the magnitudes of the two stars are the same, and practically in the middle of the series.

But if there is no indication of a "magnitude equation" there is another circumstance which is not a little suspicious, and interesting as suggestive of the introduction of fresh sources of error. The author has referred to the fact that the mean error of observation can become comparatively large when the photographic image is poor, owing to the small altitude of the star. When the residuals are collected according to the zenith distance of the star, there is some indication of a connection between the two. "There is," says Prof. Hirayama, "a common tendency for the residual error to be least at the zenith, and to increase with the zenith distance." No stars below the pole have been observed, so that there is no means of comparing the results given by stars at small altitudes on opposite sides of the zenith. But many important questions are raised in this paper, and we notice with pleasure that Prof. Hirayama proposes to continue the inquiry. We can assure him that his investigations will be watched with interest in this country.

THE MUSEUMS ASSOCIATION.

THE seventeenth annual meeting of the Museums Association was held in Bristol on July 2–5 under the presidency of Dr. W. E. Hoyle, director of the Manchester Museum. The attendance of curators and representatives from various British museums was greater than in any previous year, foreign museums and museum workers being also represented by Geheimrat Dr. A. B. Meyer, of Dresden, Prof. Conwentz, of the Provincial Museum, Dantzig, Prof. Lehmann, of the City Museum, Altona, Mr. H. L. Brakstad, Norwegian Vice-Consul, and others.

The public conference commenced on the morning of July 3 in the Council House, a warm welcome being given to the association on behalf of the city by the Lord Mayor, High Sheriff, and museum committee, after which Dr. Hoyle gave the presidential address, taking as his subject the education of a museum curator. Briefly reviewing the varied training, or lack of training, which many curators have received, Dr. Hoyle divided museums into two great classes:—(*a*) museums of art, or institutions in which objects are regarded simply as material for æsthetic contemplation, where they are arranged so that each may be seen to the best advantage and minister to the cultivated enjoyment of the onlooker; and (*b*) museums of science, in which the object is to exhibit the state of human knowledge on one or more subjects, and to supply means of increasing that knowledge.

Confining his observations to the character of training required for curators of science museums, the president urged the necessity of a fair preliminary training in manual industry and the knowledge and use of tools, and afterwards a technical and scientific training in those subjects underlying the future work of the embryo curator. As subjects necessary to be studied because of their close relation to museum collections were enumerated the natural sciences, mineralogy, geology, biology, including in the latter term botany, zoology, anthropology, and ethnology. As sciences more nearly concerned with the acquisition, registration, preservation and exposition of museum collections were instanced the rudiments of mechanical engineering, physics, and chemistry. As a kind of post-graduate course, the necessity of visiting and studying the nature and methods of work of various museums was strongly insisted upon.

Alderman W. R. Barker, chairman of the Museum and Art Gallery committee, laid before the association a paper he had prepared tracing the rise and progress of the Bristol Museum from its inception in 1808 to the present union of museum and City Art Gallery.

Mr. H. Bolton, curator of the Bristol Museum, followed with a paper describing the general character of the collections, and the steps which had been taken to bring the mode of exhibition and usefulness of the museum contents up to modern requirements, mentioning that it was the intention of the committee to introduce a type-series of mounted specimens, an osteological series, and one in which the main structural features of the animal kingdom would be shown by prepared dissections. Work on similar lines was proceeding in other departments of the museum, and ultimately it was hoped to be able to place at the disposal of any student or visitor all that is necessary in the way of types for the full degree course of any university. Papers were also read by Mr. R. Quick, on the hanging of pictures; by Mr. F. R. Rowley, on a method of displaying coins, and on models of Protozoa; and by Mr. W. W. Watts, on the City plate and insignia.

Wednesday, July 4, was occupied with the discussion of a series of papers on museum cases and fittings, the subject being opened by Dr. A. B. Meyer, of Dresden, who outlined the result of his experiments and researches during the last thirty years upon museum cases. He strongly advocated metal and preferably iron cases, which could be made dust-proof, elegant in appearance, and not more costly than wooden cases. Dr. Meyer's remarks were followed by a paper from Mr. F. A. Lucas, of Brooklyn Museum, and one by Dr. Lehmann on a simple practical dust-proof case in the Altona Museum. Mr. Bantry White, of the Dublin Museum of Science and Art, exhibited an iron museum case built in that museum's own workshops, which was very efficient, dust-proof, and not costly.

A remarkable cabinet case, with changing trays each of which could be brought into view in turn by mechanical means, was exhibited and explained by the Rev. S. J. Ford. Mr. A. M. Rodger exhibited case fittings from the Perth Museum, and Mr. Woolnough, of Ipswich, complete models of cases it was proposed to introduce into the museum at that town. The lighting of museum cases was dealt with by Mr. Thos. White, of London. Dr. F. A. Bather explained the character of some cases in the British Museum, and illustrated his remarks, as did other speakers, by photographs and drawings. Mr. J. Osborne Smith also dealt with the same subject, and exhibited the original drawings and plans of many of the more recently made cases. Owing to the interest and importance of the subject the session was continued in the afternoon until four o'clock.

Thursday was occupied by a paper on the American Museum of Natural History, by Dr. H. C. Bumpus; by a paper on wall diagrams to illustrate prehistoric archæology, from Prof. Conwentz; a paper on the Altona room in the Arts and Crafts Exhibition, Dresden, designed to show how the form of animals is the concrete expression of adaptation to their surroundings; and one on the construction and management of museums of art, by Mr. B. Ives Gilman.

The afternoons and evenings of July 3 and 5 and the whole of Friday, July 6, were occupied by visits to the zoological gardens at Clifton, a conversazione at the Museum and Art Gallery, visits to the stone circles at Stanton Drew, the ancient British lake village near Glastonbury, the Glastonbury Museum, and the Cheddar Gorge and Caves. The meetings were well attended throughout, and a highly successful conference was brought to a close on Saturday last.

THE METEOROLOGY OF THE FREE ATMOSPHERE.

AT the request of the council of the Royal Society of Edinburgh, M. L. Teisserenc de Bort gave an address on the meteorology of the free atmosphere at the meeting of the society on May 21. Subjoined is a summary of his lecture.

The methods for sounding the atmosphere employed at the present day have been in our possession but a few years. The kite, carrying self-registering apparatus, was introduced by the Americans about fifteen years ago; the sounding balloon dates but twelve years back. The use of balloons, furnished with registering apparatus, was proposed by Lemonnier, a French physicist, at the end of the eighteenth century; but they were actually employed for the first time by the Brothers Renard, and especially by MM. Hermite and Besançon, whose first observations go back to 1893.

Observations of great interest had already been made on

mountains. To these are now added observations made in air altogether free.

The distribution of the barometric pressure at a distance of several thousand metres above the ground was first examined, and maps were shown giving the isobars at 4000 metres as calculated from the pressure and temperature on the surface of the earth.

M. Teisserenc de Bort has carefully verified that the pressure in free air diminishes in accordance with the barometric formula. For that purpose he determined the heights of a large number of balloons by observing them with two theodolites. On the average the heights thus observed agree with those deduced from the barometers carried by the balloons to within 2 or 3 millimetres of barometric pressure for a height of 4000 metres. The maps of the isobars at 4000 metres show that most of the areas of high and of low pressure observed near the ground become effaced as we rise in the air, and give place to a pressure distribution of a much simpler kind, viz. a maximum of pressure all round the earth in the tropical regions, and low pressures at the poles. The average direction of cirrus clouds is in harmony with these conditions.

As regards the distribution of temperature, the following conclusions were established :—

(1) Even at a height of several thousand metres above the ground there is, contrary to what had been thought, a very sensible variation of temperature from winter to summer, the divergence of temperature between the coldest and the hottest month being 9° C. at 10 kilometres height.

(2) After it had been noticed that the rate of fall of temperature increases with the height above the ground, it was naturally supposed that temperatures at great heights in the air were extremely low. But sounding balloons dispatched from the Trappes Observatory have proved that, after a certain height, varying from 9 to 14 kilometres, the fall of temperature ceases altogether—another fact that was wholly unexpected.

(3) The zone where the temperature ceases to fall, called the " isothermal zone," is situated nearer the ground (8 to 9 kilometres in certain places) with low pressures, and further from the ground (about 12 or 13 kilometres) above high-pressure areas.

(4) As a general rule, it is colder in the upper part of an anticyclone than it is at a corresponding height above low pressures, but the contrary holds at medium heights of about 5 kilometres. The absolutely lowest temperatures are observed near high pressures. A temperature of −73° has been observed several times at Trappes, and recently as low as −80° in Austria.

(5) Balloon flights made daily for a week or more at a time, in different years and at different seasons, have shown that at intervals of a few days the atmosphere experiences variations of temperature which are much more important high up than on the ground. At a height of 11 kilometres variations of 15° to 20° are often observed at a time when variations of only 2° to 3° are found near the ground.

It is believed that the arrest of the decrease of temperature is connected with the cessation at a certain height of movements of the air having a vertical component, the air then having movements which follow the isobaric surfaces. There is no longer any temperature variation due to expansion or compression of the air.

It has been demonstrated, alike by calculation of the isobars and by the flight of balloons, that most of the depressions which appear near the ground as complete atmospheric vortices suffer deformation as the height increases, and in their northern part lose themselves in the great polar vortex; so that, at a certain height (4 to 7 kilometres), east and north-east winds are no longer found to the north of a depression, and the isobars at this height form a handle attached to the low-pressure areas of northern latitudes. On the front of a depression its characters remain distinct to the top; a sheaf of ascending air reaches the height of cirrus cloud, and then spreads over the barometric maxima to east and south-east.

M. Teisserenc de Bort exhibited his very light, compact self-registering apparatus for measuring the temperature, pressure, and humidity in the upper regions of the atmosphere. Dr. W. N. Shaw, F.R.S., expressed the indebtedness of meteorologists to M. Teisserenc de Bort, whom he had come all the way from London to hear. After referring to the main points of the address, Dr. Shaw directed attention to another important line of research for which M. Teisserenc de Bort has fitted up a fish carrier, acquired at Hull, with the aid of which he is investigating at the equator the problem of the upper trade winds.

INTERNATIONAL SCIENCE.[1]

IN an address delivered to the British Association at its Belfast meeting in 1902 I expressed the opinion that meteorology might be advanced more rapidly if all routine observations were stopped for a period of five years, the energy of observers being concentrated on the discussion of the results already obtained. I am glad to say that meteorologists have taken this remark as being meant seriously, and its echoes still reach me from distant parts of the earth. They disagree with me, but their disagreement is of the apologetic kind. I do not wish to retract or to weaken my previous statement, but merely to qualify it now to the extent that it is only to be applied to two-dimensional meteorology. There is a three-dimensional meteorology as far removed from the one that confines itself to the surface of the earth as three-dimensional space is from a flat area. Three-dimensional meteorology is a new science, which at present requires the establishment of new facts before their discussion can properly begin. The extension of our range of observations by kites and balloons is of comparatively recent origin. Mr. Archibald in this country was one of the pioneers of meteorological investigation by means of instruments attached to kites. In the United States Mr. Rotch, having established a separate observatory, succeeded in convincing scientific men of the great value of the results which could be obtained. M. L. Teisserenc de Bort, who established and maintained an observatory for dynamic meteorology at Trappes, near Paris, rendered similar services with regard to " pilot " or unmanned balloons carrying autographical instruments. The aëronautical department of the Royal Prussian Meteorological Institute, with Dr. Assmann at its head, under the direction of Prof. von Bezold, also made a number of important contributions in the early stages of the work. Prof. Hergesell, of Strassburg, similarly made numerous experiments, and chiefly through the efforts of those whose names have been mentioned, and more especially Prof. Hergesell, an international agreement has been secured by means of which kite and balloon ascents are made in several countries on the first Thursday in each month, and on three consecutive days during two months of the year. A large station for aëronautical work was recently established at Lindenberg, near Berlin, where kites or balloons are sent up daily for the purpose of securing meteorological records. The greatest height yet reached was during the ascent of November 25, 1905, when by means of several kites sent one after another on the same wire, the upper one rose to an altitude of 6430 metres, almost exactly four miles. Owing to want of funds this country could until recently only participate in this work through the individual efforts of Mr. Dines, who received, however, some assistance from the British Association and the Royal Meteorological Society. The reconstruction of the Meteorological Office has made it possible now for Mr. Dines's work to be continued as part of the regular work of the office, and further stations are being established. Mr. Cave carries out regular ascents at his own expense at Ditcham Park, and through the cooperation of the Royal Meteorological Society and the University of Manchester, assisted by a contribution for apparatus from the Royal Society Government Grant Fund, a regular kite station is being established on the Derbyshire moors.

The International Committee which collates the observations is a commission appointed by a union voluntarily formed between the directors of meteorological observatories and institutes of countries in which regular observations are taken. The meeting of directors discusses schemes of observations and encourages uniformity.

If I mention a few of the difficulties which stand in the way of a homogeneous system extending over Europe, I

[1] Discourse delivered at the Royal Institution on Friday, May 18, by Prof. Arthur Schuster, F.R.S. (Continued from p. 237.)

do it in the hope that it may perhaps ultimately assist in removing some of them. It is obviously desirable that the charts, which are intended to show the distribution of pressure and temperature, should be derived from observations made at the same hour. Germany observes at eight o'clock of central European time, and France observes simultaneously (or nearly so) by choosing seven o'clock Paris time for its readings. We observe at eight o'clock Greenwich time, which is an hour later. It is the great desire of Continental meteorologists that our standard hour should be seven o'clock; and what prevents it from being so? Chiefly and absolutely the additional cost which the Post Office must claim for the transmission of telegrams; because messages transmitted before eight o'clock are subject to an additional charge of one shilling, which may be claimed by the postmaster, the claim being possibly increased to two shillings when the postmaster and telegraphist are different persons. This is prohibitive, but it does not exhaust the inconvenience of the additional charge. For the purpose of weather forecasting it is clearly necessary that telegrams should be received as early as possible by the Meteorological Office. But the eight o'clock rule delays telegrams from some Irish stations, because eight o'clock by Dublin time is 8.25 by Greenwich time, and therefore Irish telegrams may have to wait until nearly half-past eight if they are to be transmitted without extra charge.

While the international organisation of meteorology is well on its way, though difficulties such as those I have mentioned may temporarily retard it, another question not altogether disconnected with it has been raised by Sir John Eliot. This is the establishment of an institution devoted to the collective study of meteorological problems affecting all parts of the British Dominions. It is true, not only in this, but also in other matters, that in order to take our proper position in international work it is necessary that we should set our own house in order, and we must give Sir John Eliot's proposals our hearty support. If I do not enter further into this question it is because I am to-day dealing more especially with problems which go beyond the limits of the Empire. I assume the existence of a national organisation, but lay stress on the insufficiency of this limitation.

The importance of the subject, however, may be my justification if I direct your attention for a moment to the meteorological question as it presents itself in India. We all know and realise the vital importance of the rainy season, and the benefit which the native population would derive if it were possible to predict, even if only imperfectly, the setting in of the monsoon. It appears that Dr. Walker, the present director of observatories in India, recently obtained very encouraging results in this respect. According to his investigations, a forecast of the monsoon may be derived from a knowledge of the weather during preceding months in different parts of the world. Thus a heavy rainfall in Zanzibar in May is followed by a weak monsoon, while a pressure deficiency in Siberia during the month of March indicates a probable deficiency of rain in India during the following August. I need not insist on the importance of these results, which at present are purely empirical, and require further confirmation; but it is quite clear that for the successful prosecution of these inquiries political boundaries must be disregarded, and a system of intercommunication organised between the countries chiefly concerned. Dr. Walker informs me that he has successfully arranged for telegraphic reports to be sent to him at the beginning of June from six different stations in Siberia. It is hoped that this cooperation, which was unavoidably discontinued during the late war, may now be re-established.

The course of international organisations does not always run smoothly. The efforts made toward cooperation in earthquake records have unfortunately led to differences of opinion, which have hitherto prevented a truly international system being formed; and if I give a short historical account of the circumstances which have led up to these differences it is only in the hope that this may help to remove them. The scientific investigation of earthquakes may be said to have begun when British professors of physics, engineering, and geology were appointed at the Imperial College of Engineering in Tokio. Some of them, on returning home, succeeded in interesting the British Association in the subject. Ever since 1880 that association has been an active supporter of seismic investigations. The much disturbed region of the Japanese island was naturally the first to be studied; but in 1895 Prof. Milne, as one of the secretaries of the committee, issued a circular directing attention to the desirability of observing waves which have travelled great distances, and some months later, Dr. E. v. Rebeur-Paschwitz, of Strassburg, drew up suggestions for the establishment of an international system of earthquake stations. To this scheme Prof. Milne and other members of the British Association committee gave their approval. The cooperation which thus seemed so happily inaugurated was broken by the unfortunate death of its originator. Circumstances then arose which compelled the British Association committee to go its own way. Under its direction a system was established which now includes about forty stations distributed all over the world. But the needs of different countries are not, and were not meant to be, completely satisfied by this organisation.

There is always a certain number of earthquakes having purely local importance and requiring discussion from a purely local point of view. For the purpose of such discussion relating to the disturbances which chiefly affect Central Europe, the Union (so-called Kartell) of the Academies of Vienna, Munich, Leipzig, and Göttingen formed a committee and did excellent work. In the meantime Prof. Gerland, who had succeeded Dr. Rebeur-Paschwitz at Strassburg, had personally invited a number of friends interested in the subject to a conference at Strassburg with the object of forming an international association. This was followed in 1903 by a formal conference called by the German Government, at which Great Britain was represented by Sir George Darwin and Prof. Milne. This conference drew up a scheme for an international association, and a large number of countries, including Russia and Japan, joined. Strassburg was selected as the seat of the Central Bureau. The matter came up for discussion at the meeting of the International Association of Academies, which was held in London in the year 1904, and a committee was appointed for the purpose of suggesting such modifications in the constitution of the seismic organisation as might bring it into harmony with the views of the associated academies. This committee, over which I had the honour to preside, met at Frankfort, and recommended a number of important changes, which were unanimously accepted by the second seismic conference held last summer in Berlin. In consequence of this acceptance it appears that Italy and the United States joined the seismic association, while England declared its willingness to join under certain conditions, of which the simultaneous adhesion of France was one. The following summary of the States which have joined, and their population, is copied from the official report of the last meeting at Berlin :—

Country	Population	Contribution
		£
German Empire	60,000,000	160
Belgium	7,000,000	40
Bulgaria	3,700,000	20
Chili	3,000,000	20
Congo State	19,000,000	80
Spain	19,000,000	80
United States of America	76,000,000	160
Greece	2,500,000	20
Hungary	19,250,000	80
Japan	48,000,000	160
Italy	33,000,000	160
Mexico	13,600,000	80
Norway	2,300,000	20
The Colonies of the Netherlands	5,500,000	40
Portugal	5,400,000	40
Roumania	6,300,000	40
Russia	129,000,000	160
Switzerland	3,300,000	20

It was decided at the Berlin meeting that Prof. Kövesligethy, of Budapest, should be secretary, and Prof. Palazzo, of Rome, the vice-president, of the International Seismic Association. Prof. Gerland had already previously been designated as director of the Central Bureau. The office of president of the association was left vacant until the final decision of Great Britain as to its adhesion had been settled. There the matter stands for the present.

The disastrous results of recent earthquakes and volcanic eruptions have directed increased attention to the subject. Its thorough investigation is indeed likely to yield important information on the interior constitution of the earth. A hearty cooperation to obtain and circulate the material for a detailed discussion cannot fail to bear fruit, and, even though there may be legitimate grounds for dissatisfaction at the manner in which a particular scheme has been organised, I must express my own opinion that at the present moment the permanent interests of this country would be best secured by our joining the association and helping to direct its work in a manner which would assist rather than hamper the present organisation of the British Association.

Although time is running short, I am perhaps in private duty bound not altogether to pass over in silence an organisation which has its central bureau in my own laboratory at the University of Manchester. This is a union for the observation of solar phenomena. Called into being chiefly by the energy of Prof. Hale, this association is perhaps unique in two respects. It aims more directly at conducting research work than is the case with other unions, and in so far may run the danger of hampering private efforts. This danger has, I believe, been well guarded against by the constitution adopted at the first meeting of the conference held last September at Oxford. The second peculiarity referred to is that it works a central bureau, a computing bureau (under the direction of Prof. Turner), and is going to publish Transactions without any funds beyond those doled out to it by charity. Its vitality will, I hope, help it to overcome its initial troubles. Its ambitious programme includes a definite agreement on the standard of wave-length and investigations on the permanence or variability of solar radiation.

This latter question is of considerable interest to meteorologists, and comes, therefore, within the purview of the directors of meteorological observatories, who have also, under the presidency of Sir Norman Lockyer, established a commission charged with its discussion. An arrangement has been made securing cooperation between the two bodies, the Solar Union leaving out of its programme the difficult question of the relationship between sun-spot variability and meteorological phenomena.

Although an unnecessary overlapping of two separate enterprises has in this instance been avoided, such overlapping constitutes a certain danger for the future, as the problems of geo-physics—for the investigation of which international associations are specially marked out—are so intimately connected with each other that a homogeneous treatment would seem to require a central body supervising to some extent the separate associations. Such a central body may be found in the International Association of Academies, which promises to play so important a part in scientific history that a short account of its early history may be of interest. The Kartell of some of the German academies and that of Vienna has already been referred to. In discussing the utility of its deliberations, Prof. Felix Klein, of Göttingen, first mentioned to me the idea that an association of a similar nature would be likely to prove of still greater value, if formed between the scientific and literary academies all over the world. In consequence of this conversation I tried to interest the Royal Society in the subject; and in order to obtain further information Prof. Armstrong and myself attended privately, though with the knowledge and consent of the council of the Royal Society, the meeting of the Kartell which was held at Leipzig in the year 1897. In the following year the two secretaries of the Royal Society, Sir Michael Foster and Sir Arthur Rücker, together with Prof. Armstrong and myself, attended the Kartell which then met at Göttingen. The secretaries were impressed by the great possibilities of the scheme, and the council then took the initiative and approached the academies of Paris and St. Petersburg, which both returned favourable answers.

In consequence of the correspondence between these learned societies, the Royal Academy of Berlin, in conjunction with the Royal Society of London, issued invitations for a general conference to be held at Wiesbaden on October 9 and 10, in the year 1899.

The following were represented at this meeting, at which the statutes of the new association were agreed upon :—

The Royal Prussian Academy of Sciences of Berlin.
The Royal Academy of Sciences of Göttingen.
The Royal Saxon Academy of Sciences of Leipzig.
The Royal Society of London.
The Royal Bavarian Academy of Science of Munich.
The Academy of Sciences of Paris.
The Imperial Academy of Science of St. Petersburg.
The National Academy of Science of Washington.
The Imperial Academy of Sciences of Vienna.

The unanimity of the meeting may be judged from the fact that a working constitution, which subsequent experience proved to be eminently effective, was finally arrived at on the second day. Many distinguished men took part in the discussions; amongst them Prof. Simon Newcomb and the late Prof. Virchow may be specially mentioned.

Although the Berlin Academy had never joined the German Kartell, the first idea of a wider association seems to be due to a distinguished member of that body, the historian Mommsen, who, though of advanced age, was able to be present at the first regular meeting of the association, which was held at Paris on April 16–20, 1901. In addition to the societies which took part in its foundation, the following form part of the association, and were represented at Paris :—

The Royal Academy of Sciences of Amsterdam.
The Royal Belgian Academy of Sciences, Arts and Letters.
The Hungarian Academy of Sciences.
The Academy of Sciences of Christiania.
The Academy of Sciences of Copenhagen.
The Academy "des Inscriptions et Belles Lettres" of the Institut de France.
The Academy of "Sciences, Morales et Politiques" of the Institut de France.
The Royal Society "dei Lincei" of Rome.
The Royal Swedish Academy of Sciences.

This meeting is not likely to pass out of the memory of those who took part in it. Its importance was enhanced by the social functions which were held in connection with it, and which included a luncheon given by President Loubet at the Elysée, a banquet given by the Conseil Municipal, and a special performance at the Théâtre Français. The subsequent triennial meeting of the academy, which was held in London in 1904, passed off not less brilliantly. The representatives of the learned societies were received by their Majesties at Windsor, and the Lord Mayor invited them to dinner at the Mansion House. Social entertainments, though welcome as marking the importance of the occasion, are not allowed to interfere with the very substantial work which is being done at these meetings. The list of subjects which were included in the discussion of the London assembly may give an idea of the range of activity of the association. A permanent committee is charged with the investigation of the functions of the brain, others deal with questions of atmospheric electricity, and of the measurement of magnetic elements at sea. An important proposal to carry out an exact magnetic survey along a complete circle of latitude is under discussion. The section of letters dealt with the mutual arrangements between libraries regarding the interchange of manuscripts, approved the intended edition of the Mahabharata, and considered a proposal to construct a new Thesaurus of Ancient Greek. The association also took cognisance of and received reports on independent

international undertakings, such as the Catalogue of Scientific Literature, the Geodetic Association, and the Geological Congress.

The association meets every three years. To these meetings each constituent academy may send as many delegates as may be found convenient. For the discussion of special questions the assembly divides itself into a scientific section and a literary section.

In each of these sections, as well as in the plenary meetings comprising both sections, each academy has only one vote. At each triennial assembly the next meeting place is chosen. In the intervals between the meetings the affairs of the association are placed in the hands of a council on which each academy is represented by two members or one, according as it comprises both a literary and scientific section or only one of them. The resolutions passed by the association are not binding on the constituent academies, who maintain their liberty of adopting or rejecting them.

The Association of Academies suffers unavoidably from a certain want of homogeneity, owing to differences in the constitution of its component bodies. Most Continental academies contain both literary and scientific sections, and at the organising meeting held at Wiesbaden, marked attention was directed to the fact that there was no body in England that could be considered as representative of literary studies. If matters had been left as they stood then, this country would have been altogether unrepresented as regards half the activity of the association. Efforts were made in consequence to take a more liberal view of the branches of knowledge coming within the range of the Royal Society, and to include literary subjects. Very unfortunately, in my opinion, these efforts failed, and a charter was granted to the British Academy, which has now been included as a separate body among the list of academies forming part of the association. While in this respect we have been at a certain disadvantage, the constitution of the Royal Society has the great advantage of being truly representative of the Empire. In France, on the other hand, no one can belong to the Academy of Sciences who is not domiciled in Paris. Similarly, although Germany possesses four Royal academies (Berlin, Göttingen, Leipzig, Munich), each of them is confined, as regards ordinary members, to its own locality, so that a professor of the Universities of Bonn or Heidelberg, however eminent he may be, could not become a member of any of these academies. Neither in France nor in Germany can the academy therefore be called truly representative. The disadvantages which may arise from this defect have been minimised by adopting a rule that the International Association of Academies may appoint committees for the discussion of special questions, and that members of these committees need not be members of any of the constituent academies. This to a large degree obviates what would otherwise be a considerable difficulty. Nevertheless, I believe that the circumstances to which I have directed attention form the only impediment in the way of handing over to the Association of Academies the ultimate control of every new international undertaking, and even the charge of some of those already established. It is highly desirable that we should work towards this end. An energetic enthusiast may easily start a new enterprise, and Governments are appealed to from different sides for help and support. There ought to be some authoritative body to whom the Governments could apply for advice. Overlapping and waste would thus be avoided.

It is not my desire to disguise the difficulties which have sometimes been encountered in providing for joint undertakings on a large scale. Whether national or international, combined work between men of different temperaments always requires some suppression of personality. Even stronger feelings may be involved when a central office or bureau has to be selected which specially distinguishes one locality. The advantage gained by the locality is often one of appearance rather than of reality, for these central offices should be the servants rather than the masters of the undertaking. In order to prevent national feeling being aroused by any preference given to one nation, it has been customary in some cases to have a president who belongs to a different country from that of the director of the Central Bureau; there are also a vice-president and a secretary, all belonging to different nations. It is thought that such a distribution of office may assist in preserving harmony. I believe that this is the case, but sometimes at the risk of impaired efficiency. It cannot be denied, however, that the seat of the central office of an important undertaking confers a certain dignity, and it is quite natural that a country should feel some pride in the distinction.

England on the whole has not done so badly. We should not forget that in a great portion of the world all clocks strike the same minutes and seconds. Before long all civilised countries (except Ireland) will have adopted the Greenwich meridian for their standard of time, and we may rightly, therefore, call Greenwich the central bureau of universal time.

The offices of the International Catalogue and both the central and computing bureaux of the Solar Union are situated in this country, and if we have not secured an even larger share of the onerous but honourable duties incumbent on such offices the fault is our own. The questions which at the present moment more especially require combined treatment are those of geo-physics, a subject for which very inadequate provision has been made in England. Our earthquake observations almost entirely depend on the self-devotion of one man, and the Meteorological Office, which might reasonably be expected to take charge of certain portions of the work, such as atmospheric electricity, is kept in a state of chronic poverty, and has to restrict itself to work of the most pressing necessity.

Germany, having a large number of well-equipped stations for geodetic, magnetic, and aëronautic work, naturally reaps the reward when the offices of an international undertaking have to be chosen which shall be attached to flourishing institutions in charge of men possessing the leisure and qualifications for the work.

No serious advance will be made in our own country in this respect until our universities pay more attention to the subject of terrestrial physics. This would involve the establishment by the universities of separate laboratories or institutions, to which their present funds could not be applied. The matter wants consideration in detail, and should be carried out according to a homogeneous scheme which would prevent wasteful repetition in different places. But I feel certain that until we have trained up a number of students who possess an adequate knowledge of questions of meteorology, geodetics, terrestrial magnetism, and seismology, the position which this country will take in international organisation cannot be a leading one, though it may be, and, indeed, owing to private efforts, is at the present moment, one of which we need not be ashamed.

Finally, I must lay stress on one aspect of the question which I hope may induce us to attach still greater importance to international undertakings. The cooperation of different nations in the joint investigation of the constitution of the terrestrial globe, of the phenomena which take place at its surface, and of the celestial bodies which shine equally upon all, directs attention to our common interests and exposes the artificial nature of political boundaries. The meetings in common discussion of earnest workers in the fields of knowledge tend to obliterate the superficial distinctions of manner and outward bearing which so often get exaggerated until they are mistaken for deep-seated national characteristics.

I am afraid I have only given a very inadequate account of the serious interests which are already involved in international scientific investigations. But if I may point once more to Indian meteorology, and remind you of the vital importance of an effective study of the conditions which rule the monsoon, you will, I think, realise how impossible it is to separate scientific and national interests. The solution of this particular problem requires an intimate cooperation with Central Asia and Siberia—a cooperation which has been easily secured. I do not wish to exaggerate the civilising value of scientific investigation, but the great problems of creation link all humanity together, and it may yet come to pass that when diplomacy fails—and it often comes perilously near failure—it will fall to the men of science and learning to preserve the peace of the world.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Technical High School of Prague will celebrate its hundredth anniversary in November next. Prof. Wilhelm Gintl has been appointed rector for the year 1906-7.

ON July 4, the honorary degree of Sc.D. of Dublin University was conferred upon Colonel David Bruce, C.B., Mr. E. T. Whittaker, F.R.S., Astronomer Royal of Ireland, and Sir A. E. Wright, F.R.S.

PROF. C. GRAEBE has tendered his resignation of the professorship of inorganic, organic, and technical chemistry in Geneva University, to take effect from October 1, after which date Prof. Graebe will be an honorary professor of the University.

THE cost of the new metallurgical institute now being erected in connection with the Technical High School at Aachen will be met chiefly by the voluntary contributions of the Rhine and Westphalian metallurgical industries; the sum set apart for the actual buildings is 500,000 marks. At the recent laying of the foundation stone, General-director Springomm, as president of the Verein deutscher Eisenhüttenleute, expressed the sympathy and best wishes of the society with the undertaking.

MR. F. C. FORTH, principal of the Municipal Technical Institute, Belfast, has sent us a copy of an interesting article on the compilation of technical students' records reprinted from the Journal of the Department of Agriculture and Technical Instruction for Ireland (vol. vi., No. 3). The system advocated of chronicling for ready reference data relative to students' attendances, marks, and successes has been devised to meet the requirements of a large technical institute, and as it has now stood the test of two years' working, the description of it should prove a valuable guide to other technical institutions.

SCARCELY a week passes without an announcement in the American papers of some handsome contribution to higher education from public-spirited citizens. In the last issue of *Science* received we notice that at the commencement of Brown University it was announced that 32,400*l*. had been subscribed for the John Hay Memorial Library, thus securing the additional gift of 30,000*l*. by Mr. Andrew Carnegie. Mr. D. W. Goodspeed, secretary of the board of trustees of the University of Chicago, has announced a gift of 52,000*l*. from Mr. John D. Rockefeller for current expenses for the year beginning July 1. At the recent commencement of Olivet College gifts aggregating 53,000*l*. were announced. Of this amount 43,000*l*. applies toward the Carnegie endowment, leaving only 7000*l*. to be raised to ensure receiving Mr. Carnegie's gift of 50,000*l*. By the will of the late Prof. George A. Wentworth, of Phillips Exeter Academy, 2000*l*. is bequeathed to the academy.

THE new Code of regulations for public elementary schools marks a great advance on similar publications of a few years ago. The detailed schedules of former years, with their minute instructions as to the work of separate standards, are discontinued. Great prominence is given to a few broad educational principles, on which all successful school practice must be based. The new code, in fact, supplemented by the recently published excellent suggestions for teachers, provides just that necessary official guidance which should suffice to enable properly trained teachers to adapt their procedure and curriculum to local conditions and requirements. The tendency exhibited by the central authority to give efficient teachers a freer hand is satisfactory, and we welcome it. A new scheme of arithmetic is included in the Code, and it reflects the movement started by the British Association to eliminate from school arithmetic all fanciful problems of little everyday use, and to introduce practical measurements at an early stage. The scheme in the new Code puts such measurements in the Fifth Standard work, but omits to state definitely in the same section that such practical work with a scale of inches and tenths, or centimetres and millimetres, is the most satisfactory and natural introduction to decimals. Decimals are, of course, included in the scheme, but the apparent omission referred to makes it appear that the study of decimals is to be postponed until vulgar fractions and mensuration have been mastered. Though the formal study of decimals may be deferred until the Sixth Standard is reached, the use of a decimally-divided scale for measurements should certainly form part of the work in the Fifth Standard at least, if not at an earlier stage. Mensuration without decimals is an anachronism; and the Board of Education ought to state, through its inspectors or otherwise, that use should be made of scales divided into tenths, in the measurements of rectangles and rectangular solids, and of triangles, included in the course prescribed.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 14, 1905.—"An Investigation into the Structure of the Lumbo-sacral-coccygeal Cord of the Macaque Monkey (*Macacus sinicus*)." By Mabel Purefoy **FitzGerald**. Communicated by Prof. Francis Gotch, F.R.S.

From the examination of the cross-sections of the lumbo-sacral-coccygeal cord of the Macaque monkey (*Macacus sinicus*), it is seen that:—

(1) The maximum section area of the cord, of the white substance as a whole, as well as of the dorsal and the ventro-lateral columns, is found in the fourth lumbar region.

(2) The maximum section area of the grey substance as a whole, and of the dorsal and the ventral horns, is found in the fifth lumbar region.

(3) Reckoning the cross-sectional area of the cord as 100, the maximum percentage of the white substance as a whole, and of the dorsal and the ventro-lateral columns, is found in the first lumbar region.

(4) The maximum percentage of the grey substance is reached in the first coccygeal region.

(5) Reckoning the total area of the grey substance in each cross-section of the cord as 100, the maximum percentage of the dorsal horns is found in the third coccygeal region, and that of the ventral horns in the fifth lumbar region.

January 18.—"Observations on the Life-history of Leucocytes." By C. E. **Walker**. Communicated by Prof. C. S. Sherrington, F.R.S.

January 25.—"On the Origin of the Sertoli, or Foot-cells of the Testis." By C. E. **Walker** and Miss Alice L. **Embleton**. Communicated by Prof. C. S. Sherrington, F.R.S.

In animals, those cells set aside to produce definite sexual elements go through two divisions, the first and second maiotic (heterotype and homotype) divisions, and are then, without any further division, converted directly into spermatozoa. The same thing happens in the maturation of the ovum. No post-maiotic (post-homotype) divisions have hitherto been recorded.

In plants, on the other hand, after the second maiotic division has occurred, an apparently unlimited number of generations may be produced of cells that have gone through the maiotic phase, and consequently possess only half the somatic number of chromosomes. In the first of the above papers, the occurrence of maiotic phenomena is recorded among the leucocytes and the cells which are their immediate ancestors. According to these observations, after the first and second maiotic divisions have occurred, they are followed by an indefinite number of generations of cells possessing only half the somatic complement of chromosomes. The first maiotic division is preceded by amitosis and mitosis of the somatic character, just as happens in the testes of many animals, if not in all. It must be remembered that in certain plants only a few of the cells which have gone through the maiotic phase ever become sex cells. The others may form tissues having somatic characters and functions. This parallel between certain vegetable cells and leucocytes is carried further by the observations recorded in the second of the above papers.

Here it is stated that at an early stage in the develop-

ment of the testis, before the tubules or pockets are formed, it is impossible to discriminate between the cells destined to become foot-cells and the leucocytes or their immediate ancestors in the same animal.

Among these cells, also, divisions are seen where the chromosome number is half what is found in the somatic cells. The conclusion drawn from this is that the undifferentiated cells which surround the male ova, and which eventually form both the foot-cells and the walls of the pockets or tubules of the testis, are derived from leucocytes or have immediately common ancestors. If these observations be correct, we have, therefore, animal cells which, though reduced, form tissues possessing somatic characters and functions known to happen in plants.

The bearing of these observations upon the cancer problem is obvious when the fusion between leucocytes and tissue cells recorded elsewhere is borne in mind.

May 17.—"Some Physical Constants of Ammonia: a Study of the Effect of Change of Temperature and Pressure on an Easily Condensible Gas." By Dr. E. P. **Perman** and J. H. **Davies.** Communicated by Principal E. H. Griffiths, F.R.S.

(1) The vapour density of ammonia at 0° has been found to be 0·77085 (mass of 1 litre in grams at latitude 45°), previous results being 0·7708 by Guye and 0·7719 by Le Duc.

(2) When the ammonia and the glass vessel were thoroughly dried no appreciable adsorption of ammonia by glass, or condensation of ammonia on the surface of glass, was found to take place.

(3) From density determinations at different temperatures, the coefficient of expansion of ammonia has been deduced as 0·003914 between 0° and −20°, and 0·003847 between 0° and 100°.

(4) From Rayleigh's determination of the compressibility of ammonia and our own value for the density, the molecular weight of ammonia has been calculated as 17·030, and the atomic weight of nitrogen as 14·007.

(5) Incidentally, the density of air free from water vapour *and carbon dioxide* has been determined as 1·2920 (lat. 45°).

(6) The deviation from Dalton's law for a mixture of approximately equal volumes of air and ammonia has been found to be about 1 part in 1000.

(7) The pressure-coefficient of ammonia has been determined, the pressure being atmospheric at 15°. Between 0° and −20° the coefficient was 0·004003, and between 0° and 98° it was 0·003802.

The determination of the vapour pressure of liquid ammonia was repeated at some of the lower temperatures, using *pure* ammonia, in order to obtain an accurate value for its boiling point. From the results, the boiling point of liquid ammonia at 760 mm. pressure was found to be −33°·5 C.

June 7.—"On the Osmotic Pressures of some Concentrated Aqueous Solutions." By the Earl of **Berkeley** and E. G. J. **Hartley.** Communicated by W. C. D. Whetham, F.R.S.

This communication gives an account of measurements of osmotic pressures of aqueous solutions of cane sugar, dextrose, galactose, and mannite. The method adopted is that briefly outlined by us in vol. lxxiii., Roy. Soc. Proc. A gradually increasing pressure is placed upon the solution (which is separated from the solvent by a semi-permeable membrane) until the solvent, which at first flows into the solution, reverses its direction, and is squeezed out. The pressure, when there is no movement of the solvent, is considered to be the osmotic pressure. Owing to the difficulty of determining the exact point at which no movement takes place, and for other reasons, the experiments are carried out so as to enable an observation to be made of the rate of movement of the solvent, both when the pressure on the solution is just below and when just above the turning-point pressure. The osmotic pressure is deduced from these rates. The range of pressures covered by the experiments is from 12 to 135 atmospheres.

A description is also given of the methods adopted for making the copper ferrocyanide membranes, and it is pointed out that with the best membranes, in most cases, a small quantity of solution comes through during the experiment. It is shown that even a small leak causes a considerable lowering of the observed pressure, hence the final results accepted are those where the leak was least.

Attention is directed to the fact that the osmotic pressures of cane-sugar solutions, when measured directly and when calculated from their vapour pressures, agree to within 3 per cent.

Zoological Society, June 19.—Sir Edmund G. Loder, Bart., vice-president, in the chair.—The nudibranchs of southern India and Ceylon, with special reference to the collections and drawings preserved in the Hancock Museum at Newcastle-on-Tyne: Sir Charles **Eliot.** This paper was an attempt to settle the synonymy of various Nudibranchiata of the Indo-Pacific with the help of Kelaart's drawings and the collections made by him and Walter Elliot, and now preserved at Newcastle. It also contained some new information as to the anatomy of several species (particularly *Platydoris formosa, P. papillata, Doriopsilla miniata, Kalinga ornata,* and several Pleurophyllidiidæ).—An account of the Entomostraca taken during a bathymetrical survey of the New Zealand lakes, and a comparison of this fauna with that of the English lakes: Dr. G. S. **Brady.**—A paper dealing with the higher Crustacea obtained during the above-mentioned survey: Prof. C. **Chilton.**—A classification of the Selachian fishes: C. T. **Regan.** The author stated that the Selachii were regarded as entitled to rank, at least, as a well-marked subclass, and he divided them into two principal groups, viz. Trematopnea and Chasmatopnea, the latter including the single order Holocephali.—An account of the polyclad Turbellaria from the Cape Verde Islands collected by Mr. C. Crossland: F. F. **Laidlaw.** The collection shows that, on the whole, the fauna of this region of the Atlantic agrees closely with that of the Mediterranean so far as the polyclads are concerned. The most interesting of the sixteen or seventeen species represented in the collection are, perhaps, a species of Anonymus (of which several specimens were taken) and *Traunfelsia elongata,* gen. et sp. nov. The latter is an elongated form remarkable for the possession of marginal tentacles, which are not usually associated with a long, narrow body in this class. A unique feature in this genus is the presence of a pair of alveolar glands, each with a long duct opening on either side of antrum masculinum. The genus is referred to the Diposthiidæ of Woodworth.—A large unknown marine animal observed off the coast of Brazil during a cruise in the Earl of Crawford's yacht the *Valhalla*: E. G. B. **Meade-Waldo** and M. J. **Nicoll** (see p. 202).

Royal Microscopical Society, June 20.—Dr. Dukinfield H. Scott, F.R.S., president, in the chair.—The structure of some Carboniferous ferns: Dr. D. H. **Scott.** The author pointed out the change which had taken place during the last three years in our conception of the Carboniferous ferns. So many examples of fern-like plants were now known to have borne seeds, or were suspected of having been seed bearers, that comparatively few undoubted ferns were left, and it was questioned whether, at least in the Lower Carboniferous, true ferns existed. One family, the Botryopterideæ, was admitted to be well represented in Lower as well as Upper Carboniferous times, and Mr. Newell Arbor had proposed to establish a group of Primofilices to include this and other primitive ferns of the Palæozoic age. The object of the communication was to give a few illustrations of this ancient race of ferns. The Botryopterideæ were first described, beginning with the type-genus Botryopteris. The genus Zygopteris was next considered. A new genus from the Lower Coal-measures of Lancashire, for which the name of Botrychioxylon was proposed, was then described. Two or three other examples of the family having been noticed, Dr. Scott described certain annulate fern sporangia. The germination of spores within a sporangium was demonstrated, and this sporangium had quite recently been identified as belonging to *Stauropteris Oldhamia.*

Chemical Society, June 21.—Prof. R. Meldola, F.R.S., president, in the chair.—The Cleve memorial lecture: Prof. T. E. **Thorpe**.—The constituents of the essential oil from the fruit of *Pittosporum undulatum*: F. B. **Power** and F. **Tutin**. The results show that the oil contains *d*-pinene, *d*-limonene, esters of valeric, formic and other acids, a sesquiterpene, palmitic acid, and a phenol.—Mobility of substituents in derivatives of β-naphthol: J. T. **Hewitt** and H. V. **Mitchell**.—The decomposition of nitrocellulose: O. **Silberrad** and R. C. **Farmer**. The decomposition products are ethyl nitrate, ethyl nitrite, ethyl alcohol, nitric and nitrous acids, ammonia, formic, acetic, butyric, dihydroxybutyric, oxalic, tartaric, *iso*saccharinic, and hydroxypyruvic acids. Carbohydrates were also present.—Note on gunpowder and bullets made about 1641, recently discovered in Durham Castle: O. **Silberrad** and W. S. **Simpson**. The gunpowder was found to approximate closely in composition to the black powder now used in this country. The ingredients had been merely ground and mixed together. It seems probable that this powder was of Prussian origin.—The constitution of acetone: Miss M. **Taylor**. The results prove that acetone does not behave either towards sodium or Grignard's reagent as *iso*propenylalcohol, $CH_3.C(OH):CH_2$.—Diazo-derivatives of the mixed aliphatic aromatic ω-benzene-sulphonylaminobenzyl amines: G. T. **Morgan** and Miss F. M. G. **Micklethwait**.—Influence of substitution on the formation of diazoamines and aminoazo-compounds, part v.—*s*-Dimethyl-4:6-diamino-*m*-xylene: G. T. **Morgan** and A. **Clayton**.—Improved apparatus for the determination of molecular weights: P. **Blackman**.

Linnean Society, June 21.—Dr. A. Smith Woodward, F.R.S., vice-president, in the chair.—A contribution to the botany of southern Rhodesia: Miss L. S. **Gibbs**. The collections on which the report was based were obtained in August to October, 1905, at the end of the dry season. The air is dry and the sun's rays very strong, temperature from 80° to 90°, so that the country presented a burnt-up aspect, and the trees were bare, except a few evergreens. The veld is systematically burnt, to promote young growth for cattle-food, to the detriment or destruction of trees and shrubs. Distribution of species is wide, and the present paper tends to a confirmation, with many new records. Twenty-three new species are described, amongst the more interesting being the grass *Erianthus teretifolius*, Stapf, and a characteristic Elephantorhiza.—The authentic portraits of Linnæus: W. **Carruthers**. The author recalled the fact that in 1889 he made the subject the chief topic of his address at the anniversary meeting on May 24 of that year; he subsequently visited Sweden, Germany, and the Netherlands to inspect the originals, and read a paper detailing his results at the general meeting held on November 19, 1891; a transcript of his remarks had been prepared, but did not satisfy him, and nothing was published. The approaching bicentenary celebration of the birthday of Linnæus, for which the Swedes have been making extensive preparations, had induced him to revise his old transcript, and add some recently ascertained facts, which he now submitted to the society.—Plantæ novæ Daweanæ in Uganda lectæ: Dr. Otto **Stapf**. Mr. M. T. Dawe, officer in charge of the Forestry and Scientific Department of the Uganda Protectorate, made an expedition from Entebbe, through Buddu and the western and Nile provinces of that territory. His collections were transmitted from time to time to Kew, and his report was issued as a Blue-book (1906, Cd. 2904) last April; it gave an account of his journey, with some rough illustrations of specially noteworthy plants. Much new light is thrown on distribution, and new species are described, amongst them the new genus of Rutaceæ, Balsamocitrus, Stapf, and a new species of Warburgia (Canellaceæ). As an appendix, Mr. Dawe gives a summary of his report on the vegetation of the country traversed.—The genitalia of Diptera: J. **Hopkinson**.—The structure of bamboo leaves: Sir Dietrich **Brandis**.

Physical Society, June 22.—Prof. J. Perry, F.R.S., president, in the chair.—The effect of radium in facilitating the visible electric discharge *in vacuo*: A. A. C. **Swinton**. It has been shown by Edison, Fleming, and others that the passage of the electric discharge *in vacuo* is much facilitated by heating the kathode. More recently it has been shown that the passage of the discharge is still further facilitated by coating the heated kathode with oxides of the alkaline metals. It is generally held that the efficacy of the hot oxides in this direction is due to their giving off negatively-charged ions or corpuscles. The author therefore decided to ascertain whether similar effects could be obtained by painting the kathode with radium, and as radium gives off corpuscles when cold, it was anticipated that it might not be necessary to heat the kathode. Using a continuous current up to 400 volts pressure, this was found not to be the case, the radium having no appreciable effect in producing a visible discharge. When the radium-coated kathode was heated to redness, the radium was found to have a very marked action in facilitating the production of a luminous discharge. Experiments were made which proved that the mere presence of radium in the tube was insufficient to produce the effect, and, furthermore, it was found that the tube would only allow visible discharges to pass in the direction that made the radium-treated electrode the kathode, the tube acting as a unidirectional valve in the same way as do tubes with kathodes coated with oxides.—The effect of the electric spark on the actinity of metals: T. A. **Vaughton**. It has been pointed out by several observers that some metals, such as aluminium, cadmium, zinc, magnesium, &c., although not radio-active in the ordinary sense of the word, yet have the power of affecting a photographic plate. The electric spark has a remarkable influence on this "actinity," in some cases causing an increase, and in others apparently diminishing it. The alteration is not merely momentary, but remains for months. It is, however, quite superficial, and may be removed by slightly rubbing the surface of the metal with emery-paper. In the case of aluminium sparked with gold, the direction of the current does not make much difference in the actinity of the sparked plate, but in the case of other couples the difference is very marked. For example, if a cadmium strip is sparked with antimony, the cadmium being connected with the positive terminal, the cadmium becomes very active photographically, not only on the spot sparked, but all over its surface. If, however, the cadmium is connected with the negative terminal and sparked with a positive terminal of antimony, the cadmium remains very slightly more active than if not sparked at all.—The dielectric strength of thin liquid films: Dr. P. E. **Shaw**. The range of voltage used in the experiments is from 25 to 400, and the corresponding spark-lengths vary from about 0·15 μ to 6·0 μ (μ=0·001 mm.) for the insulating liquids used. The apparatus employed for measuring length is the micrometer designed by the author for measuring gauges (Proc. Roy. Soc., April). The substances used were olive oil, castor oil, linseed oil, rape oil, turpentine, fusel oil, oil of resin, cod-liver oil, neat's-foot oil, paraffin, transformer oil, the homologous series C_8H_{12}, C_8H_{14}, C_8H_{16}, C_8H_{18}, and armacell, ohmaline, and Sterling varnishes. The best insulators are paraffin and transformer oil, though for these, as for all commercial oils, great care was taken to remove water and acid by prolonged heating to 110° C., and treating with potassium carbonate. No simple connection can be traced between specific inductive capacity and dielectric strength.—The effect of electrical oscillations on iron in a magnetic field: Dr. W. H. **Eccles**. In attempting to make precise measurements of the effect of high-frequency oscillations on iron held magnetised by a magnetic field, two main difficulties are met. The one is that arising from the fact that the oscillatory currents induced on the surface of the iron investigated shield the inner layers, and thus make the mass of iron affected a variable quantity. The other difficulty arises in the matter of producing oscillations of determinate and invariable character. The author has endeavoured to meet the first difficulty by using oscillations so feeble that they affected only the outermost layers of the iron wires employed, and these even only slightly. The second difficulty has been met by using the oscillations produced in an open insulated solenoid by a single small measurable spark passed to one end of the solenoid.

EDINBURGH.

Royal Society, June 18.—Dr. Munro, vice-president, in the chair.—A study of the dietaries of students' residences in Edinburgh: Dr. Isabella **Cameron.** The objects of the investigation were to compare the dietary of the middle classes with that of the working classes, which had already been carefully studied, to ascertain how far this diet conformed to the various standard diets, and to investigate the question of the reduction of cost through combination. The dietaries of four men's residences and one women's residency were studied for one week, which was equivalent to 1129 men for one day. The average amount consumed per man per diem was:—proteids, 143 grams; fats, 138 grams; carbohydrates, 511 grams; fuel value, 3973 calories. The expenditure came to fully 1*s.* 2*d.* per day per man, nearly double the cost of the average labouring man's diet. When compared with similar institutions in America, the Edinburgh residences were found to consume more proteid and carbohydrate, but less fat. There was also less waste.—The theory of epidemics: Dr. John **Brownlee.** The growth and decay of an epidemic seemed to depend on the acquisition of a high degree of infectivity at the start, this infectivity being then lost at a rate expressible mathematically as an exponential. This truth was realised by Dr. Farr, but the subject did not seem to have been pursued with any definite scientific aim. Dr. Brownlee had subjected various epidemic statistics to mathematical analysis, and had found that the curves representing their growth and decay could be well represented by Prof. Karl Pearson's curve of type iv. The correspondence was very close, except in the neighbourhood of the vertex. The general conclusion was that the condition of the germ had much more to do with the causation of an epidemic than the constitutional peculiarity of the persons affected at the moment. There was no evidence in favour of the idea that the epidemic ended because of the lack of susceptible persons.—The plant remains in the Scottish peat mosses, part ii.: Francis J. **Lewis.** This part had to do with the Scottish Highlands, the preceding part having discussed the peats of the Lowland Uplands. These Highland peat mosses began later than the Lowland mosses, and did not show the intercalated Arctic condition after the retreat of the ice-sheet. The bottom layers in the mosses in Caithness and Inverness had Arctic plants, but these were lacking in the Skye mosses, which accordingly were shown to have begun still later. The succession of layers was broadly similar to the succession already made out in the Lowland mosses, but in the Highland peats of recent age there were two distinct dry woodland mosses full of trunks of *Pinus sylvestris*, separated by a layer of sphagnum moss. The peat deposits over Scotland thus showed a definite succession of changes which could be correlated with the later stages of the Glacial epoch.

PARIS.

Academy of Sciences, June 25.—M. H. Poincaré in the chair.—The formation of endothermic compounds at high temperatures: M. **Berthelot.** According to the current thermodynamical theories, endothermic compounds can be formed and are stable at high temperatures. The author criticises the experimental observations adduced in support of this view, and concludes that no exact observation has been brought forward establishing, either in principle or in fact, that very high temperatures can cause a reversal of chemical affinity by directly forming endothermic compounds by simple heating.—The generalised problem of Dirichlet and Fredholm's equation: Émile **Picard.**—The radio-activity of gases evolved from the water of thermal springs: P. **Curie** and A. **Laborde.** The data given in a previous paper are corrected, and some additional determinations given for some new springs.—The action of steam upon sulphides at a red heat. The production of native metals: Armand **Gautier.** The sulphides of iron give rise to magnetic iron oxide, sulphuretted hydrogen and hydrogen. In the case of lead sulphide, taken as a type of the sulphide of a metal which does not decompose water, the primary products would appear to be lead, sulphuretted hydrogen and sulphur dioxide, the two latter substances reacting to give free sulphur. Copper sulphide gave copper, sulphur dioxide, and hydrogen. These experimental facts are applied to the consideration of volcanic phenomena.—The condensation of $\beta\beta$-dimethylglycidic ester with sodio-malonic ester. Syntheses of terebic and pyroterebic acids: A. **Haller** and G. **Blanc.** Dimethyl-glycidic ester, heated on the water bath with sodio-malonic ester, gives 4-methyl-2 : 3-dicarboxyl-pentanolide-4, and this, boiled with hydrochloric acid, gives terebic acid, the latter being characterised by its conversion into isocaprolactone and pyroterebic acid.—The external work created by the statical and dynamical actions of the internal work of the motor muscle: A. **Chauveau.**—The treatment of pulmonary tuberculosis by serotherapy: MM. **Lannelongue, Achard,** and **Gaillard.**—The identification of pathogenic Trypanosomes: attempts at diagnosis: A. **Laveran** and F. **Mesnil.** The serum of an animal which has acquired immunity against a particular trypanosome frequently possesses to a high degree specific properties which can be utilised for the identification of trypanosomes. The authors give a detailed account of experiments made in this connection, and show that the application of this method is not without difficulties.—The indication for the anti-tuberculous vaccination of young ruminants by the alimentary canal: S. **Arloing.** Details of experiments on young goats are given from which the author concludes that complete immunisation can be effected by the aid of human or bovine tubercle bacilli, suitably modified, introduced into the alimentary canal.—M. Gernez was elected a member in the section of physics in the place of the late M. Pierre Curie.—The deformation of certain tetrahedral surfaces: G. **Tzitzéica.**—A theorem of algebraic surfaces of the nth order: G. B. **Guccia.**—Differential equations of the second order and first degree the general integral of which is uniform: M. **Gambier.**—Diminution of velocity and change of trim of ships by the reflex action of water on the bottom: E. **Fournier.**—A simplified study of the effects of capacity of alternating current cables: A. **Blondel.**—Interferential photography: the variation of the incidence: polarised light: M. **Ponsot.**—An arrangement permitting of placing simultaneously several prisms in the position of minimum deviation: P. **Lambert.**—A simple method for the study of the movements of metallic vapours in the oscillating spark: G. A. **Hemsalech.** The sparks are blown on one side by a current of air of known velocity, resulting in curved lines in the spectrum, from measurements of which the tangential velocities of the metallic vapours can be determined.—The methods of photographing the absorption lines of the colouring matters of the blood: Louis **Lewin,** A. **Miethe,** and E. **Stenger.** Details of the apparatus used are given. The present note contains no results.—The heat of formation of carbonyl-hydroferrocyanic acid: J. A. **Muller.** The heat of combustion, determined in the calorimetric bomb, was 3444 calories per gram, from which the heat of formation was calculated as -122 cal.—The kathodic phosphorescence of europium diluted with lime. Study of the ternary system lime-gadolina-europia: G. **Urbain.**—The refractive index of substances dissolved in other solvents than water: C. **Chéneveau.** Results are given for solutions of lithium chloride in water, methyl and ethyl alcohols, and in glycerol.—The variations in state undergone by amorphous carbon under the influence of a sudden variation of temperature: O. **Manville.** The variation in state was measured by the alteration in the temperature at which the carbon commenced to give carbon dioxide in a current of oxygen.—The double sulphate of iridium and potassium, $Ir_2(SO_4)_3 . 3K_2SO_4$: Marcel **Delépine.**—The properties of the substances formed by the action of hydrochloric acid upon certain metallic silicides: M. **Boudouard.** These substances contain hydrogen, and may be regarded as mixtures in variable proportions of silicoformic anhydride and silico-oxalic hydrate.—The crystallography of iron: F. **Osmond** and G. **Cartaud.**—The action of oxygen on rubidium-ammonia: E. **Rengade.** The three metals potassium, cæsium, and rubidium, dissolved in liquid ammonia, give in presence of oxygen a white dioxide and a yellow tetroxide. Potassium and cæsium give in addition a dark trioxide, but there is no evidence of the formation of an analogous oxide of rubidium.—Researches on the pyrazolones: new methods of synthesis: Ch. **Moureu** and J. **Lazennec.** The reaction between the arylpropiolic esters and hydrazine, forming

pyrazolones has been extended to the alkylpropiolic esters. The pyrazolones can also be obtained when the ester is replaced by the amide or by the β-oxyalkylacrylic esters obtained from the acetylene compounds by a method described in a previous paper. The theory of the reactions is discussed.—Phenyl migrations in the halohydrins and in the α-glycols: M. **Tiffeneau**.—Cinnamenyl-paraconic acid: J. **Bougault**.—Researches on the relations of functional groups in distant positions: cyclic amines: E. E. **Blaise** and M. **Houillon**. Octamethylene diamine chlorhydrate gives by the action of heat an unsaturated hydrocarbon and a secondary cyclic base. This has been proved to be identical with a synthetically prepared specimen of butylpyrrolidene.—The basicity of the xanthyl oxygen: R. **Fosse** and L. **Lesage**. A description of a series of double salts, of which xanthyl-lead bromide, $CH(C_6H_4)_2O.Br+2PbBr_2$, may be given as a type.—The production of Ascidia by traumatisms: L. **Blaringhem**.—The origin of the materials utilised by the ovary: Jean **Friedel**. The assimilating power possessed by the green carpels of many plants is well known. From experiments on *Ranunculus acris* the author concludes that the ovary utilises both its own products of assimilation and the reserves of the peduncle. If the conditions in which it is placed suppress one of these two modes of nutrition, the ovary can arrive at complete development from the other.—The longevity of seeds: Paul **Becquerel**. Experiments were carried out on 550 species belonging to fifty families, the age of which varied from twenty-five to 135 years. The only seeds preserving their vitality for more than eighty years were those protected by a thick skin and possessing slightly oxidisable reserves.—A disease of the plane tree due to *Gnomonia veneta*: J. **Beauverie**.—Some new Madagascan Asclepiadaceæ producing caoutchouc; J. **Costantin** and I. **Gallaud**.—The biology of the Virgularia: Ch. **Gravier**.—A new form of operculated Cirripede, *Pyrgopsis Annandalei*: A. **Gruvel**.—Prehistoric remains in the neighbourhood of Kayes, Soudan: Fr. **de Zeltner**. The deposits of stone instruments are large, and formed out of rocks still existing in the district. The instruments cannot be classified with any of the usual European types, are highly polished, and show considerable skill in their manufacture. It is impossible at present to fix their age.—A method of isolating the hæmatablasts of the blood in a state of purity: L. Le **Sourd** and Ph. **Pagniez**.—Researches on animal electricity: MM. **Girard** and Victor **Henri**. The *rôle* of the cellular elements in the transformation of certain carbohydrates by the intestinal juice: H. **Bierry** and A. **Frouin**.—The problem of statical work: Ernest **Solvay**. A criticism on a paper of M. Chauveau on the same subject.—The sensibility of the retina for luminous radiations: Milan **Štefánik**. Using a spectroscope with glass prisms and a suitable coloured screen the red end of the spectrum is visible with sufficient clearness for measuring the lines down to λ 3830. The photographic results obtained by M. Millochau with the same apparatus give the same limit. It follows that the retina is sensible for all the radiations which pass the spectroscope.—The use of sodium chloride in the histological impregnation of tissues by silver: Ch. **Achard** and M. **Aynaud**. An experimental proof of the view recently put forward by M. Quinton that the results are due to the presence of sodium chloride in the intercellular spaces, the chloride of silver thus formed darkening in the light.—A method of detecting iron in living tissues: A. **Mouneyrat**.—Study of the transmissibility of tuberculosis by alimentary casein: Marcel **Guédras**. Food products for infants containing dried casein as a base may transmit tuberculosis. Casein dried at a low temperature may still contain the tubercle bacillus.—The extension of the marine invasion of the upper Sparnacian in the neighbourhood of Paris: Paul **Combes**, jun.—The existence of the Cretacean in the Oran schists: MM. **Ficheur** and **Doumergue**.—The Yprés clays of the department of Aisne and the climatic conditions at the Lutetian epoch: Paul **Fritel**.—The trajectory of electric corpuscles in space under the influence of terrestrial magnetism, with applications to the aurora borealis and to magnetic disturbances: Carl **Störmer**.—Two relief maps of Paringu and Soarbele (Southern Carpathians) executed from unpublished topographical sketches: E. **de Martonne**.

CALCUTTA.

Asiatic Society of Bengal, June 6.—Indian meteorites recently acquired by the Geological Survey: L. L. **Fermor**. The crusts of some of them show interesting flow-structures.—(1) Notes on a rare Indo-Pacific barnacle. Remarks on *Conchoderma hunteri*, Owen, which the author, agreeing with Hoek, regards as a variety of *C. virgatum* (Spengler). (2) Contributions to Oriental herpetology. No. 4. Notes on the Indian tortoises. Remarks on some obscure species, with a list of the Indian Chelonia. (3) Notes on the common Hydra of Bengal: Dr. N. **Annandale**. The systematic position of *Hydra orientalis* is discussed, with a description of its anatomy. As the result of two years' investigation, the author concludes that the species is dicœcious, but that sexual reproduction plays an unimportant part in the life cycle.—Rawāts and Merāts of Rajputana: R. C. **Bramley**.—An old reference to the Bhotias: H. **Beveridge**.—Parasites from the Gharial (*Gavialis gangeticus*, Géoffr.): Dr. **von Linstow**. Two new nematodes, each representing a new genus, and a new linguatulid are described. The former were found in the stomach and on the mesentery; the latter in the lungs and trachea.

NEW SOUTH WALES.

Royal Society, May 2.—Mr. H. A. Lenehan, president, in the chair.—Annual general meeting. An address was delivered by the president.—A specimen of diamond in the matrix: E. F. **Pittman**. The specimen was found by Messrs. Pike and O'Donnell in their claim at Oakey Creek, near Inverell. The diamond is a small one, weighing about one-third carat, and the material in which it is embedded is an igneous rock known as dolerite. The dolerite occurs at Oakey Creek as a pipe or dyke, and the specimen is of special interest as throwing some light upon the question of the origin of the diamond.

CONTENTS.