THURSDAY, OCTOBER 25, 1906.

THE GEOLOGICAL HISTORY OF SEA-LEVEL.

The Face of the Earth (Das Antlitz der Erde). By Prof. Eduard Suess. Translated by Dr. Hertha B. C. Sollas, under the direction of Prof. W. J. Sollas. Vol. ii. Pp. vi+556; illustrated. (Oxford: Clarendon Press, 1906.) Price 25*s.* net.

THE first volume of this translation has been previously reviewed in NATURE, and we can renew our congratulations to the translator on her admirable rendering of this great work. Prof. Suess's eloquence depends on his ideas and his poetical imagery, and thus his writings suffer less by translation than those of most men. Doubt may be felt whether some of the proposed equivalents of technical terms, and such words as quer-Andian, will be generally adopted in English. In reading the volume it is necessary to remember that the original was published eighteen years ago. The French translation, edited by M. de Margerie, was brought up to date and illustrated by additional maps; but this edition exactly follows the original, and does not even add the date of its first publication. We are, however, frequently reminded of its age by such statements as that the Arctic Ocean is "of very trifling depth," or that the author cannot hazard a guess as to the structure of the Celebes. In many cases the facts stated are now known to be incorrect; but later research has removed Prof. Suess's difficulties probably more often than it has added to them.

The main purpose of this volume is the statement of the evidence for Suess's contention that continents are never uplifted in mass, and that the occurrence of raised shore lines and horizontal sheets of marine rocks is due to the lowering of sea-level, and not to the raising of the land. Suess, therefore, returns to pre-Playfairian geology, for Playfair maintained that the level of the land is less stable than that of the sea. This apparently improbable conclusion became, owing to the brilliant advocacy of Lyell, the fundamental principle of the Uniformitarian school of geology.

The contrary view was dismissed by Herbert Spencer as one of the gratuitous assumptions of what he called "illogical geology." Nevertheless, it is now advocated by the geologist who has probably the widest general acquaintance with geological literature, and is gifted with a scientific insight that has materially advanced each of the many branches of geology to which he has given his attention.

Prof. Suess's argument is that a continental uplift is impossible. A continent may subside, but it cannot be uplifted in mass. Rocks may be raised locally when uptilted during the formation of a mountain chain; but he denies the possibility of the uniform uplift of widespread masses composed of irregular materials. The sea has certainly encroached at times upon the land, and has at others receded; but instead of these changes being due to the sinking and rising of the land, Suess maintains that they are due to variations in sea-level.

That the sea-level is not uniform is indisputable. It varies from causes which need only to be stated to be accepted. The water is heaped up in places by wind and rivers. Elsewhere it is lowered by rapid evaporation, and the surface is maintained at the lower level by the greater weight of the salter water. Thus the surface of the Mediterranean, according to Suess, is funnel-shaped, the lowest part of the funnel being in the area of especially salt water in the neighbourhood of Crete. Variations in wind and rainfall or in the course of rivers; the reduction in the lateral attraction of the land, in consequence of its denudation; the retardation of an on-shore current by increased friction due to shoaling, may all lead to a local retreat of the sea. Thus Suess attributes a raised beach near Bombay to sedimentation having checked the incoming tide, and thus caused a local depression of sea-level. The apparent effect of these causes on the shore-line would be the same as that produced by an actual uplift of the land. As the retreat or advance of the shore-line may be produced by the oscillation either of the land or of the sea, Suess objects to the usual terminology, which always speaks of the uplift or subsidence of the land. To avoid unproved assumptions he speaks of negative and positive movements, according as the sea-level falls or rises relatively to the adjacent land. Sir Archibald Geikie has suggested terms—the emergence and submergence of the land—which are equally non-committal, and have the advantage of being self-explanatory. The encroachment or retreat of the sea may be a merely local incident or it may be a world-wide phenomenon; in the latter case, Suess speaks of it as a eustatic movement, and explains it as due to an increase or reduction in the capacity of the ocean basins. A negative movement, *i.e.* an emergence of the land, would be caused by an increase in the depth of the oceans by a subsidence of their floor, which lets the water fall away from the land.

This volume may be considered in two sections; in the first chapters Prof. Suess states his heterodox doctrine, and the mass of stratigraphical evidence in its support. In the second section he examines the leading cases relied on by the champions of secular elevation of the land. These two sections of the book appear of unequal value, for they deal with movements of probably different character and origin. The first part describes the great movements of emergence and submergence which are world-wide in their range; Suess's greatest service to geology has been his recognition of this fundamental fact and its consequences. It is a most helpful discovery, and Prof. Suess offers us the only reasonable explanation yet advanced. The evidence is summarised by Suess in chapters ii. to vi. of this volume. Therein he describes and compares in detail the coasts of the Atlantic and the Pacific, and gives a summary of the geological history of the oceans. The striking resemblance in the lithological succession in some of the geological systems in remote parts of the world can only be explained on the assumption that they are controlled by some world-wide agency; this, Suess's fundamental proposition, seems to be supported by the general evidence of stratigraphical geology.

The second division of the subject is the discussion of the leading cases which have been used to prove the actual uplift and subsidence of the land, such as the raised shore-lines of Norway and northern Europe, the bored pillars of the Temple of Serapis, near Naples, the raised beaches around the Baltic, and the submerged peat bogs and forests on the British coasts. Suess examines these cases in detail, and denies that they give any evidence of secular uplift. He rejects what are generally considered some of the best established of geological truths, such as the still progressive tilting of Scandinavia. Suess denies these popular conclusions, and during his argument claims that both Lyell and Darwin mistook kitchen middens for raised sea beaches. Suess examines the evidence in detail for each case, and maintains that the inferences based on it are invalid. The shore-lines of Norway he claims to have been formed along the shores of glacier-dammed lakes. The Temple of Serapis, he maintains, has no connection with secular movements, because it is actually in the breached crater of a volcano. Submerged forests, he points out, may be due to growth behind storm beaches, or on land along a low shore which has sunk by the shrinkage of an underlying water-logged bed. The raised beaches around the inner Baltic he explains by the gradual lowering of the water by the emptying of that sea. The slow emergence of the north Baltic shore is, therefore, according to Suess, the consequence of a climatic change, not of an earth movement; and Suess advances evidence to prove that the level of the southern Baltic has been constant throughout historic times.

The latter part of this volume is perhaps of most popular interest, but it is the least convincing part of the "Antlitz," and perhaps the least essential to Prof. Suess's main position. Suess admits some cases of uplift, as at the Temple of Serapis, and he admits that some of the lower Norwegian shore-lines are true sea beaches. We may accept Dr. Günther's evidence showing that the uplift near Naples was somewhat wider than Suess admitted, or accept a slow uprise of the land near the great lakes of America, without rejecting the doctrine that the major changes in the range of the sea are due to changes in its level. Suess only briefly refers to the phenomenon of isostasy; and the work of Colonel Burrard in India shows that the plumb-line agrees with the pendulum as to the unequal density of the blocks in the earth's crust; and therefore some areas may have been uplifted to restore that hydrostatic equilibrium at which others are still upheld.

The second division of this volume shows that the easy inference that every submerged forest and every raised beach involves a movement of the land is not justified. Suess shows that they can be explained without any assumption of earth movements. Each case must be judged on its merits. We can accept either the explanation of a limited emergence or submergence of the land without rejecting Prof. Suess's main proposition that, in the geological past, the major changes in the range of the sea have been due to variations in its level. J. W. G.

REFUSE DESTRUCTORS.

(1) *The Disposal of Municipal Refuse.* By H. de B. Parsons. Pp. x+186. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1906.) Price 8*s.* 6*d.* net.

(2) *Garbage Crematories in America.* By W. M. Venable, M.S. Pp. x+200. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1906.) Price 8*s.* 6*d.* net.

(1) THE author has not attempted in this book to produce a treatise dealing with the designing of the details for the final disposal of city refuse, but rather to set forth clearly the principles underlying the sanitary and economic handling and destruction of such material. The book owed its origin to certain designs which Mr. Parsons was engaged upon in connection with the disposal of the refuse of the city of New York, and as a result the bulk of the appliances and plant which the author describes are those which are employed in the Empire City, and there is a number of excellent reproductions of photographs of the methods adopted in that city both for collecting and for disposing of the refuse.

In chapter iii. it is shown that the general refuse for which a method of collection and disposal must be provided can be divided into five classes:—(1) ashes; (2) garbage; (3) rubbish; (4) street sweepings; and (5) snow; and tables are given to show the average composition of the first four of these, and the weight which has to be collected annually in a number of selected American cities; in New York the refuse varies from 2·6 lb. to 4·9 lb. per head per diem. The methods of collecting the various classes of refuse are then dealt with, and the author rightly lays stress on the absolute need of arranging the collections at regular intervals, and of the use of properly designed, covered, and water-tight carts; the important problem of cleansing streets crowded with vehicular traffic is also briefly discussed.

In the next two chapters the methods of disposal are taken up, and the various systems in use contrasted and compared; such processes as those of dumping on land or dumping in water should never be permitted; they are hopelessly insanitary; one of the illustrations—"Disfigurement of Beach by Dumping at Sea"—is a striking instance of the abominable results which may arise from such cheap and nasty methods. Mr. Parsons is evidently of opinion that the reduction process (only applicable when the garbage is separately collected), by which oil and grease are extracted and sold, can never be made a paying process, and it seems, therefore, highly undesirable to put up plants of this nature, when they are liable to produce such serious nuisance from foul smells. It is pointed out that the incineration process, which has been such a success in the cities of England and Germany, has so far not been adopted on a large scale in the United States, but the author considers that this method is bound to become more and more common in the States; where it has been a failure it is entirely due to faulty design of the destructors, and to the desire unduly to cheapen first cost.

Undoubtedly the form of civic government in

America, with its frequent changes of administration and its too often objectionable policy of the spoils to the victors, renders such problems as the economic and sanitary disposal of city refuse much more difficult to solve than in the case of the cities of Europe, where the municipal engineering and sanitary staff have much greater influence and powers of control.

(2) Called upon to remedy defects in existing crematories in the United States, Mr. Venable has made a complete study of the principles of design of every type of crematory so far built in the States, and this book is the result. In an introductory chapter the author points out that the crudity of the methods of disposal still in use in many cities is almost incredible, and he traces much of the slow progress of reform in this matter to the frequent changes in the administrative officials. In the second chapter tables are given as to the quantities which have to be collected, and the average composition of the refuse in a few large cities; in four cities in the States the weight per head per annum ranges from 1140 lb. to 1670 lb.

The problem of burning refuse without offence is then taken up, and Mr. Venable insists on the absolute importance of so designing the furnace that a temperature is reached which renders the discharge of odours from the chimney stack impossible. In chapter iv. the various types of crematories are divided up into classes, based on the fact that there is, or is not, some attempt at preliminary drying; each class is then described in some detail, and illustrations are given of a well-known example of each class, and lists of all the patents so far granted in the States for such crematories; the next chapter deals with the cost of working destructors, and the heat available from the products of combustion for steam raising.

In chapter vi. a complete history is given of the building of crematories in the States from 1887, the pioneer year, to the present date, and sectional drawings are reproduced of many of the furnaces which have been put up during that period. Mr. Venable is an advocate for the separate collection of garbage, refuse, and ashes, and, therefore, while quite ready to admit that the destruction of refuse in England, where usually the whole of the refuse is collected in one receptacle, is admirably carried out at the present day, he does not think that the British type of destructor is ever likely to come into extensive use in America; he, however, gives details of some of the tests carried out on Meldrum furnaces in Great Britain. In the last three chapters the materials and methods of construction likely to give the most satisfactory results are discussed, and, lastly, a draft specification is given.

These two books will be extremely interesting to English municipal authorities, because they deal fully with the methods of disposal of city refuse in the United States, methods which differ radically from those in use in our own country, and, while still convinced that we are ahead of our Transatlantic cousins in this important sanitary problem, nevertheless there is much we can learn from them.

SOME RECENT WORKS ON PHYSIOLOGY.

On Carbohydrate Metabolism, with an Appendix on the Assimilation of Carbohydrate into Proteid and Fat, followed by the Fundamental Principles and the Treatment of Diabetes, dialectically discussed. By Dr. F. W. Pavy, F.R.S. Pp. xi+138. (London: J. and A. Churchill, 1906.) Price 6*s.* net.

The Dynamics of Living Matter. By Prof. Jacques Loeb. (Columbia University Biological Series, No. 8.) Pp. xi+233. (New York: The Columbia University Press; London: Macmillan and Co., Ltd., 1906.) Price 12*s.* 6*d.* net.

Geschmack und Geruch. By Dr. Wilhelm Sternberg. Pp. viii+149. (Berlin: Julius Springer, 1906.) Price 4 marks.

DR. PAVY'S new book on carbohydrate metabolism deals with a subject to which he has devoted a long life of study and original research, and his opinions are therefore entitled to the most careful consideration and respect. He treats the subject partly from the physician's point of view, for the disease known as diabetes cannot be properly understood until the nature of the metabolism which the carbohydrates undergo in health is a matter of certain knowledge. Those acquainted with Dr. Pavy's previous writings will be aware that he has never accepted the glycogenic theory of Claude Bernard, and in the present brochure he brings forward fresh evidence of what he regards as its incorrectness. Dr. Pavy also was the first to direct attention to the glucoside nature of the proteids, and this view is also amplified. Most attention, however, will be centred on the new doctrine of absorption he puts forward, and to the important *rôle* in this process which he assigns to the lymphocytes. He supposes that what first occurs is that these cells assimilate nutrient matter and incorporate it in their protoplasm, and subsequently carry it to the tissues. Among other facts in support of this view he directs attention to the great increase in the lymphocytes of the blood after a meal. One imagines this view will not be immediately accepted, partly because it is doubtful whether the lymphocytes are sufficiently numerous, or capable of sufficiently rapid integration and disintegration to bear the burden of the large amount of material which has to be transported, and partly because the acceptance of such a theory will involve the rejection of much recent physiological work in which it has been shown that the food-proteids are broken down during digestion into the small molecules of the amino-acids of which they are composed. Dr. Pavy has produced an interesting and suggestive book, but he has made no experimental attempt to disprove the new ideas of complete hydrolysis of proteids in the intestine which are rapidly gaining credence.

Prof. Jacques Loeb's book is the outcome of a series of lectures he gave at Columbia University in 1902. He has entitled it the "Dynamics of Living Matter," and it is an attempt to explain the phenomena of life on the basis of physical chemistry. Prof. Loeb has

been an arduous worker at this branch of science, and it will be convenient to have in a compact form the outcome of his numerous fuller publications, which it is the object of this book to present. Prof. Loeb's name is best known in connection with the parthenogenesis which he has artificially produced in unfertilised marine eggs, by altering the saline constituents and other physical conditions of the surrounding water. This subject is here given in its most recent developments, but the book naturally contains a good deal in addition. We may regard the work as a useful counterblast to those who term themselves neo-vitalists. It can hardly be considered the last word on the subject. Physical chemistry in relation to inorganic material is in a state of flux, one theory displacing others with startling rapidity. It is, therefore, a little early to apply it to organic and living substances with any hope of obtaining universal acceptance of the theories put forward. The speculations indulged in are interesting, and the facts will settle down into their proper places later on.

The third book in this physiological batch relates to a small corner of physiological inquiry, namely, taste and smell, and mainly the former. Dr. Sternberg has devoted attention to this sub-branch of a branch of physiology, and has produced a readable pamphlet. It is, however, a little difficult to understand why books should be written with such limited scope, and it is doubtful if they are really needed.

MATTER AND RADIO-ACTIVITY.

The Electrical Nature of Matter and Radio-activity. By Prof. Harry C. Jones. Pp. ix+212. (London: Archibald Constable and Co., Ltd., 1906.) Price 7*s.* 6*d.* net.

THIS book consists of a series of articles, written in semi-popular style, reprinted from the *Electrical Review*. The first third of the book is occupied with the electronic theory of matter, and follows the usual popular lines. The subject is treated only from what may be called the Cavendish Laboratory point of view, and, in fact, we read that we owe the whole electronic conception to Prof. J. J. Thomson. The optical and spectroscopic foundations for the theory are omitted, and the names of Larmor, H. A. Lorentz, and Zeeman are not mentioned.

It is difficult to attempt to review this part of the book, for if the reviewer has interpreted a recent paper by Prof. J. J. Thomson aright, the view that the constituent electrons of an atom are present in sufficient numbers to contribute any appreciable part of its mass appears to have been disproved. Here, however, we read:—

"There is one point at least brought out so clearly that there can scarcely be any question about it, and that is that matter is a pure hypothesis."

And again:—

"The atom according to this theory is *very complex*. Take, for example, the atom of mercury. This contains somewhat more than 150,000 electrons, and some of the heavier atoms are even more complex."

The author, by thus presenting so dogmatically and literally the speculations which have centred around the electron as the basis of matter, has directed attention away from the solid experimental work on which our knowledge of the nature of electrons rests. It is this work, and not the sweeping electronic hypothesis, which is connected with radio-activity. But for the pioneer work on the ionisation of gases done in the Cavendish Laboratory and elsewhere, the electrical method of radio-active measurement could not have reached its present perfection, and it is safe to say that, deprived of this method, radio-activity would have advanced but slowly. But whether the atom of mercury has 200 or 150,000 electrons is a question which fortunately has nothing to do with the very fundamental and independent conclusions of the nature of matter formed from radio-active evidence.

Radio-activity, the second topic, is started in chapter v., and with the remainder of the work and the mode of treatment no exception can be taken, except that it is not very up-to-date. The last chapter, which is entitled "Most Recent Work in Radio-activity," attempts, however, to accomplish this.

The book as a whole gives a comprehensive and interesting survey of the radio-activity of matter as it is interpreted by the disintegration hypothesis. Perhaps the best chapters are those dealing with the reproduction of radio-active matter and the theory arising therefrom. Here the chemical training and point of view of the author are in evidence, and the significance of the continuous reappearance of the products of change after complete removal by chemical or other means is very clearly brought out.

Attention may be directed to some inaccuracies and errors of minor importance. The author does not seem very clear about the nature and properties of the γ rays. We learn that their power to affect the photographic plate is much greater than that of the β or even the α particles, an error which is frequently repeated. Their origin is ascribed to the *impact* of β rays on solid matter rather than to the acceleration of the β particle during *expulsion*. In the experiment of causing, by means of a glass tube containing radium, a discharge to pass between two points just so far apart that ordinarily the spark fails, most of the ionisation from the glass tube is ascribed to the γ rays. It is safe to say that if the glass were as thick as this the experiment would fail. The statement that the emanation can be condensed at low temperatures like an ordinary gas into a *liquid* is obviously a slip, for a little later we read that no liquid or even mist will be seen. Twice later, however, the statement is repeated, and liquid appears a loose word for non-gaseous. The β rays are ascribed little power of exciting phosphorescence, and the effect on a platino-cyanide screen is said to be greater for α than for β and γ rays. F. S.

OUR BOOK SHELF.

Résistance, Inductance et Capacité. By M. J. Rodet. Pp. x+257. (Paris: Gauthier-Villars, 1905.)

THIS book is devoted entirely to the three subjects which form the title, and it has evidently been the author's aim to include everything within the limits mentioned likely to be of use to engineers or physicists.

As a whole the author has succeeded, and has produced a valuable book of reference. The subjects are treated in the order mentioned. Under the heading of resistance, in addition to the usual constants, information is given as to the conductivities of insulators, solid and liquid, and the insulation due to a film of oil between a rotating shaft and its bearings. An account is given of the various rectifiers, including the Cooper-Hewitt.

Under the heading of inductance a full and clear statement is given of the usual phenomena, and the various methods of calculating coefficients of self- and mutual inductance are explained, but no mention is made of a rectangular coil such as is used in certain instruments of the dynamometer style. The inductance of cables is also studied, and a reference is made to the apparent increase of resistance of conductors traversed by alternating currents, but no mention is made of the internal self-induction of an iron rail, which is an important factor in the application of alternating currents to electric traction.

The initial portions of that part of the book which is devoted to the study of capacity follow the ordinary methods of exposition. Tables of specific inductive capacity of various substances are given, and information is presented as to the variation of this property with temperature. Following this, the distribution of the potential in a compound condenser is described, as, for instance, in a condenser in which the dielectric is composed of two plates of glass separated by a layer of air. (This matter is of practical importance in the building of high-voltage machines, as brought out by Messrs. Hobart and Turner in their recent book on insulating materials.) A brief reference is made to the electrodynamic condenser proposed by Mr. Swinburne, and a section is devoted to the study of capacity effects due to cables and overhead transmission lines.

The book would have been more complete if the researches of the late Dr. John Hopkinson had been referred to as to the specific inductive capacity of materials at very low temperature. For practical men, however, this volume contains almost everything that they are likely to want, and to them it can be thoroughly recommended.

Natural Phenomena. A Collection of Descriptive and Speculative Essays on some of the By-paths of Nature. By F. A. Black. Pp. xiv+366. (London and Edinburgh: Gall and Inglis, n.d.)

IN this book Mr. Black offers some essays which might well be of value to the student of physiography. Treatises on this subject are usually crammed very full of facts, and more interest might be awakened and a wider horizon opened to the student, if he reads such a work as this in connection with the ordinary text-books. There are ten essays altogether; four deal with some points connected with our own atmosphere, and four discuss problems of elementary astronomy, arising mainly from the motion of the earth on its axis. The remaining two treat of the Sargasso Sea and the Zodiacal Light with its allied phenomena. These seem to be highways rather than by-paths.

It would not be correct to say that Mr. Black is always exact in his descriptions; he is apt to be somewhat loose, and his book suggests that he has not consulted the most recent authorities. But he is never so far wrong as to be misleading. He may puzzle the student by apparent contradictions, due to the introduction or exclusion of circumstances which can exercise an important influence upon the point under consideration. Particularly would we caution the student to beware of those explanations for which the author himself is responsible, and in which he seeks to remove difficulties that have not yet received a satisfactory solution. An example will be found in the discussion on the semi-diurnal barometric inequality. The author seems, too, to have lost his way in the chapter on weather cycles; but the book is calculated to arouse interest, to stimulate curiosity, to promote further study, and on these grounds one may welcome its appearance. The illustrations are generally effective, and a very good index accompanies the book.

A Text-book of General Zoology. By Dr. Henry R. Linville and Dr. Henry A. Kelly. Pp. x+462; illustrated. (London and Boston: Ginn and Company, 1906.) Price 7*s.* 6*d.*

THIS addition to the long shelf of text-books of zoology has some fresh features. Practical experience has led the authors to begin with the Arthropods, work down to the Protozoa, and then ascend the vertebrate series. The study of insects has been found the best introduction to the broad problems of zoology, and in the earlier chapters a modified inductive method is pursued. About half-way through the book, after the student has become familiar with systems of organs, he is introduced to physiological principles, illustrated with special reference to the earthworm. Throughout the book prominence is given to the study of animal behaviour and the environmental conditions. Thus there is a feeling of fresh air through the chapters. The authors have reacted from the position of identifying zoology with comparative anatomy, and the introduction to the science which they have presented seems to us, not only interesting, but educationally wholesome. Most of the illustrations are original, and many of them are beautiful.

Science Readers. Book VII. By Vincent T. Murché. Pp. 299. (London: Macmillan and Co., Ltd., 1906.) Price 1*s.* 9*d.*

Object Lessons in Elementary Science. Stage VII. By Vincent T. Murché. New and revised edition. Pp. xvi+322. (London: Macmillan and Co., Ltd., 1906.) Price 2*s.*

THESE books deal with elementary physics. The first is intended for pupils to read in class, lesson by lesson, after they have attended an explanatory and experimental demonstration from the teacher on the subject in hand. The second book contains notes of lessons designed only for the use of teachers. The notes are accompanied by helpful advice, blackboard sketches, and many other evidences of the wide experience of the author. Both volumes are attractively illustrated and well printed, though it may well be doubted if the bewildering profusion of types in the second book adds to its helpfulness. The author is a master of simplicity of expression, and the information he supplies is, as a rule, trustworthy. The books deserve the careful consideration of teachers of very elementary classes.

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.]*

Absorption of the Radio-active Emanations by Charcoal.

THE interesting property of certain kinds of charcoal, notably that of the cocoa-nut, of rapidly absorbing gases, except the inert gases belonging to the argon family, is now well known since the recent experiments of Sir James Dewar.

In a recent investigation I had occasion to pass the radium emanation through a tube filled with cocoa-nut charcoal, and was surprised to find that the emanation was completely absorbed by it. If a slow current of air, mixed with the emanation of radium, thorium, or actinium, is passed through a tube filled with charcoal, the issuing gas is completely deprived of emanation. This occurs at ordinary temperatures, and there is no necessity for initial cooling of the charcoal. This property of charcoal of absorbing the radium emanation can be shown by a very simple and striking experiment. If a side tube containing a fraction of a gram of charcoal is attached to a vessel containing the emanation released from several milligrams of radium bromide, in the course of time the emanation is absorbed by the charcoal. At ordinary temperatures, several hours or days, depending on the size of the vessel, are required to effect a complete absorption as the emanation diffuses slowly through the air. If some powdered willemite is added with the charcoal, the gradual absorption of the emanation is shown by the increasing brilliancy of the phosphorescence produced in the surrounding willemite.

It makes no difference whether the charcoal has been initially heated to get rid of the absorbed air or whether it has already absorbed its full quantity. At low pressures of the gas, using charcoal which has been previously heated, the removal of the emanation takes place rapidly. This is probably due to the rapid absorption of the gas which carries the emanation with it. The charcoal retains the emanation at ordinary temperatures, for I have found that the emanation retained in a charcoal tube open to the air loses its activity at the normal rate observed in sealed vessels.

The greater part of the emanation is released by heating the charcoal below a red heat. I have not yet settled whether the release of the emanation is due to an alteration in the absorptive power of the charcoal for the emanation at high temperatures, or whether the emanation is mechanically carried away by the rush of air which takes place when the charcoal is heated.

Since the emanations behave like inert gases of the argon family, it is somewhat surprising that charcoal should so readily absorb them. It must be remembered, however, that in ordinary experiments a very minute quantity of the emanation is present, and it is not unlikely that even the gases argon and helium are absorbed by charcoal to a small degree.

This property of charcoal of retaining the emanation promises to be of service in laboratories where radium is kept in a state of solution. It is dangerous to keep radium in the form of solution in sealed vessels, as the gradual production of hydrogen and oxygen in the solution raises the internal pressure, which would ultimately lead to the bursting of the vessel. At the same time, the escape of the emanation causes a radio-active contamination of the laboratory which renders delicate experiments on radio-activity or ionisation very difficult.

This problem will be solved by the use of a small tube containing cocoa-nut charcoal attached to the vessel, with one end open to the air. The air inside the radium vessel is kept at atmospheric pressure, while the emanation is completely stopped in the charcoal. The emanation mixed with a small quantity of gas can at any time be obtained from the charcoal by heating.

Experiments are in progress to test whether this property of charcoal can be utilised to determine quantitatively the amount of radium emanation existing in the air, and also the amount of emanation diffusing to the atmosphere from the soil.

E. RUTHERFORD.

McGill University, Montreal, October 6.

The Recent Radium Controversy.

I WAS absent from Montreal during the time of the interesting discussion on radium which appeared in the *Times*, and it is only quite recently that I have had an opportunity of reading the correspondence in full. In the course of this discussion some weight has been attached to a remark in the second edition of my book "Radio-activity," viz. that radium is a compound of helium and lead. It is far from my intention to reopen this discussion, on which I think quite enough has already been said, but in the last issue of NATURE (September 27) which I have just received, there appears a letter by Lord Kelvin in which this remark is still further emphasised.

Lord Kelvin quite correctly quotes my words, but I feel that the statement, apart from its context, is liable to leave an erroneous impression of my views on the question, especially in the minds of those who are not directly acquainted with my writings.

At the risk of being somewhat lengthy, I should like to quote fully some statements made in my book which, I think, clearly show my attitude on this question.

V. p. 482 :—"In order to explain the presence of helium in radium on ordinary chemical lines, it has been suggested that radium is not a true element, but a molecular compound of helium with some substance known or unknown. The helium composed gradually breaks down, giving rise to the helium observed. It is at once obvious that this postulated helium compound is of a character entirely different from that of any other compound previously observed in chemistry. Weight for weight, it emits during its change an amount of energy at least one million times greater than any molecular compound known (see section 249). In addition it must be supposed that the rate of breaking up of the helium compound is independent of great ranges of temperature—a result never before observed in any molecular change. The helium compound in its breaking up must give rise to the peculiar radiations and also pass through the successive radio-active changes observed in radium.

"Thus in order to explain the production of helium and radio-activity on this view, a unique kind of molecule must be postulated—a molecule in fact which is endowed with every single property which on the disintegration theory is ascribed to the atom of the radio-elements. On the other hand, radium, as far as it has been examined, has fulfilled every test required for an element. It has a well marked and characteristic spectrum, and there is no reason to suppose that it is not an element in the ordinarily accepted sense of the term.

"On the theory that the radio-elements are undergoing atomic disintegration, the helium must be considered to be a constituent of the radium atom, or in other words, the radium atom is built up of parts, one of which, at least, is the atom of helium. . . ."

P. 483 :—"Taking the view that the α particles are projected helium atoms, we must regard the atoms of the radio-elements as compounds of some known or unknown substance with helium. These compounds break up spontaneously, and at a very slow rate even in the case of radium. The disintegration takes place in successive stages, and at most of the stages a helium atom is projected with great velocity. This disintegration is accompanied by an enormous emission of energy. The liberation of such a large amount of energy in the radio-active changes at once explains the constancy of the rate of change under the action of any of the physical and chemical agencies at our command. On this view, uranium, thorium, and radium are in reality compounds of helium. The helium, however, is held in such strong combination that the compound cannot be broken up by chemical or physical forces, and, in consequence, these bodies behave as chemical elements in the ordinarily accepted chemical sense.

"It appears not unlikely that many of the so-called chemical elements may prove to be compounds of helium, or, in other words, that the helium atom is one of the secondary units with which the heavier atoms are built up. In this connection it is of interest to note that many of the elements differ in their atomic weight by four—the atomic weight of helium.

"If the α particle is a helium atom, at least three α particles must be expelled from uranium (238·5) to reduce its atomic weight to that of radium (225). It is known that five α particles are expelled from radium during its successive transformations. This would make the atomic weight of the final residue 225−20=205. This is very nearly the atomic weight of lead, 206·5. I have for some time considered it probable that lead is the end or final product of radium. The same suggestion has recently been made by Boltwood."

Then follows a discussion of the evidence on which this suggestion is based.

I think that the above quotation makes my position clear on this subject. E. RUTHERFORD.

McGill University, Montreal, October 11.

Radium and Geology.

THE Hon. R. J. Strutt has advanced weighty reasons in favour of supposing radium to be confined to a certain shallow layer over the surface of the earth. To assume, however, that a heavy element is thus restricted in distribution appears to me to present difficulties. It would appear that an *a priori* probable reason why uranium should disintegrate more rapidly near the surface than at greater depths would bridge over the difficulty, and, if for that reason only, would deserve attention.

I think such a reconciliation of observational facts with the probabilities involved would be found in the view that the break up of uranium is not entirely spontaneous, but is partly secondary in character, *i.e.* that disruption of an α particle from an unstable atom may precipitate the failure of neighbouring atoms, as Prof. J. J. Thomson has suggested might happen in the case of radium. If this be the case, and we assume that the uranium is in general distributed in random aggregates throughout the earth, a reason is at once forthcoming for Mr. Strutt's results. The lighter constituents in the outer crust—aluminium, silicon, oxygen—exert a lesser screening action than the heavy metals deeper down. The conflagration is, as it were, isolated where the heavier metals interpose to absorb the energy of the α ray which initiates the changes leading to radium. It is probable that if the absorption is adequate to reduce the kinetic energy below a certain critical amount, there would be no propagation of disruption.

The remarkable fact observed in Mr. Strutt's experiments that radium is more abundant in the heavier silicates of plutonic rocks than in the lighter is not opposed to this view, but rather in keeping with it; and the absence of detectable radium in metallic meteorites need not be occasioned by the absence of uranium, but by the slower breakdown of the latter.

I cannot claim to speak authoritatively on the literature of this subject, but I can recall no other experiments bearing on this matter than those quoted by Prof. Rutherford in the last edition of his "Radio-activity." The case of uranium does not appear to have been investigated. Prof. Rutherford records an experiment in which he dissolved some pure radium bromide in 1000 times its bulk of a solution of barium chloride, and found no change in the γ radiation. I venture to suggest that this experiment is not conclusive. Increasing the volume 1000 times increases the average distance of the molecules but ten times, even were these fixed in the medium. This leaves the intervening distances still of the order of millionths of a centimetre. The heaviest metal brought to such tenuity would exert no appreciable screening influence, even from the α rays, to say nothing of more penetrating radiations. Mr. Eve's experiments, which are also quoted by Prof. Rutherford, are not, I think, to the point.

As cosmical effects of the greatest interest are involved, I think the question of how far radio-active effects are spontaneous deserves full investigation, and I think more especially with regard to the primary step, the generation of radium from uranium. If this is dependent on the matrix and on concentration, entirely new considerations arise.

It is not impossible, in the present meagre state of our knowledge, that the penetrating radiations observed at the surface of the earth have to do with the genesis of radium from uranium, the failure of such rays to penetrate deep into the crust limiting the production. The suggestion is continuous with that advanced above. J. JOLY.

Geological Laboratory, Trinity College, Dublin.

IN reply to Mr. O. Fisher's interesting letter of October 11 in this Journal under the above heading, it may be suggested that, though a state of stable thermal equilibrium exists now in the earth, it did not in the past, and that the earth has cooled down from a great initial temperature. We are, however, met with this difficulty, that the movements of the crust have been enormous in *late* geological times, as shown in the great mountain ranges of Tertiary date. This seems to be a fact entirely antagonistic to the suggested explanation.

No doubt some of the current geologico-dynamic theories will go to the wall should Mr. Strutt's interesting researches be confirmed, but I am of opinion that his work will ultimately prove helpful to sounder ideas of the origin of earth structure. T. MELLARD READE.

Park Corner, Blundellsands, October 13.

THE age of the great mountain ranges mentioned above by Mr. Reade, though comparatively late, is much earlier than that of the changes of vertical level investigated by Prof. Hull and Dr. Spencer to which I referred. They are evidenced by the drowned plains bordering the Atlantic on both sides, and by the deep cañons in them which are the continuations of existing river channels. These changes of level are considered to be of Pliocene or early Pleistocene date, and, therefore, geologically very recent. Godwin Austen came to a similar conclusion about the English Channel.

I thank Mr. Strutt for noticing (p. 610) my letter in NATURE of October 11. The fact of uranium not having been recorded in analyses of the rocks, as referred to by Mr. Strutt, has occurred to myself, but not being a chemist I have not alluded to it. But it seems to me that there ought to be an appreciable store of uranium present, large in proportion to the radium it is producing, if the latter is not permanent. That there is not appears to indicate that the disintegration of the radium, and therefore the escape of heat from it, is in some way checked in the earth's crust, as suggested by Mr. Rudge in his letter to the *Times* of August 18, and that consequently the temperature gradient is not due to radium in the crust, but to the cooling of the interior. I think it is in this direction that we must seek for a reconciliation between radium and geology.

Graveley, Huntingdon, October 19. O. FISHER.

Meteorological Data.

I SHALL be glad if you will enable me through your columns to make known to those interested in the collection of meteorological data the following information.

A number of copies of the Cape of Good Hope Magnetical and Meteorological Observations, vol. ii., "Meteorological Observations, 1841–6," have been placed at my disposal by the Controller of H.M. Stationery Office for distribution. The volume contains hourly observations, for each day, of pressure, temperature, and humidity, with a journal of other meteorological data.

I shall be glad if any scientific institution or library which desires a copy will be good enough to communicate with me upon the subject at the Meteorological Office, 63 Victoria Street.

I have also available for distribution in a similar manner a few copies of the following works:—

"Meteorological Observations taken during the Years 1829 to 1852, at the Ordnance Survey Office, Phœnix Park, Dublin, . . . and Other Places in Ireland."

"Abstracts from the Meteorological Observations taken at the Stations of the Royal Engineers (including 15 Colonial Stations) in the Year 1853–4, with Notes on Meteorological Subjects."

"Abstracts from the Meteorological Observations taken at the Stations of the Royal Engineers (comprising 13 British and 18 Colonial Stations) in the Years 1853–4, 1854–5, 1855–6, 1856–7, 1857–8, and 1858–9."

"Abstracts from the Meteorological Observations taken in the Years 1860–61, at the Royal Engineer Office, New Westminster, British Columbia."

These volumes will be issued without payment.

I may also mention at the same time that the Meteorological Committee, acting in accordance with the recommendation of the fourth International Conference on Scientific Aëronautics, has undertaken to subscribe for a number of copies of the international publication of the observations of the upper air on the "international days," which will be issued by Prof. Hergesell, the president of the commission. I shall be glad to know whether any scientific institution or library wishes to subscribe for a copy of this publication. The amount of the subscription is 1*l.* per annum. W. N. SHAW.

The Breeding Habits of the Tsetse-fly.

I SHOULD be greatly obliged if you could find space in your columns for the following extracts from a letter which I have received from my friend Dr. A. G. Bagshawe announcing the discovery, I believe for the first time, of the pupæ of the tsetse-fly (*Glossina palpalis*) in nature. As this species of fly is now known to be the agent which disseminates the infection of sleeping sickness, any discoveries relating to its breeding habits are of the utmost importance from the point of view of devising measures for extirpating the fly or checking its increase. Together with my colleagues Lieuts. Gray and Tulloch, I spent a great deal of time, when I was in Entebbe, in searching for the pupæ of the fly, and we offered the native boys a rupee each for them, but all our efforts to find them in nature were unsuccessful, although captive flies deposited great numbers of pupæ in our cages. I ought, perhaps, to explain at this point that the tsetse-fly is viviparous, and produces a full-grown larva, one at a time; the larva is of a light yellowish tint when born, and wriggles about actively for an hour or so, and then turns in a short time to a dark brown pupa, about the size of a grain of wheat.

Dr. Bagshawe, who is already well known for the botanical collections he has sent home, has succeeded where we failed, and as I do not know what steps he has taken to secure the priority for this most important discovery, I hasten to make it public on his behalf. It will be seen that the pupæ have been found in the banana plantations. Since bananas are the staple food of the Baganda, it would be impossible to destroy the plantations without creating a famine. I may mention, however, that we found the tsetse-fly swarming on the deserted island of Kimmi, on the Victoria Nyanza, where there were no plantations, so that this is perhaps not its only breeding place.

E. A. MINCHIN.

Lister Institute of Preventive Medicine, October 17.

(*Extract from Dr. Bagshawe's Letter.*)

"On August 29 I got them [the pupæ] at last. I had marked down a particular spot as likely, and had pitched my camp near by to search. Along the lake shore for about 100 yards was a belt of bananas 10–20 (40?) yards in width, and behind that undergrowth, going back 100 yards or more. Fly were thick and bothered one up to sunset.

"On the second day one of the porters I had coached brought me a pupa while I was searching a hole in a tree. He had found it among the banana rootlets. I searched there at once, and soon found some empty pupa cases. The next day I had a lot of my people at work and 53 pupæ were found, all in the loose crumbling soil round the bananas. In the scrub behind there are none to be got. . . .

"I made a series of experiments lately to find out how long a stretch of river the individual fly haunts. I started on the assumption that a fly with five legs is as good as one with six, and if one snipped off a piece of a known leg that fly could be identified when caught again. Six series of experiments could be made. It worked admirably. The experiments want repeating on a larger scale (I hope to do it on the Semliki), but I have shown clearly that the range is *at least* a mile. This is the reason why the breeding places have eluded search so long.

"(Signed) ARTHUR G. BAGSHAWE.

"Albert Edward Lake, September 1, 1906."

Suspended Germination of Seeds.

IN Mr. Claridge Druce's letter in NATURE of October 11 he rightly remarks that in order to prove the suspended germination of seeds over long periods, instances are required in which the factors of wind-carried seeds, &c., can be with some certainty eliminated. The following case, though not absolutely conclusive, may still be of interest.

Personally I am of opinion that the seed of Digitalis does preserve its germinating power for a considerable time. A few years ago I cleared a space, speaking from memory, of say forty yards by thirty yards, occupied by old Portugal laurels 25 feet to 30 feet high, planted fully sixty years ago, with *Rhod. ponticum* lining the path in front; the space, except on the path side, is surrounded by thick coverts. The nearest growing foxgloves were to the west along a 6-feet path running parallel with the long side of the cleared area, and distant, say, ten yards; both sides of this intervening space are lined by old rhododendrons; seed blown along would fall on the path or the edge of the clearing. The laurels were removed in January and February, when all, or nearly all, the seed would have been shed. Notwithstanding this, the next spring the whole of the cleared ground was covered with a uniform carpet of seedlings, practically hiding the bare ground. It seems to me that, even if some wind-blown seed penetrated the evergreen barrier, the seedlings would have appeared in patches.

I have known many other somewhat similar instances, but none quite so specialised as the above. I may add that the spot is exceptionally protected from wind, having tall forest trees on all sides.

ARCHIBALD BUCHAN-HEPBURN.

Smeaton-Hepburn, Prestonkirk.

Biometry and Biology.

OWING to the proof of my letter in last week's NATURE reaching me too late for careful revision, one or two slips escaped notice. Of these, I would wish to direct attention to the interchange of the words *intra-racial* and *inter-racial* in the second paragraph on p. 609 (column 1, line 14).

KARL PEARSON.

Biometric Laboratory, University College, London, October 19.

SPEED AND STABILITY IN RAILWAY TRAVELLING.

THE Salisbury railway accident, being followed after no very long period by the somewhat similar disaster at Grantham, undoubtedly raised a feeling of considerable uneasiness in the public mind. The recent publication by the Board of Trade of Major Pringle's report on the former calamity should do something to allay this apprehension, if only because it shows that the cause of the derailment of the train was not "mysterious," but is fully to be explained. That the evil we know is less alarming than one which vaguely threatens is a fact for which we have classic authority.

The accident occurred on July 1 at the Salisbury Station of the London and South-Western Railway, the train being the special boat express from Plymouth to London, carrying passengers who had arrived by the American liner *New York*. The train consisted of four eight-wheeled vehicles hauled by a four-

coupled engine with a leading bogie, having an eight-wheeled bogie tender. The coaches were not of excessive length, the longest being 48 feet, and all were on bogies; the engine was one of the company's usual modern express type, and although the boiler is mounted higher than was formerly the practice, the train was well calculated to run safely round curves under usual conditions: yet it was a curve that caused the accident. In saying this we are not verbally in agreement with Major Pringle's report or with the verdict of the coroner's jury at the inquest on the unfortunate victims, both of which attribute the accident to excessive speed. No doubt the speed at which the curve was taken was too high, but if the curve had not been so sharp the speed would have been perfectly safe; in fact, it was the curve which was the abnormal feature, the speed being ordinary for ordinary conditions. It may seem like splitting hairs to cavil over terms in this manner, but the matter has greater significance than may appear. If we allow the accident to have been due simply to speed, then the railway authorities have done all that they can do when they order drivers—as they always have done—to reduce speed to within safe limits; but if it is stated that the accident was due to excessive curvature of track, then the company will appear not to have done all that is possible until they flatten the curve. Whether the danger warrants the expenditure is another matter, but we may remember that so long as drivers are human and liable to err, the chance of disaster is always present whilst such an abnormal curve exists on a main line over which express trains run; in other words, if the Salisbury curve did not exist accident from the same cause would be impossible.

Speed is always a doubtful point in the elucidation of the cause of accident, but there is no doubt, from the evidence at the inquest and the Board of Trade inquiry, that the train was travelling very greatly in excess of the thirty miles an hour laid down by the regulations as safe for the curve immediately to the east of Salisbury station. One witness estimated the speed to have been as high as seventy miles an hour, and Major Pringle considers that possibly this may not have been an extravagant estimate. When the engine and tender left the line it came into violent contact with a milk train moving on the down line, and the wreckage also struck a light engine standing in a bay close by. Particulars of the loss of life have been fully published, and it will be sufficient to say that on the express twenty-four passengers were killed, seven were seriously injured, the engine-driver and fireman were killed, and a ticket collector and two waiters on the dining car were injured. The guard of the milk train and the fireman of the light engine were also killed, and the driver was badly scalded.

The chief interest of Major Pringle's report, as in all reports of this nature, centres in his conclusion as to the probable cause of the accident. Speaking at large, there is no doubt, as we have stated, but that the disaster was due to high speed on an awkward curve, and the evidence all points to the fact that the engine and tender turned over bodily; how the forces set up acted so as to bring about the result is the problem that remains to be solved.

According to the plan of this part of the line, given in the report, the up line is straight through the station, but at the eastern end of the platform a curve to the left of ten chains radius (compound) extends for a distance of about ninety-two yards. In the body of the report is a statement attributing a radius of eight chains to the curve, this representing the sharpest part of it. There is a rising gradient of 1 in 158, and the maximum superelevation on the curve is 3½ inches. It was on this part of the line that the accident occurred, the overturned engine being found at the termination of the curve, and just in front of facing points with reverse curves of 7½ chains radius; naturally there could be no superelevation at the points. The report states that the three leading vehicles of the express were overturned in various directions, the frames stripped of woodwork and completely destroyed. The fourth vehicle fared little better. Comparatively little damage was done to the last vehicle, which came to rest in an upright position, with the last pair of wheels on the proper rails. The engine and tender were both overturned on their right sides, but less damage was done than might have been expected, and the engine was shortly afterwards hauled to Nine Elms on its own wheels. Five vans of the milk train were completely destroyed, and five were damaged. This destruction of rolling-stock was accompanied by remarkably little damage to permanent way on the up line over which the express was running, but a length of about forty yards of the down line was torn out and destroyed.

The weight of the engine was nearly 54 tons (53 tons 19 cwt.), 16 tons 17 cwt. being on the leading bogie, 19 tons 2 cwt. on the leading driving axle, and 18 tons on the trailing axle. The tender weighed 44 tons 17 cwt., 23 tons 2 cwt. being on the leading bogie, and 21 tons 15 cwt. on the trailing bogie. The centre of gravity of the engine was calculated at about 5 feet above the rail-level, and that of the tender at about 4¾ feet.

So far we have most of the chief data generally at command for calculating what would be the limit of safe speed for travelling over the part of the line where the accident occurred. Calculations for the centre of gravity of an engine are somewhat tedious, even when all data are at command, and the figures given appear somewhat low for an engine of the type. In former days this would have been of less consequence, but the tendency to raise the boiler, so that the chimney becomes nothing more than a "frill round a hole"—as a railway engineer recently said—makes the centre of gravity a factor that needs more attention, although the effect in this respect of the modern high boiler is far more apparent than real.

It is unfortunate that our chief railways were designed for lower speeds than are now required, and altogether for more primitive conditions; thus it is possible that when Salisbury Station was built it was not anticipated that a train would ever run through, and the curve of 8 chains would be without danger for a stopping train.

Major Pringle says that the engine in question, with a centre of gravity 5 feet above the rails, when traversing a curve of 8 chains, would be in unstable equilibrium at a speed of about sixty-seven to sixty-eight miles per hour, even if full allowance were made for the beneficial effect of 3½ inches superelevation. Major Pringle does not give his calculations, but, as he says, the result may be taken as agreeing with modern formulæ. The rule $\frac{WV^2}{1{\cdot}25\,R}=E$, where W = width of gauge in feet, V = velocity in miles per hour, R = radius of curve in feet, and E = elevation of outer rail in inches; or if the speed V were expressed in feet per second the formula would become WV^2/gR, where g is 32.2. If the formula were used to calculate the superelevation for a speed of sixty miles per hour, it would give superelevation of 25.6 inches; on the other hand, at the speed of thirty miles an hour—that laid down as a maximum by the railway company's engineers—the rule would give

superelevation of 6·4 inches. The maximum superelevation on the South-Western Railway is 6 inches, and it is, of course, altogether impossible to work with any such superelevation as more than 2 feet. It will be understood that the whole of the constraining force required to keep the engine moving in the curve is supplied by the resolved component of the weight of the engine acting parallel to the plane of the radius towards the centre of curvature.

It will be evident, therefore, that superelevation is a remedy of limited efficacy for a serious defect. The centrifugal force at sixty miles per hour (a speed that the evidence of figures shows to have been exceeded, but which we adopt as a convenient standard) would be $\frac{54\times88^2}{32\cdot2\times528}$, or, approximately, 24½ tons (24·597).

The accompanying diagram (Fig. 1) illustrates the resultant of the two opposing forces acting on the engine.

M = centre of gravity of the engine 5 feet above rail-level. The line MQ = the weight of the engine, and MF = the centrifugal force at sixty miles an hour to the same scale. Completing the parallelogram MFRQ, then MR = the resultant of the two forces. Producing MR, it cuts the rail-level at the point H, which is 5·29 inches inside the outer rail; AE is the superelevation. There would only be, therefore,

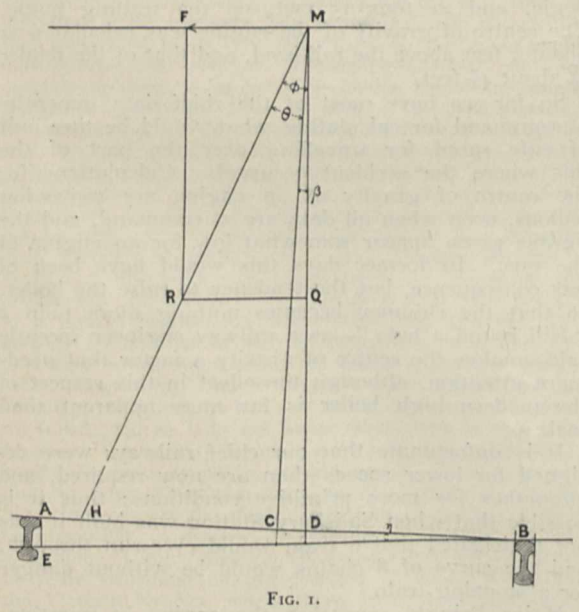

FIG. 1.

about 5 inches between the points A and H. The narrowness of the margin of safety with the data assumed is indicated very clearly in the diagram by the nearness of H to A; should H coincide with A, the engine is just on the point of turning over.

The working out of the problem is as follows:—

MQ = 54 tons.
MF = 24·596 tons.
MC = 60 inches.
AE = 3·5 inches.
AB = 56·5 inches.

$$\tan\phi=\frac{MF}{MQ}=\frac{24\cdot596}{54}=0\cdot45548$$

$\phi = 24^\circ\ 29'$

$$\text{sine}\ \beta=\text{sine}\ \eta=\frac{AE}{AB}=\frac{3\cdot5}{56\cdot5}=0\cdot0619$$

$\beta = 3^\circ\ 33'$
$\theta=\phi-\beta=24^\circ\ 29'-3^\circ\ 33'=20^\circ\ 56'$
CH = MC tan ϕ = 60 × 0·383 = 23 (app.)
AH = 28·25 − 23 = 5¼ inches.

Working backwards with the same data, and assuming the resultant to pass through A, it will be found that the critical speed would be practically sixty-six miles per hour.

In order to calculate CH quickly and with an approximation sufficient for practical purposes, the above working may be very much simplified by the following formula, which has been suggested by Prof. Dalby:—

$$CH=h\left(\frac{V^2}{gR}-\frac{e}{G}\right),$$ where e = superelevation in inches, G = the gauge in inches, V = the velocity in feet per second, g = 32·2, R = radius of curve in feet, h = height of centre of gravity of engine above the rail level in feet.

The way in which the formula is obtained from Fig. 1 is as follows:—

$$\beta=\frac{AE}{AB}=\frac{e}{G}\ \text{app.}$$

$$\phi=\frac{QR}{MQ}=\frac{WV^2}{gR}\div W=\frac{V^2}{gR}\ \text{very approximately.}$$

$$\text{Therefore}\ \theta=\phi-\beta=\frac{V^2}{gR}-\frac{e}{G}\ \text{approximately.}$$

$$\text{Therefore CH}=CM\times(\phi-\theta)=h\left(\frac{V^2}{gR}-\frac{e}{G}\right).$$

The above gives a very nearly correct result when the point H is in the neighbourhood of C, as it should be. The error increases as H approaches A.

We may compare the value of CH obtained by the two methods; we have already shown by the exact method that CH = 23 inches. Applying the approximate formula CH = 23·6 inches.

From the foregoing calculations it would appear that if the train were travelling at a speed of more than sixty-six miles an hour the engine would turn over sideways, but it will be understood that deductions drawn in this way are not proof, though they may be evidence, of what has occurred. The speed of the train is, of course, a very indeterminate quantity; the maximum superelevation was, as stated, 3½ inches, but, to judge by the plan, this did not extend on the curve for a greater distance than about 50 feet, and it would appear that at the spot where the trouble commenced (to judge by the damage to the line) the superelevation was somewhat less. Again, in placing the position of the centre of gravity of the engine, there are various unknown factors which it would be necessary to take into consideration to enable a true result to be reached; for instance, there is the unequal compression of the springs causing lateral displacement of the centre of gravity, rush of water in the boiler, and the extent of wear of wheels and rails.

G. R. DUNELL.

ESTIMATION OF BLOOD-PRESSURE.

THE subject of blood-pressure is one of great interest both to the physiologist and the clinical physician. By blood-pressure is meant the pressure which the blood exerts on the interior of the heart and blood-vessels, but it is chiefly with the vascular blood-pressure—arterial, capillary, and venous—that the physician deals. Our conception of intravascular pressure is facilitated by considering what happens when an aperture is made in an artery, capillary, or vein of a living animal. In the case of the artery the blood squirts out with considerable force, the height of the jet measuring the pressure exerted on the interior of the vessel. Experiment shows that the pressure falls slowly from the heart to the region of the smallest arteries, or arterioles, where there is a considerable fall, the pressure in the capillaries and

veins being comparatively low; in the large veins opening into the right heart it may, indeed, be minus, owing to the suction action of the thorax, and hence when these veins are cut air may actually be sucked into the blood-stream.

The vascular blood-pressure is subject to considerable variation both in health and disease, and it will readily be seen that its accurate estimation is of great clinical value. To take an illustrative case. In certain poisoned states of the blood the small arteries undergo considerable contraction; in consequence of this the blood cannot pass into the capillaries and veins with its wonted facility, and tends to be dammed back upon the large arteries and heart; in other words, the blood-pressure rises in the left ventricle and in the whole arterial tree proximal to the contracted area, and this heightened pressure is further augmented by an increase in the force of the heart-beat, called forth by the necessity to overcome the increased resistance. An increased strain is thus put upon the heart and arteries, and this, if long continued, may lead to disease in them; and in this way such serious affections as aneurism, heart-disease, and apoplexy may be brought about. The importance of early detecting such cases of augmented pressure is apparent, in that it enables steps to be taken to correct the underlying faulty condition of blood, and thus to ward off grave consequences.

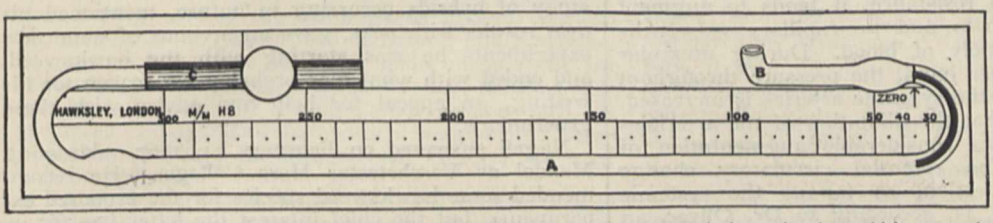

FIG. 1.—Dr. George Oliver's Hæmomanometer (reduced to half size). A is the graduated glass tube along which moves the coloured spirit-index, represented by the dark curved line at the right-hand bend; B is the open end on to which fits the rubber tube communicating with the enveloping bag, or armlet; C is kept closed by means of an air-block, while the blood-pressure is being taken.

Until recently the physician had to be content to rely upon his sense of touch in estimating blood-pressure, and thus it was that the older physicians spoke of a "hard" and a "soft" pulse, the former indicating a high and the latter a low blood-pressure. More modern physicians describe the pulse as "compressible" or "incompressible," or the vessel as being in a state of high or low "tension," according to the readiness with which it yields to the pressure of the finger. This tactile method is, however, far from trustworthy. Not only is long experience needed to acquire even moderate efficiency in it, but from a variety of causes the most skilful are liable to make false estimates by its means; nor do the findings admit of accurate record. In short, though useful as a rough-and-ready method, it lacks the precision needful for scientific observation.

The earliest method of estimating the arterial blood-pressure consisted in cutting the artery of an animal and observing the height to which the blood was forced out. Later the more delicate plan was adopted of connecting the interior of the vessel with a mercurial manometer, by means of an elastic tubing filled with saline solution. Clearly neither of these methods is available for clinical purposes. Recently, however, a method has been devised in which the employment of the knife can be dispensed with, and one, moreover, yielding results quite as accurate as those just referred to. It consists in enveloping some part of the upper extremity—arm, forearm, or finger—in a gutta-percha bag, and connecting the latter, by means of a tubing, with a manometer. The bag is blown up until the pulse on the distal side of it is obliterated, the pressure then registered by the manometer representing the "systolic," or "obliterative" pressure. The "diastolic" pressure, or that obtaining between the heart beats, is measured by noting the excursions of the manometric index produced by the pulsations of the artery; it is held that the maximum movements occur when the pressure on the artery is just sufficient to balance the diastolic pressure.

Hitherto the manometer most frequently used in these observations has been the ordinary mercurial one; but Dr. George Oliver, of Harrogate, has recently devised an instrument which is not only more handy, but would appear to give more accurate readings than the mercurial manometer. It consists of a fine bored glass tube (Figs. 1 and 2) which during use is kept closed at one end, and connected at the other with the enveloping bag by means of elastic tubing. A minute drop of coloured spirit introduced into the glass tube serves as the index. At the commencement of an observation the index is at zero, which is situated at the open end of the tube. As the bag is blown up the index is driven onwards, compressing the air in front of it, and advancing with every increment of pressure. The instrument is readily graduated by means of a mercurial manometer. It will be seen from this description that the

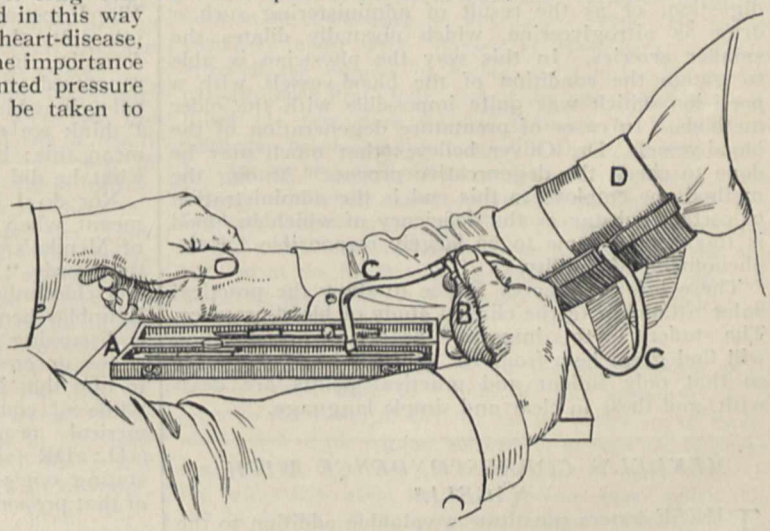

FIG. 2.—Method of employing Dr. Oliver's hæmomanometer. A is the hæmomanometer; D is the armlet; C is the rubber tubing connecting the armlet with the glass tube; B is the rubber ball for inflating the armlet; this is provided with a screw (covered by the thumb), by means of which the armlet and tubing may be gradually deflated.

pressure on either side of the index is equal, a circumstance which tends to reduce to a minimum the errors due to inertia of the index, and this is of great advantage in estimating the diastolic blood-pressure.

In a valuable booklet recently issued by Dr. Oliver [1] on blood-pressure gauging, he sets forth some of the more important results he has arrived at by means of this ingenious instrument. This physician attaches considerable importance to the study of the pressure in the smallest arteries and capillaries by means of a digital bag. He finds that while arteriolar dilatation lowers the pressure in the larger arteries by lessening peripheral resistance, it tends to augment that in the capillaries and pre-capillary vessels by increasing their supply of blood. During muscular exercise, on the other hand, the pressure throughout the entire length of the systemic arteries is increased, owing to the fact that the dilatation of the arterioles is accompanied by a considerable augmentation of cardiac action. The essential circulatory change attending upon digestion, so far as the systemic system is concerned, is, according to Dr. Oliver, an increment in the capillary and pre-capillary pressure, whereby an increase of lymph-exudation is effected, and the products of recently digested food thus speedily conveyed to the tissues. Such an augmentation in the exudation of lymph he claims to have demonstrated.

Of special interest are Dr. Oliver's observations on the blood-pressure of the aged and elderly. With advancing years the smaller vessels tend to become rigid and impervious, and thus to lose their power of dilating in response to physiological requirements, such as digestion and muscular exercise. When this happens the blood-pressure in them is found to be habitually low, and to fail to rise readily during digestion, or as the result of administering such a drug as nitroglycerine, which normally dilates the smaller arteries. In this way the physician is able to gauge the condition of the blood-vessels with a precision which was quite impossible with the older methods. In cases of premature degeneration of the blood-vessels, Dr. Oliver believes that much may be done to check the degenerative process. Among the methods he employs to this end is the administration of certain substances the deficiency of which in blood is thought by some to be largely responsible for the phenomena of senility.

These brief references suffice to show the practical value attaching to the clinical study of blood-pressure. The student in this important branch of investigation will find great help from Dr. Oliver's book, the more so that only salient and practical points are dealt with, and these in clear and simple language.

MENDEL'S CORRESPONDENCE WITH NÄGELI.[2]

THESE letters constitute a valuable addition to the pile of literature that has accumulated under the name of one of the most remarkable figures in the history of biology—Gregor Mendel; for we doubt if ever has so great a fame been built on the contents of a single short paper. The fact that this paper remained unknown from 1865, when it was published, until 1900, when it was rediscovered, is both the measure of how much Mendel was before his time and the reason for the uniqueness of the picture of him which presents itself to the eyes of most of us. We have, it is true, neat and compendious biographies of Mendel, but they reveal to us little of the man himself, and it is still a distant and mysterious monk that appears to us, with his classical peas in his cloister garden. The value of these letters is that they lift the veil for us here and there, and extend to us an invitation to a "private view" of his work, and offer us an opportunity of a nearer acquaintance with its author.

The correspondence was begun by Mendel, who wrote to Nägeli on New Year's Eve, 1866. In this letter he referred to Nägeli's great services to the study of hybrids occurring in nature, mentioned his own results with peas, gave an account of some new experiments he was starting with the hawksweed, and ended with what was probably the reason for his writing, an appeal for help and advice with these experiments.

Nägeli answered on February 24, 1867, addressing Mendel as Verehrtester Herr College. He recommended some hawksweed species for the proposed experiments, but the chief interest the letter has for us lies in the criticism which it contains of Mendel's well-known formulæ. Nägeli said: "Die Formeln dürften Sie wohl ebenfalls für empirische halten, da dieselben als rationellen nicht zu erweisen wären." Mendel's reply to this criticism is a little difficult to understand, and Prof. Correns remarks in a footnote, "Ich weiss nicht, ob Mendel hier das, was Nägeli unter empirischer und rationeller Formel meinte, ganz verstanden hat." But I suggest Mendel's reply becomes intelligible if we divide it into two sections (the first of which ends with the sentence to which Correns's note is appended), and regard each section as an answer to one of two interpretations, of the criticism, by Mendel, who I imagine was not quite sure what Nägeli meant. In the first part of his answer Mendel interprets the criticism as meaning that the simple formulæ, in which only one pair of characters is concerned, are "empirical," and that the complex ones, in which many are concerned, are "rational." I think we may be pretty sure that Nägeli did *not* mean this; however, I am not here concerned with what he did mean.

Nor do I stop to discuss what Nägeli may have meant when I come to consider the second section of Mendel's reply. The point is that it begins with the words "Was schliesslich die Angaben über die Verschiedenheit der von den Hybriden gebildeten Keimbläschen und Pollenzellen betrifft. . . ." Mendel is discussing an entirely different subject now, and he shows unconsciously by this fact that it never occurred to him that Nägeli might mean by his criticism that while of course it was impossible to deny the numerical proportion of the different categories (1D : 2DR : 1R), that was a very different thing from stating one's belief that the suggested interpretation of that proportion (the random union of

$$50\%\,D + 50\%\,R \text{ with } 50\%\,D + 50\%\,R)$$

was true, and that it was very desirable that these two entirely different things should not be confused. Nägeli may or may not have meant this, but the point of interest is that it did not occur to Mendel that he might have done, which shows that so far was he from confusing these two things that the possibility that he might have done never occurred to him as an interpretation of Nägeli's criticism.

I have discussed this at some length because such confusion is not rare among modern students of heredity.

This second letter of Mendel's was accompanied by several packets of peas, which were sent to set Nägeli's doubts at rest.

[1] "Studies in Blood-pressure: Physiological and Clinical." By Dr. George Oliver. (London: H. K. Lewis, 1906.) Price 2s. 6d. net.

[2] "Gregor Mendel's Briefe an Carl Nägeli, 1866–73. Ein Nachtrag zu den veröffentlichten Bastardierungsversuchen Mendels." Edited by C. Correns. Abhandl. d. K. S. Gesellsch. d. Wissensch., math.-phys. Kl. xxix. iii. Pp. 189–264. (Leipzig: B. G. Teubner, 1905.) Price 3 marks.

The remaining letters, of which there are eight, consist of two things—on the one hand of discussion of the results of the hawksweed experiments and of appeals for rare or unobtainable species of that genus, and on the other of personal and friendly communications. The former are interesting only to the specialist, and to him even the interest is chiefly historical, since Mendel did his crossings without the knowledge which we now possess, that the hawksweed sometimes exhibits parthenogenetic reproduction.

At the beginning of the third letter we get a glimpse of Mendel. He is giving his reason for not having studied the hawksweeds in their natural habitat in the neighbourhood of Brünn, and proceeds: ". . . . auch tauge ich mich nicht mehr recht für botanische Excursionen, da mich der Himmel mit einem Uebergewichte gesegnet hat, welches sich bei weiteren Fusspartien, namentlich aber beim Bergsteigen, in Folge der allgemeinen Gravitation, sehr fühlbar macht."

Later, in the same letter, we read of him nearly ruining his eyesight by the extremely difficult operation of castrating Hieracium, and we can picture him, with bent head close to flower, absorbed in his beloved experiments. That Mendel did this work because he loved it, and not for the hope of any reputation he might gain by it, is abundantly evident. The impatience with which he waited for the blossoming of certain hybrids finds eloquent expression in the last words of the third letter. And Prof. Correns remarks in his introduction: "Die Briefe zeigen, dass das was Mendel *veröffentlicht* hat, in der Tat in gar keinem Verhältnis steht zu dem, was er *gearbeitet* hat." The reason that he published so little lies also in the fact that in '68 a great change took place in his circumstances, which robbed him of his time. ". . . . Meine Wenigkeit wurde nämlich am 30 März von dem Kapitel des Stiftes, dessen Mitglied ich bin, zum lebenslänglichen Vorstande gewählt."

That Nägeli entertained a high opinion of Mendel is shown by the trouble that he took to obtain the plants which Mendel wanted; and that, as a result of this correspondence, Nägeli grew not only to esteem him as a man of science, but to value him as a friend, is shown by the fact that in the first five letters he addresses Mendel as Verehrtester Herr College, but that in the last five he calls him Hochgeehrter Herr und Freund. And that, I think, sums up one's feelings when one reads these letters. At the beginning, we feel, Mendel stands to us in the relation of a *College* only; at the end we feel that he is both our *College und Freund*. Is there not something that attracts us in passages like the following, from the end of the seventh letter? "We have been rejoicing here for weeks past in the most glorious spring weather. Compared with the yearly average, the vegetation is thirteen days in advance, and everything is in leaf." A. D. D.

NOTES.

THE pupils of M. Moissan are taking the opportunity presented by the twentieth anniversary of the isolation of fluorine to offer their distinguished master a medal in commemoration of this important event in the history of chemistry. The execution of the medal has been entrusted to M. Chaplain. The promoters of this happily-conceived scheme have decided to extend to men of science generally an invitation to contribute to the expenses. Every subscriber of 25 francs will receive a replica in bronze of the medal. Donations may be sent, up to November 30, to the treasurer to the committee of management, M. P. Masson, 120 boulevard Saint-Germain, Paris. Fuller particulars may be obtained from the secretary of the committee, Dr. Guichard, 3 rue Michelet, Paris.

PROF. T. H. MIDDLETON, professor of agriculture in the University of Cambridge, has been appointed assistant secretary to the Board of Agriculture and Fisheries, in succession to Dr. W. Somerville.

THE death of Mr. William Sedgwick, a member of the medical profession who combined the active duties of his calling with the pursuit of scientific investigation, is announced in Wednesday's *Times*. Mr. Sedgwick was born in 1821, and during the 'sixties of last century he devoted much attention to the study of heredity, and published articles upon the subject which were referred to and quoted by Darwin. Soon after his establishment in Marylebone as a general practitioner, London was visited by the great cholera epidemic of 1854; and Mr. Sedgwick devoted much attention to the chemical changes incidental to the disease, and made them, in 1889, the subject of his presidential address to the Harveian Society.

THE death is announced in St. Petersburg, on October 19, of Prof. T. T. Beilstein, the well-known Russian chemist. His numerous researches in organic and analytical chemistry, and especially his work on the aromatic series, enriched science with many new discoveries, and gave a new direction to chemical industry. He also made extensive researches on Caucasian naphtha and coal-tar. His works, written in German, were very numerous, the chief of them being his "Handbuch der organischen Chemie" and his text-book on analytical chemistry. Prof. Beilstein was born in St. Petersburg on February 5, 1838. He studied chemistry under Prof. Bunsen at Heidelberg, and also attended the lectures of Liebig at Munich. He studied physics under Prof. Jolly, and at the age of eighteen published his first work on the diffusion of liquids. At Göttingen he obtained the degree of Doctor of Philosophy. In 1859 he became assistant professor of chemistry at the Breslau University, and in 1866 was appointed professor of chemistry at the St. Petersburg Technological Institute, where he remained the rest of his life. He also lectured at the St. Petersburg Military Academy, and was made an academician of the St. Petersburg Academy of Sciences in 1886.

THE proposed new scheme for the mathematical tripos will be voted upon at Cambridge this afternoon. In a letter to the *Times* of October 22, the professors of mathematics and of the cognate subjects of physics and engineering, and all the other official teachers of mathematics in the University, state the chief grounds upon which they are in favour of the proposed changes. The traditional system of placing the names in the mathematical tripos list in order of merit is shown to be unsatisfactory, and to involve the sacrifice of the educational interests of many students. The number of men who wish to devote their whole course at Cambridge to the study of mathematics is much smaller than twenty years ago. At the present time, however, there are a considerable and increasing number of students of engineering and of physics who require mathematics up to a fairly high level, but do not come into contact with the mathematical school proper. To provide for the needs of the important class of men who ought to spend part, but not the whole, of their time at Cambridge in studying mathematics is one of the chief objects aimed at in the proposed new scheme. It will be for the advantage of the special mathematical students,

as well as of those who learn mathematics with a view to its application in physics or in applied science, that the teaching of the subject be unified. The two classes of students may thus avoid the opposite dangers of taking a too purely abstract view of the science on the one hand, and of regarding it as consisting of a set of empirical rules on the other. The letter is signed:—Robert S. Ball, Lowndean professor of astronomy and geometry; G. H. Darwin, Plumian professor of astronomy; A. R. Forsyth, Sadlerian professor of pure mathematics; B. Hopkinson, professor of mechanism and applied mechanics; J. Larmor, Lucasian professor of mathematics; J. J. Thomson, Cavendish professor of experimental physics; H. F. Baker, Cayley lecturer in mathematics; E. W. Hobson, Stokes lecturer in mathematics; and R. A. Herman, J. G. Leathem, H. W. Richmond, university lecturers in mathematics.

DR. WILLIAM OSLER, regius professor of medicine at Oxford, delivered the Harveian oration at the Royal College of Physicians on October 18. He took as his subject "The Growth of Truth" as illustrated by the history of Harvey's discovery of the circulation of the blood. Truth, he said, grows like a living organism, and its gradual evolution may be traced from the germ to the mature product. All scientific truth is conditioned by the state of knowledge at the time of its announcement. Thus, at the beginning of the seventeenth century, the science of optics and its mechanical appliances had not made possible (so far as the human mind was concerned) the existence of blood capillaries and of blood corpuscles. Jenner could not have added to his inquiry a discourse on immunity. Sir William Perkin and the chemists made Koch possible, Pasteur gave the conditions which produced Lister, Davy and others furnished the preliminaries necessary for anæsthesia. To scientific truth alone may the *homo mensura* principle be applied, since of all the mental treasures of the race it alone compels general acquiescence. That such general acquiescence, such aspect of certainty, is not reached *per saltum*, but is of slow, often of difficult, growth, marked by failures and frailties, but crowned at last with an acceptance accorded to no other product of mental activity, is illustrated by every important discovery from Copernicus to Darwin. The growth of truth corresponds to the states of knowledge described by Plato in the "Theætetus"—acquisition, latent possession, conscious possession. Scarcely a discovery can be named which does not present these phases in its evolution. In a hundred important problems acquisition has by slow stages become latent possession; and then there needs but the final touch, the crystal in the saturated solution, to give us conscious possession of the truth. When those stages are ended, there remains the final struggle for general acceptance. But however eminent a man may become in science, he is very apt to carry with him errors which were in vogue when he was young, errors that darken his understanding, and make him incapable of accepting even the most obvious truths. It is a great consolation to know that even Harvey came within the range of this law; it was the most human touch in his career.

AFTER an interval of only three weeks, another violent hurricane burst over the more western portions of the West Indies on October 17, apparently with little or no warning of its approach. As is usually the case with tropical storms, the area of the cyclonic whirl was small, for while the Cuban provinces of Havana and Pinar del Rio were devastated, Matanzas and Santiago were not affected. In the city of Havana the cyclone attained terrific violence on the morning of October 18, structures being rocked as if by an earthquake. Many buildings were demolished, there were numerous shipping casualties, and the loss of life was considerable. The storm was accompanied by deluging rain, which soon flooded the streets and rendered vehicular traffic of all sorts impossible. Enormous waves raised by the wind dashed thirty-five lighters in pieces against the wharves. The destruction in the city is estimated at a couple of million dollars. Passing on to Florida, the hurricane wrought great havoc on its way, wrecking ships and causing great loss of life. One captain reports that he took shelter under Elliott's Key on the morning of October 18, but shortly afterwards a huge wave swept the island, and its 250 inhabitants are believed to have perished. Owing to the interruption of telegraphic communication, the full extent of the damage in Florida is not known, but at alligator-breeding Miami various places of worship, the concrete-built prison, and a hundred houses were involved in the ruin. Mixed up with the information relating to the Cuba-Florida hurricane are messages reporting immense destruction by floods in the Central American Republics. So far as can be gathered from the brief cablegrams, rain-storms, and not wind-storms, have been the cause of the damage. In San Salvador the storms are said to have been incessant during ten days, the country being flooded, and the physical features completely altered in many places. Aqueducts and iron bridges have been carried away, the railway, electric lighting, and telegraph services disorganised, there has been great loss of life, a man-of-war lost, and the losses in cattle and crops have been very heavy. The casualties in Guatemala and Honduras are estimated at many millions of dollars.

THE type of weather has been very unsettled during the past week, and exceptionally heavy rains have occurred in Scotland and in the north-east of England, while in most parts of the country rain has fallen each day. Snow has occurred at times in Scotland. In the south and south-east of England the weather has been unusually warm for the time of year; and with the single exception of October 19 the reading of the thermometer at Greenwich has exceeded 60° each day. On Monday, October 22, the Greenwich temperature was 69°, which is 3° higher than any previous record on the corresponding day since 1841, a period of sixty-five years, and on Sunday, October 21, the thermometer registered 67°·5, which is 1°·5 higher than any previous reading. The nights have also been exceptionally warm, the thermometer at times scarcely falling below 60°. Strong winds and gales have occurred over the northern and western portions of the kingdom.

ACCORDING to a paper by Dr. W. E. Hinds, forming Bulletin No. 59 of the Entomological Bureau of the U.S. Department of Agriculture, the damage done to crops by the Mexican cotton-boll weevil is in a fair way of being to a considerable extent neutralised as the result of the presence of the insect itself. Cotton-bolls (or buds), it appears, when pierced by the beak of the weevil show a decided tendency—more strongly developed in some strains than in others—to proliferation, producing internally a number of large thin-walled cells placed so close together, and so loosely combined, that the whole structure presents a granular and gelatinous texture. Amid this abnormal tissue (which is in no wise poisonous to the insects) the grubs of the weevil are hatched, and proceed to develop. A considerable percentage is, however, found to perish, and it is inferred "that the great majority of the deaths due to

proliferation may be caused by the mechanical effect of the formation in first enveloping the larva so closely as to prevent its movement, and then the continued formation producing sufficient internal pressure slowly but surely to crush to death the foe whose attack has called forth this as self-defence on the part of the plant." Proliferation may be stimulated by puncturing the cotton-buds, while strains should be selected for cultivation in which the proliferating tendency is most marked. Already the effects of proliferation in keeping the weevil in check appear to be of more importance than those due to parasites, and it is expected they will rapidly increase. Of course the weevil will endeavour to accommodate itself to the new conditions, but, since man is on its side, it is hoped that the plant will conquer.

IN the latest issues of the fishery series of the publications of the Danish Commission for the Study of the Sea (Meddelelser fra Kommissionen for Havundersøgelser: Fiskeri, vol. ii., Nos. 1–3, Copenhagen, 1906), the larval and post-larval stages in the life-history of certain members of the flat-fish and cod families are described in great detail, with a wealth of illustration. The plaice, dab, and flounder form the subject of the first part, and while the features by means of which the young stages of each may be recognised are pointed out, the illustrations show the manner in which the symmetrical larva gradually changes into the unsymmetrical "flat-fish." The statement that young plaice have been found while in the early bottom-stage in deep water is shown to be due to confusion with the dab, and the special need of protection by the former on account of its shallow-water habitat is emphasised. Attention is directed to the curious circumstance that when leaving the pelagic for the bottom stage these fishes diminish in size. From the other species the dab, when it reaches the bottom-stage, is distinguished by its large eyes and narrow bodily form. In the second part the early stages of several of the more typical members (Gadus, &c.) of the cod-family are described and illustrated, while in the third part the species of ling (Molva) receive attention. All the lings are distinguished from cod by the great length of the pelvic fins in the early stages, and it is not a little remarkable that two such nearly-related species as the common and the blue ling should differ widely in regard to the development of pigment-bands on the hinder part of the body at this period of life. The blue ling in this respect occupies, indeed, a position intermediate between the common ling and the torsk (Brosmius).

IN the fourth part of the "Plankton" series of the above-mentioned publication Mr. O. Paulsen discusses the distribution of the crustacean *Calanus finmarchicus* in Icelandic waters. This species, which forms the staple food of several kinds of fishes, breeds chiefly in the spring, when death follows propagation. There is, however, reason to believe that a certain percentage breeds at other seasons. Reproduction takes place only in the sea to the southward of Iceland, these crustaceans being carried to the west, north, and east coasts of that island by the Irminger current. As the species forms an essential element in the food of the herring, it is probable that the migrations of the shoals of the latter fish are largely influenced by the presence of swarms of the crustacean. Towards autumn the numbers of Calani at the surface decrease, and as the species has then reached its second developmental stage, it is probable that it descends into deep water to pass the winter, rising again to the surface with the return of spring to undergo the final transformation.

IN the Calcutta *Medical Journal*, vol. i., No. 2, Mr. C. L. Bose is the author of an article on the toxic principles of the bitter variety of the fruit of *Luffa aegyptiaca*. The fruit is not infrequently compounded into a curry, and in consequence of a case where the effect was injurious an examination was made resulting in the extraction of two glucosides, the one resembling *colocynthin* in some of its reactions.

TO accompany a collection of botanical books and portraits illustrating the history of plant classification, arranged in the botanical gallery of the Natural History Museum, South Kensington, the keeper of the department has drawn up a short guide explaining the chief features of the various exhibits. Among early works may be seen the "Materia Medica" of Dioscorides dated 1499, Brunfels's "Herbarium," Gerard's "Herbal," and Bauhin's "Prodromus." The collection also includes a copy of Linnæus's "Systema Naturæ," and volumes by de Jussieu, de Candolle, and more recent noted systematists.

THE botanical series of Memoirs of the Department of Agriculture in India is inaugurated with a volume giving an account of the early stages in the development of the haustoria of *Santalum album*, by Mr. C. A. Barber. The haustoria arise on the root of the seedling as early as the lateral rootlets, and independently of any stimulus due to contact with foreign bodies; they continue to form on the young rootlets, providing the most important absorbing organs. The chief features are the central core or nucleus, and the external clasping folds; when the haustorium comes into contact with an inorganic body, a succession of nuclei and folds may be produced. Frequently a strand of glandular cells is developed that assists in penetration.

THE number of Engler's *Botanisches Jahrbuch* issued in August, vol. xxxviii., part ii., contains a series of determinations of new African plants, forming the twenty-ninth fascicle of "Beiträge zur Flora von Afrika." The volume opens with a short list of Cyperaceæ, prepared by the late Mr. C. B. Clarke. Dr. R. Schlechter, who contributes a quota of Orchidaceæ and Burmanniaceæ, alludes to the rarity of species of the latter order; five species are now added, of which two, allied to Thismia, are placed under new genera, Afrothismia and Oxygyne. The Compositæ and Labiatæ are determined by Drs. M. Guerke and O. Hoffmann. The paper in the supplement on the Cornaceæ deserves attention, if only for the discussion of the aberrant genus Garrya. The writer, Mr. W. Wangerin, restores the order Garryaceæ, and places it near the Betulaceæ and Salicaceæ. Evidence is also adduced for separating the genera Alangium, Nyssa, and Davidia from the Cornaceæ.

THE new series of archæological monographs to be issued by the Bureau of American Ethnology starts with a description of the antiquities of the Jumez Plateau, a mountainous region in New Mexico lying west of the Rio Grande del Norte. This country supported at one time a numerous population, but on account of climatic changes it was abandoned some six or eight centuries ago. It abounds in the ruins of ancient settlements, which fall into two classes—cliff-dwellings, some of which are artificial, some natural, and the pueblos or many-chambered houses inhabited by several families. One of the latter contains upwards of six hundred rooms, and they were usually erected in situations capable of defence. The popular theory that the cliff-dwellings were the work of the ancestors of the present Indian tribes must now be abandoned, partly because there is no resemblance between

the art of the two races, and, secondly, the ancient people were dolichocephalic, while the existing inhabitants are brachycephalic. This older race, of whom little is as yet known, was skilled in various arts, particularly that of mortuary pottery, and the finds from their settlements include weapons and implements of stone, bone, and shell, with some rude stone images, fire and medicine stones, all of which are illustrated and described by Mr. E. L. Hewett.

THE reports of H.M. Inspectors of Mines show that the use of coal-cutting machinery in British collieries continues to increase. In 1903 there were in use 643 machines, 755 in 1904, and 946 in 1905. These 946 machines produced more than eight million tons of coal, and as the total output of Great Britain was 236 million, there is still a wide field open for the introduction of coal-cutting machines. Of the machines in use, 500 were driven by compressed air and 446 by electricity.

THE most striking paper in the *American Journal of Science* for October is that by Mr. A. L. Day and Mr. E. S. Shepherd on the lime-silica series of minerals, in which the authors give the results of a study of mineral and rock formation by direct measurement at the temperatures at which the minerals combine and separate, like the solutions of ordinary chemistry under ordinary conditions. The entire series of mixtures of lime and silica have been prepared and studied. The only serious attempt hitherto made to determine the constitution of this series of minerals is that of Boudouard (Journal of the Iron and Steel Institute, 1905, p. 339), but the method he used is shown to be a very inaccurate one.

THE summary report of the Geological Survey Department of Canada for 1905 (Sessional Paper, 1906, No. 26) gives a concise account of original investigations carried out in the field and at the Ottawa headquarters with the object of increasing the knowledge of the mineral wealth of Canada. The staff of the Survey numbers sixty-seven, and under the direction of Dr. Robert Bell a large number of important explorations and surveys were carried out during the year. Dr. Bell himself gives an account of the cobalt mining district on the Timiskaming and Northern Ontario Railway. Specimens of pure silver weighing from a few pounds up to twenty pounds or more have been obtained in a number of the mines. Nuggets of mixed silver and calcite, weighing upwards of 100 lb., are exhibited in some of the mining offices in the district.

THE seventy-third annual report (1905) of the Royal Cornwall Polytechnic Society contains, among other papers of scientific interest, a verbatim report of a lecture entitled "An Early Chapter in the History of Cornwall," which was delivered by Sir Norman Lockyer at Penzance in April last. Sir Norman explained that the work he has recently inaugurated, dealing with the *raison d'être* of the stone circles and other stone monuments of the county, has barely commenced; much more remains to be done, but the evidence so far obtained, that their erection depended upon the utilitarian necessity for regulating the calendar by observations of celestial timekeepers, is so remarkably conclusive that it is very desirable that many other workers should carry it on until the whole of these monuments have been considered in all their details. The results obtained in Cornwall amply confirm the similar conclusions obtained from the study of Egyptian temples, and are themselves confirmed by the latter. A number of slides showing Lady Lockyer's photographs of the principal circles, *e.g.* "The Hurlers" and "The Merry Maidens," were exhibited on the screen, accompanied by maps and tables showing the wonderful similarity of purpose of sight-lines which, owing to varying local conditions, are themselves dissimilar in their directions.

WE have been favoured by Mr. F. Berwerth with a reprint of an interesting paper he has contributed to *Tschermaks Mitteilungen* (vol. xxv., part iii.) on the meteorite of Kodaikanal, Palni Hills, Madura district, Madras. This meteoric iron is of special interest in that, on etching, it exhibits a crystalline mass of large octahedral iron grains between which globular masses of silicates of unusual character have separated out. The general structure of the iron is thus of a porphyritic type. The ratio between the iron mass and the silicates is approximately 10 to 1. Careful examination has shown that the silicate segregations are of two kinds, a spherolithic ground mass and glassy globules. The former consists of weinbergite, diopside, bronzite, apatite, and chromite, and the latter of a glassy magma containing suspended bronzite and chromite. The new silicate compound to which the author gives the name of weinbergerite is found by analysis to have the composition represented by the formula $NaAlSiO_4+3FeSiO_3$. Mr. Berwerth also sends a reprint of his paper on artificial metabolites contributed to the Vienna Academy of Sciences (*Mathem. naturw. Klasse*, vol. cxiv., part i.), in which he gives the results of experiments made with a small plate of the Toluca iron to ascertain the accuracy of his view that the great group of crystalline-granular meteoric irons are octahedral irons re-crystallised in consequence of heating in a solid condition. The plate, 5 mm. in thickness, was embedded in powdered charcoal in a graphite crucible and heated for seven hours at a temperature of about 950° C. The results obtained induce the author to propose to term the re-crystallised meteoric irons "the group of the metabolites." With the increasing knowledge of the physical characters of the artificial iron-nickel alloys, fresh light will be thrown on the various forms of iron metabolites.

A CHEAP edition (price 7*s.* 6*d.* net) of M. Vallery-Radot's "Life of Pasteur," translated from the French by Mrs. R. L. Devonshire, has been published by Messrs. A. Constable and Co. The original English edition appeared in two volumes five years ago, and was reviewed at length in NATURE of December 5, 1901 (vol. lxv., p. 97). As Pasteur's son-in-law, M. Radot had exceptional opportunities for preparing this biography, and his work is a faithful and fascinating history of Pasteur's scientific life and aspirations.

OUR ASTRONOMICAL COLUMN.

A NEW FORM OF PHOTOMETER.—In the attempts which from time to time have been made to photograph the solar corona without waiting for a total eclipse of the sun, the intensity of the atmospheric halo about the sun's disc has played an important part. Obviously the most suitable locality for these attempts would be where the atmospheric glare is least intense. With this in view, MM. Deslandres and Bernard have designed a photometer having for its special aim the determination of the intensity of the circumsolar light.

The apparatus consists of an equatorially-mounted telescope tube having affixed to the narrower end, which is directed towards the sun, an opaque disc which just occults the actual solar disc. At the other end of the tube the light

is received on the one half of a small piece of ground-glass, the other half of which may be evenly illuminated by the light from a standard osmium lamp. By varying the distance of the latter the illumination of both halves may be equalised, and the distance of the lamp read off on a suitably divided scale.

M. Deslandres suggests that this photometer will be found extremely useful in determining the most suitable localities for solar observations of all kinds. By the interposition of violet glass the relative intensity of the glare which would affect spectroheliograph observations might be determined, and, similarly, the substitution of red glass would show the suitability of the atmosphere for the experiments on the photography of the corona, in which it is proposed to utilise the red rays (*Comptes rendus*, No. 3, 1906).

A NOVEL PLANISPHERE.—In collaboration with Mr. G. P. Serviss, of the Brooklyn Institute, Mr. L. Barritt, of 150 Nassau Street, New York, has recently published a planisphere which should prove very useful to amateur astronomers, teachers, and others who are interested in celestial phenomena.

As regards the constellations the apparatus is similar to other planispheres, but, in addition, it allows the user to determine the approximate positions of the planets, the sun, and the moon at any time and date. This is effected by having the ecliptic divided up into degrees, so that small discs representing the various bodies may be affixed at any indicated point in their respective paths. A set of tables accompanying the apparatus shows where each disc is to be affixed at different dates during the next twenty years, and thus by placing these discs as directed, and rotating the circular card for the current time and date in the usual way, the actual position of each celestial body may be seen at a glance. The observer may also, of course, determine approximately the times of rising and setting for each body on any date during the period 1906–1925. The price of the complete apparatus is five dollars.

THE OXFORD UNIVERSITY OBSERVATORY.—Prof. Turner's report of the work done at the Oxford University Observatory during the period May 1, 1905, to April 30, 1906, directs attention to the fact that the observatory staff is almost entirely engaged upon the proof-reading of the Oxford section of the Astrographic Catalogue, and that, in consequence, it does not seem advisable to undertake any new piece of observational work. The first of the eight volumes of the catalogue is now practically ready, and the printing of it has been commenced. It contains the measures of 66,000 star-images on the 160 plates with centres of declination +31°.

The report also contains brief accounts of the eclipse expedition to Aswan, and of the meeting of the Solar Research Union at Oxford in September, 1905.

THE PONCA SUN DANCE.[1]

FEW Amerindian ceremonies have attracted more attention than the Sun Dance. It is found among the Arapaho, the Cheyenne, the Dakota, and the Blackfeet; and now we have a record of the rite among the Ponca. Unfortunately this account of the dance is far from complete; Mr. Dorsey was able to witness it once only, in addition to which it had become a theatrical performance for the benefit of white visitors.

The ceremony is held in June or July, and the name means "Sun-seeing-Dance," *i.e.* a dance which the sun witnesses; the priests are medicine-men who have fasted four times during previous ceremonies; these "thunder-men" select the dancers, and it is a considerable honour to be thus chosen, for each dancer is held to bear a part of the sufferings of the tribe. Camp is moved on the day before the dance, the time of the ceremony having been previously proclaimed; continence must be observed by all who take part.

Five days in all were needed when Mr. Dorsey was present, of which the first was taken up with preparations. The forenoon of the second day was occupied with a mimic combat, after which the ceremonial huts were removed into position by female relatives of the priests. The supposed enemies in the fight were the men who left the camp to "spy the centre-pole" of the dance lodge; while the lodge was being erected, the centre-pole was felled and brought to the camp; at the same time four altars were prepared, one for each hut. The third day opened with a race to the centre-pole, which was still outside the camp, lying crosswise to the sun. It was then painted and raised into position; an altar was prepared, and before it was finished the dancers entered the lodge, bringing a painted buffalo skull. Prayers were offered by the dancers, and the dance began; it was continued at intervals during the whole of that day and night, and on both the fourth and fifth days the sunrise performance was specially important; on several occasions the priests made before the performers what seem to be hypnotic passes. Until the final dance all fasted; female relatives then brought food to the dancers, and the chief laved the mouth and sprinkled the head of each dancer with water. The last ceremony was the offering of a portion of skin, cut from the shoulder of each dancer, to the sun, by placing it at the foot of the centre-pole.

Raising the Centre Pole on the third day of the Ponca Sun Dance.

All the participants were painted more than once, and careful descriptions of them are given, together with coloured plates of the more important. The remainder of the thirty-five plates show the altars and various scenes of the rites.

Mr. Dorsey was struck by the comparative simplicity of the ceremony, but he suggests that it may possibly be a case of degeneration. The centre-pole represents an enemy, and in its fork is supposed to be the Thunder Bird's nest; the altar is the sun or fireplace, which existed in the beginning; the buffalo bull came from the interior of the earth. The altar consists of the sage plant, symbolical of the people, the sun, and the buffalo. No satisfactory account of the origin of the dance could be obtained, and Mr. Dorsey offers no suggestion as to its significance. It has, however, been dealt with in the annual reports of the Bureau of Ethnology (vol. xi.) as regards the Dakota, and vol. iv. of the Field Columbian series contains a long account of the Arapaho dance by Mr. Dorsey himself. The statement on p. 88 of the present report that torture is not found among the Arapaho appears to be directly contradicted by the latter report (pp. 179 *et seq*).

N. W. T.

[1] "The Ponca Sun Dance." By G. A. Dorsey. Field Columbian Museum, Anthropological Series, vii., ii. (Chicago, 1905.)

GEOLOGICAL STUDIES IN SOUTH AFRICA.

THE Report of the Geological Survey of the Transvaal Mines Department for 1904 (Pretoria, 1905, price 7*s.* 6*d.*) is a folio volume, issued at a very moderate price. It contains twenty-three plates, from which our figures are reductions, and two large coloured maps, the latter being conveniently placed in an envelope at the end. The cessation of topographical work in the country must in future hamper systematic geological mapping, and the Geological Society of South Africa has already approached the Colonial Secretary in Pretoria on the subject (Proc. Geol. Soc., S. Africa, 1906, p. liv). It might be thought that military considerations alone would be sufficient to place an accurate map among the first requirements of the colony.

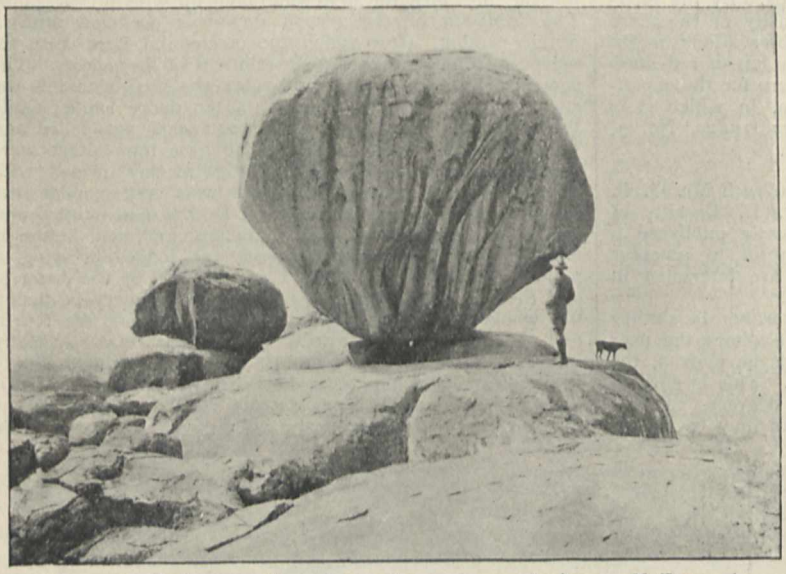

FIG. 1.—Weathering of granite on characteristic kopje near Chuniespoort, N. Transvaal.

The director of the Survey, Mr. Kynaston, describes a traverse of the country between Pretoria and Pietersburg, during which he visited the remarkable Salt Pan, some twenty-five miles N.N.W. of Pretoria. This lake, which is about as salt as the Dead Sea, lies in a circle of granite hills, 250 feet below their crest, and about 200 feet below the general level of the country on their outer side. Its salts include 72·70 per cent. of sodium chloride and 27·25 per cent. of sodium carbonate. Except that an explosive origin has been suggested by Cohen, no adequate explanation of the hollow is as yet forthcoming. Considering, moreover, the antiquity of the last volcanic eruptions in this area, a crater of explosion ought to have become long ago filled up by products of denudation. One feels tempted to ask if it is possible for the materials filling an igneous neck to sink back long after they have solidified. Could the fragmental materials so common in South African pipes behave in this way? Mr. A. W. Rogers has cited cases where the weathering of these necks has caused hollows at the surface; but the Salt Pan near Pretoria is 200 feet to 250 feet in depth.

On Mr. Kynaston's return journey from the mouth of the Elands River, the most northerly known outliers of the glacial Dwyka conglomerate were traversed (Fig. 2). The boulder-bed, as described in supplementary notes by Mr. Mellor, does not seem more than 50 feet thick, and is associated with sandstones. It was laid down, as in other cases, on a land-surface eroded by streams, and the original topography is now being revealed by the denuding action of the Elands River and other agents.

Mr. A. L. Hall (p. 37) describes the geology of the tin fields north-east of Pretoria, where the ore occurs promisingly in a rock of greisen type; and Mr. Mellor (p. 45) deals with the picturesque area of Rhenoster Kop. The Permian glacial striation in this district, seen on the uptilted Waterberg Sandstones, has an almost constant direction of S. 33° E. After other papers on special districts, Mr. S. M. Tweddill describes some of the rocks collected, and has been allowed a handsome series of photographic plates, showing his thin slices in ordinary light and with crossed nicols. The latter figures are produced by the three-colour process, but it is questionable if much is gained by them. Colour-photographs of the sections in ordinary light would probably be more effective, and would equally serve to confirm the author's determinations. The "acicular crystals of Clay-slate" in the description of Plate XV.*a* puzzle us not a little, especially as in the text on p. 76 the "stellate forms" are similarly said "to be clay-slate." In a country where everything depends on field-relations, where the scale of phenomena is large, where the mention of a new discovery suggests comparison with something else a thousand miles away, one probably expects too much from the petrographer. One can imagine the prospector, who has returned bronzed and muscular after his days upon the veld, reading the bare descriptions of rocks with a certain irritation. If they could be inserted in connection with the account of the masses in the field, their true interest would at once appear, for the South African of all men has a pleasurable keenness for geology.

FIG. 2.—Weathering of Permian glacial conglomerate, showing the original boulders, Toitskraal, Elands River.

This fact is well attested by the publication of the dis-

cussions that take place at the meetings of the Geological Society of South Africa (Proceedings of the Society for 1905), and by the considerable space given to written criticisms and replies. The Transactions would be very incomplete without these additions, which may be commended to the notice of many publishing societies in our islands. Dr. F. W. Voit, for instance, read a paper (Trans. Geol. Soc., S. Africa, vol. viii., p. 106) on September 4, 1905, entitled "Preliminary Notes on 'Fundamental Gneiss Formation' in South Africa," in which he claimed that the gneisses of the Limpopo Flats correspond to the fundamental formation of the continent of Europe. At the meeting three members contributed structural and mineralogical details from their own notebooks (Proc. for 1905, p. lvii), recorded with an altogether admirable clearness of expression. The full paper was read on October 30, 1905 (Trans., p. 141). Dr. Voit points out, in agreement with his predecessors, that the main granite is intrusive in the Swaziland beds, "long drawn out lenses of quartzite, chlorite, actinolite, and other schists, swimming, as it were, in a granite magma." But the Limpopo gneisses are, for him, still older, and he looks forward to finding the granite intrusive in them also. By the way, we must object to his using, on p. 145, the term "interbedded igneous sheets" for intrusive masses that have come up along planes of fracture in the granitoid mass. On November 20 (Proc. for 1905, p. lxv) the author sent in a letter in which he supported his views by quoting Mr. Anderson's observations in Natal, and on December 18 Messrs. Sandberg and Jorissen made a reply to Dr. Voit, in which Credner is cited as their authority, in a manner that almost recalls the Wernerian discussions of a hundred years ago. The bottom, if we may speak irreverently, is here knocked out of the "Urgneissformation" with considerable vigour, and the references to European literature, though disfigured by a few misprinted place-names, add zest to a spirited discussion.

Dr. Hatch, in his presidential address (Proc. for 1906, p. xxv), refers to Dr. Voit's suggestion, and remarks that the Limpopo gneiss may be only "a sheared or metamorphic portion of the granite." The address, on the geological history of the South African formations, covers ground on which much has been written, and on which silence might now conveniently be preserved, until some of the critical questions touched on can be decided by new and indubitable evidence.

Mr. J. P. Johnson (Trans. Geol. Soc., S. Africa, vol. viii., p. 135) describes and illustrates primitive stone implements from the plateau of the Victoria Falls. Mr. Lamplugh directed attention to these (Report of Brit. Association for 1905, p. 300) as being possibly older than the excavation of the Batoka Gorge, and Colonel Feilden has already urged their importance upon the readers of this Journal (NATURE, vol. lxxiii., p. 77). We trust that we have said enough to show that geology in the best sense, as a critical and comparative science, flourishes in the dusty and inchoate city of Johannesburg. Probably there is no part of the world where geological phenomena play so large a part in the thoughts of cultivated men.

GRENVILLE A. J. COLE.

AËRONAUTICS AND METEOROLOGY.

THE fifth conference of the International Commission of Scientific Aëronautics was held at Milan, and commenced its sittings on October 1. The conference was formally opened by Prof. Celoria, representing the committee of the Milan Exhibition, M. Gavazzi, representing the municipality, Prof. Palazzo, and Prof. Hergesell, president of the commission.

A large number of representatives attended the conference; Mr. Dines represented the Meteorological Office, and the other English members were Major Baden-Powell, Mr. Patrick Alexander, and Mr. Charles Cave.

The first meeting for the discussion of scientific questions was held in the afternoon of October 1 under the presidency of General Rykatchew and Prof. Palazzo. Prof. Hergesell read his report, and various questions were discussed relating to the business of the conference. In the evening the committee of the exhibition entertained the members of the conference at dinner.

On October 2 the members went to Pavia, where M. Gamba showed them over the observatory, and liberated two *ballons-sondes*. After visiting the university the members were entertained at luncheon by the municipality of the town.

The second meeting was held on October 3 under the presidency of Prof. Assmann and M. Teisserenc de Bort. Dr. Erk urged the necessity of making ascents in the neighbourhood of the Alps for studying local phenomena, such as the Föhn. M. de Quervain explained a method of using small pilot balloons for determining the winds at different altitudes; small india-rubber balloons were liberated and watched with a theodolite; assuming that the balloon ascended with uniform velocity, it was possible to determine its course from one station. Prof. Hergesell spoke very highly of the method which he had used at Strasburg and elsewhere, and mentioned that in Spitsbergen he had watched the balloon to a distance of 80 kilometres. M. Ebert explained his method of determining the deformation of the electrical equipotential surfaces in the neighbourhood of a balloon, and exhibited a new apparatus for measuring the ionisation of the air.

The third meeting was held in the afternoon of October 3 under the presidency of Colonel Vives y Vich and Mr. Cave. General Rykatchew and M. Riabouschinsky read the reports of the work of their observatories. M. de Quervain read a paper on the thermal inertia of thermometers used in kite and balloon ascents. In connection with this an important discussion took place on the relative value of *ballons-sondes* and kites for the study of the air up to 5000 metres or so. Prof. Hergesell strongly advocated the use of balloons in preference to kites; General Rykatchew and M. Berson thought that kites were far more suitable.

Mr. Rotch read a paper on the ascents of *ballons-sondes* in America, and General Rykatchew read a paper on the temperature gradient as observed at Pavlovsk.

Prof. Hergesell explained a method of recording vertical movements in the atmosphere by attaching a "log" to balloons. M. de Quervain gave proofs of the reality of the isothermic zone.

In the morning of October 4 the members visited the aëronautical section of the exhibition, and *ballons-sondes* were liberated by M. Gamba, M. Teisserenc de Bort, and Prof. Hergesell. In the afternoon the fourth meeting was held under the presidency of Mr. Rotch and M. Scheimpflug. General Rykatchew described M. Kouznetzow's method of determining the height of clouds at night by means of a search-light, and gave some of the results obtained at Pavlovsk. M. Köppen, M. Teisserenc de Bort, and Mr. Rotch observed that the method had been used at Hamburg, in France, and in America. Mr. Alexander read a communication on the forms of propellers for flying machines.

M. Moedebeck urged the necessity of having descriptive charts for aëronautical purposes that would show, for exampie, dangerous places such as those where there were wires carrying currents at a high potential. M. Scheimpflug gave an account of his method of making maps from photographs taken from balloons. M. Teisserenc de Bort read a report on the necessity of extending the number of stations at which ascents are made, and Prof. Hergesell said he would make every effort to carry out this suggestion. Prof. Palazzo said he hoped that he would shortly be able to establish a kite station on Mount Etna. M. Hinterstoïsser then gave a lecture on aëronautics from the points of view of science and sport, and illustrated it with lantern-slides.

On Friday, October 5, M. Mangili, president of the committee of the exhibition, entertained the members in an excursion by steamboat on the Lago Maggiore. It had been proposed to make kite ascents, but this proved impossible owing to want of wind. Prof. Hergesell attempted to demonstrate his method of dropping *ballons-sondes* at sea. Unfortunately his apparatus had not arrived, and the *ballon-sonde* sent up did not come down as soon as was intended, and was last seen at a great height and still ascending.

The fifth meeting was held on October 6 under the presidency of M. Köppen and Mr. Dines. Prof. Hergesell explained his method of making balloon ascents at sea. Two balloons are used, one being held by a fastening that can be opened electrically; a small battery is sent up with the instruments, and the electromagnetic release can be worked by a contact actuated by the barometer, or by a contact on the recording drum of the instruments; the latter has been found the better method in practice. One balloon being released, the system slowly falls, until a float hanging below the instruments touches the water; the balloon is inflated so as to hold the instruments above the sea, the float alone touching the water. Both M. Teisserenc de Bort and Prof. Hergesell stated that they are designing a method by which instruments may be dropped from *ballons-sondes* by wireless telegraphy; the former also hopes to be able to detach kites by the same method. M. Teisserenc de Bort thought that for work on land, when for any reason the height of the ascent had to be limited, his method of using paper balloons was to be preferred.

Baron von Bassus exhibited an instrument for reading the records of kite and balloon ascents. He claimed that his instrument would give readings with great accuracy, and that simultaneous points on the different curves could be obtained easily. He thought that by its use small inversions of temperature could be detected that were often overlooked.

M. Teisserenc de Bort then gave an account of the expedition to the equatorial regions of the Atlantic organised by Mr. Rotch and himself. Extremely good results had been obtained, and, contrary to expectation, it was found that in the upper air far lower temperatures were recorded over the equator than at corresponding heights in temperate latitudes. Over the equator the isothermal zone did not seem to exist, but the temperature went on decreasing up to the highest points reached. At heights of 13 to 14 kilometres temperatures had been found as low as −80° C.

At the concluding meeting, held on the afternoon of October 6, various resolutions were passed relating to future conferences. It was resolved that in future the meetings should be held every three years, and that, so far as possible, they should be restricted to three days. Papers relating to instruments and to methods of observation should have precedence over those dealing with the results of observations. It was also agreed that, instead of the present arrangement of having one international day each month, there should be three days together four times a year for the purpose of the international ascents. This arrangement should come into force in March, 1907.

The president then read telegrams that it was proposed to send to the King and Queen of Italy, to the Spanish Minister of War and others, who had taken an interest in the work of the commission. After several speeches the conference then closed.

On Sunday, October 7, an aëronautic *fête* was held in the grounds of the exhibition, and eight balloons made ascents, several members of the conference being passengers. The majority of the balloons descended in the neighbourhood of Pavia.

MODERN NEEDS IN UNIVERSITIES.[1]

UNIVERSITIES in America and Canada are paying more and more attention to our own language and classics, and less and less to Latin and Greek. Not that the latter are excluded, but they no longer outrank other branches of study. Their doors are open to the new forces of the day, and they have at their heads a body of remarkably able and zealous men who not only keep the universities foremost as progressive educative agencies, but whose potent voices are heard upon public questions, as leaders of the higher ideals in politics and national affairs. Much can also be said of those occupying similar positions in Scotland. St. Andrews has just erected a new chemical laboratory for research, Dundee is about to erect such schools as we are to-day to open for Edinburgh. We all know where Glasgow stands in modern branches of education. Aberdeen has just been supplied with new buildings efficiently equipped for the study of science and medicine. No less than eleven new chambers have been assigned to modern studies, to meet pressing demands. The University of London recently separated economics and engineering from arts, and established separate faculties. It is also announced that owing to the unrivalled facilities found in the metropolis, it has to be prepared for the advent of new schools of practical study or research. In the new Universities of Liverpool, Manchester, Birmingham, Leeds, and Sheffield, modern studies are to be paramount. They are to resemble the American type. Harvard University has just been left 800,000*l.* sterling for an institute of technology, but as one of the foremost of such schools is in Boston, she has proposed union with that, and offered if needed new buildings, as part of the University. McGill University, Montreal, has just had handed over to her the agricultural college built by Sir Wm. Macdonald at a cost of 600,000*l.* Thus the millions are now being devoted to science and practical studies, theology and classics being in the opinion of donors already amply provided for. This betokens a steady march forward from the policy of the past, not that it is desirable to exclude any of the former university courses, but there should be added others needed to guide and advance the new knowledge which is creating new conditions.

I judge Scotland to be as far and as happily advanced beyond England in university as she is in elementary public-school education. Her universities are not for a class, but for the people, stirring hives of Democracy. But Scotland may expect the new universities of the five principal English cities to approach nearer to American institutions in character, for their educational atmosphere and aims are very different indeed from those of Oxford and Cambridge, and similar to those of the great American cities. They will be modern universities, fully equipped for the work of to-day. Scotland has to keep marching on. The progress of scientific departments in British universities, considerable as it has recently been, of which the schools we are about to open here to-day are gratifying evidence, yet has not kept pace with the startling progress of science itself and the wonderful discoveries which threaten to revolutionise human conceptions. The discovery of argon by Rayleigh, Becquerel's rays, Röntgen rays, uranium, and, finally, the Curies' radium, threatens to relegate the old atomic theory itself to the list of discarded "creeds outworn," except that science has no creeds. She has only theories and opinions based upon phenomena, all held lightly because subject to progressive discoveries that may be revealed through her unceasing search for knowledge. Science has no preconceived dogmas; she has but one end, the pursuit of truth. It was long claimed for the classics that they alone appealed to the imagination, while dry, prosaic science was incapable of doing so. This is a grievous mistake. The recent discoveries that have startled the world are sublime, and appeal with intense force to the imaginative faculties of man. The scientific man of to-day lives in an atmosphere of wonder, arousing all his higher powers and compelling reverence. At each startling revelation he feels "as some watcher of the skies when a new comet swims into his ken."

The older branches of learning in our universities may well welcome the newer branch, cap in hand, not only as the foundation of material progress, but also as one of the very highest agencies in the imaginative domain. It is the man of science in our day

> "Who can extract each particular virtue from the sun,
> And teach dull nature what her forces are."

This mighty force of our day—science—has hitherto been the Cinderella of the sisterhood of knowledge, but the Prince has appeared at last and taken her by the hand. It is now the turn of the elder sisters to greet the once neglected princess. She will more than justify the millions which are now being showered upon her in the most progressive lands. Thus has the university developed to the present all-embracing type through the successive reigns of scholasticism, theology and ancient classics, always

[1] From an address delivered by Dr. Andrew Carnegie at the opening of new buildings for the natural philoscphy and engineering departments of the University of Edinburgh on October 16.

behind the age, conservative in the highest degree. Science has arisen and established her claim to equality. We have long had the Republic of Letters; we now hail the Republic of Knowledge. The ceremony of to-day bears testimony to the growing power of Edinburgh University; her prominence as a teacher of one of the noblest of all professions, perhaps the one in which those who practise it devote gratuitously a greater part of their time and attention than the members of any other profession, is not likely to be lost. On the contrary, all evidence to-day leads to the opposite conclusion. She is to remain famous for her medical school, and is now also destined to increase her reputation as a scientific instructor through the possession of the increased facilities now provided. The physical laboratory and engineering school, which, with the cordial cooperation of the municipal authorities, have been so ably secured by the principal and the University Court, are the necessary tools which will enable her to extend her work in these important branches of knowledge. They mark an epoch in her long career, and are to testify to future generations that the officials in charge of her work in the beginning of the twentieth century were alive to the duty of keeping her abreast of the new knowledge, of enlarging the field of her activities, and of welcoming the development of the scientific and so-called practical courses, thus keeping her, true to her high mission, in the front rank in all branches. I heartily congratulate the University of Edinburgh upon to-day's acquisitions, from which I hope are to come worthy successors of Faraday, Lockyer, Becquerel, Curie, Rutherford, Rayleigh, Ramsay, Mendeléeff, Kelvin, Tait, and others, to give her such fame in science as the names of Hume, Carlyle, Dugald Stewart, Hamilton, Chalmers, Simpson, and others have already conferred upon her in other fields of knowledge.

AGRICULTURAL NOTES.

Condensed Vegetable Milk.—Mr. T. Katayama, a writer in a recent issue of the Bulletin of the Agricultural College, Tokyo (Bulletin, College of Agriculture, Tokyo Imperial University, vol. vii., 1, April, 1906), describes the preparation of condensed vegetable milk, a product which, though not yet in commerce, would appear to have possibilities for tropical countries. The Japanese prepare vegetable milk from soy beans by soaking, crushing, and boiling in water. The liquid obtained is said to be very similar in appearance to cows' milk, but it differs widely in composition. The average composition of soy milk is given as:—water, 92·5 per cent.; protein, 3·02 per cent.; fat, 2·13 per cent.; fibre, 0·03 per cent.; nitrogen-free extract, 1·88 per cent.; ash, 0·41 per cent. To this material Mr. Katayama added sugar and a little dipotassium phosphate, the latter to prevent protein separating out; he then evaporated the mixture, and obtained a condensed milk. This product is described as having a yellowish colour, an agreeable taste like cows' milk, but a slight odour of beans. It is recommended for culinary purposes as a cheap substitute for ordinary condensed milk.

Cherry Leaf Scorch.—Mr. E. S. Salmon, mycologist at the South-Eastern Agricultural College, Wye, directs attention (Journal, South-Eastern Agricultural College, Wye, No. 15, July) to a danger which threatens the cherry growers of Kent. For the past few years the cherry leaf scorch (*Gnomonia erythrostoma*) has been gradually obtaining a footing in the county. In 1901 Dr. Carruthers pointed out the dangerous character of this disease, but his warning, we are informed, was "wholly disregarded." During the past spring Mr. Salmon visited all the districts in which diseased trees were reported, and he publishes a map showing that leaf scorch now occurs in many orchards from Sevenoaks on the west to Selling on the east, and from Tunstall on the north to Pluckley on the south. It has thus already reached the borders of the Sittingbourne and Faversham districts, and with the next favourable season it will probably invade the valuable orchards in these important cherry-growing centres. The disease is easily detected. The young leaves are infected in spring, and in summer the leaves shrivel up and look as if they had been scorched. They do not fall off in winter, but persist until the following season, forming plague centres from which the young leaves are infected as the buds open. The only thoroughly effective remedy is the collection and burning of dead leaves; it is a costly process, but by this means the disease was banished by Prussian fruit growers after it had devastated some of their best orchards. Mr. Salmon also recommends the use of Bordeaux mixture in spring to render the young leaves proof against infection, and he is experimenting with this mixture in orchards near Pluckley; but he remarks that unless growers cooperate in fighting the disease there is little chance of getting rid of it.

Prussic Acid in Fodder Plants.—In vol. i., part iii., of the *Agricultural Journal of India*, Dr. J. W. Leather gives some particulars about the occurrence of prussic acid in fodder plants. It is well known to the Indian ryot that a feed of green *jowari* (*Andropogon Sorghum*) occasionally proves fatal to cattle, while in recent years stock-owners in this country have now and again been startled by cases of poisoning arising from the use of imported beans. It is only within the past year or two that the cause of such mysterious cases of poisoning has been explained. Certain plants contain glucosides which, when acted upon by a particular enzyme, produce prussic acid. Of such plants Dr. Leather mentions, in addition to Andropogon, flax, the two common beans *Dolichos lablab* or *val* and *Phaseolus lunatus*, the Rangoon bean, and the tapioca plant. The ferment is present in the plant, but, except conditions favourable to its activity occur, no prussic acid is formed. Hence it happens that a food, which is usually quite wholesome, may suddenly develop poisonous qualities. Dr. Leather analysed some green *jowari*, which had been fed to cattle with fatal results, and found in it 1·25 grains of prussic acid per lb. of green fodder. Analysing the same crop a month later, he found that the poison had diminished to 0·75 grain. This is in accordance with the ryot's experience; he is most afraid of young *jowari*. The leaves were found to contain much more prussic acid than the stalks, and ten times as much as the inflorescence.

Artificial Manures for India.—In connection with the possible introduction of a sulphuric acid industry into India, Mr. F. G. Sly, I.C.S., contributes a note on mineral fertilisers to the *Agricultural Journal of India*. He quotes experiments which show that soluble phosphatic manures would be of great value in Bengal, and he indicates that a demand for such manures may arise in India before very long. The native sources of mineral phosphates are not particularly promising, but it is suggested that Christmas Island phosphate, which can be landed in Calcutta for about 50*s.* per ton, would supply suitable raw material for the Indian manufacturer of superphosphate of lime.

Agriculture in Egypt.—The bi-monthly Journal of the Khedivial Agricultural Society of Egypt has given place to a year-book, and if subsequent issues maintain the promise of the first number former readers of the journal will appreciate the change. The first (1905) volume of the new year-book, which has recently reached us, is a well-printed, well-illustrated royal octavo book of 277 pages. It comprises two sections, the first contributed by officers of the society, the second by members of the staff of the Khedivial School of Agriculture. The greater part of the volume is devoted to the cotton crop. The first paper, by Mr. F. C. Willcocks, deals in detail with the cotton-worm, the larva of the moth *Prodenia littoralis*, which appeared in Egypt about forty years ago, and for thirty years has done serious damage. The Government has now adopted stringent measures in the hope of ridding Egypt of this plague. All cultivators are required to notify its appearance, and to collect and destroy the eggs at once. The larva damages the plant chiefly by feeding on the under-surfaces of the leaves, but it also attacks the buds and young bolls. This insect is very prolific, and there may be seven generations in a season. In a second paper Mr. Willcocks gives a very complete account of the cotton boll-worm *Earias insulana*, which is the destructive boll-worm of Egypt as well as of India. For this pest no effective remedy has yet been found. The cotton cut-worm *Agrotis ypsilon* is also described and figured. The secretary of the society, Mr. G. P. Foaden, writes a general article on the selection of cotton seed, and directs attention to the methods in use in the United States of America. Of the

other contributions, the most important are those contributed by the society's botanist, Mr. W. L. Balls, on the physiology of a simple parasite, and the sexuality of cotton. The first paper gives an account of a damping-off fungus which produces a disease among seedlings known to the American cotton grower as "sore-shin." Mr. Balls attributes the failure of seedling cottons in Egypt chiefly to the attacks of this fungus. The actual damage done varies greatly in different seasons. Weather which is too cold for the young cotton plant is favourable to the parasite, and "sore-shin" is largely a question of temperature. Remedies are now being sought for, and it is suggested that careful attention to the seed-bed might prevent, or at least mitigate, the disease. Mr. Balls's second paper describes some cytological work undertaken as a preliminary to investigations on questions of heredity. The descriptions and drawings of the sex cells, of fertilisation, and of the seed should prove of interest and value to economic botanists engaged upon the improvement of the cotton plant.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Combined examinations for sixty-six entrance scholarships and various exhibitions at Pembroke, Gonville and Caius, King's, Jesus, Christ's, St. John's, and Emmanuel Colleges will be held on Tuesday, December 4, and following days. Mathematics, classics, and natural sciences will be the subjects of examination at all these colleges. Forms of application for admission to the examination at the respective colleges may be obtained as follows:—Pembroke College, W. S. Hadley; Gonville and Caius College, the Master; King's College, W. H. Macaulay; Jesus College, A. Gray; Christ's College, Rev. J. W. Cartmell; St. John's College, Dr. J. R. Tanner; Emmanuel College, the Master, from any of whom further information respecting the scholarships and other matters connected with the several colleges may be obtained.

At a meeting of the master and fellows of Pembroke College, held on October 10, Mr. C. F. Russell, formerly scholar of the college, was elected to a fellowship. Mr. Russell was Bell scholar in 1902, and was bracketed fourteenth wrangler in the mathematical tripos, part i., 1904; he was placed in the second division of the first class in the mathematical tripos, part ii., 1905, and was Smith's prizeman in 1906.

The Gedge prize has been awarded to P. P. Laidlaw, of St. John's College, for his essay entitled "Some Observations on Blood Pigments."

Dr. Hobson, Prof. Larmor, Prof. H. Lamb, Trinity College, professor of mathematics at Victoria University, Manchester, and E. W. Barnes, Trinity College, have been nominated examiners for part ii. of the mathematical tripos in 1907, and Prof. Hopkinson and W. H. Macaulay, of King's College, examiners for the qualifying examination for the mechanical sciences tripos in the current academical year.

W. E. Dixon, of Downing College, and R. Stockman (Edinburgh), professor of materia medica and therapeutics in the University of Glasgow, have been nominated examiners in pharmacology, and T. S. P. Strangeways, St. John's College, and T. Ritchie (Edinburgh), examiners in general pathology for the first part of the third examination for the degree of M.B. in the current academical year.

Prof. J. A. Ewing, King's College, has been nominated an elector to the John Winbolt prize in civil engineering to be awarded in the year 1907; and Dr. Marr and Dr. J. W. Judd examiners for the Sedgwick prize.

Mr. J. J. Lister, fellow of St. John's College, has been nominated a member of the board of electors to the professorship of zoology and comparative anatomy until February 20, 1913, in succession to the late Prof. W. F. R. Weldon.

MR. J. F. M. DRUMMOND, Caius College, Cambridge, formerly Frank Smart student in botany, has been appointed lecturer in botany at Armstrong College, Newcastle-upon-Tyne.

THE annual general meeting of the Association of Teachers in Technical Institutes will be held at the Birkbeck College, London, on Saturday, October 27, commencing at 3 p.m. The chair will be taken by Mr. W. J. Lineham, president of the association.

THE Peking correspondent of the *Times*, in a telegram of October 21, announces the abolition of the old system of examinations in China. In partial substitution there will be held an annual examination in Peking of Chinese graduates educated abroad. This year all Chinese holding foreign diplomas were invited by the Board of Education to submit themselves for examination in the subjects they studied abroad. About fifty responded, of whom forty-two were admitted, twenty-three with Japanese degrees, seventeen with American, and one each with German and English. At the examinations nine were granted the Chinese doctorate, twenty-three the degree of Master of Arts, and ten were rejected.

THE Bristol Education Committee has placed the Castle Council Schools, embracing large buildings which accommodated more than a thousand children, at the disposal of the governors and principal of the Merchant Venturers' Technical College, Bristol, which was recently damaged seriously by fire. These schools are being fitted with the necessary lecture theatres, laboratories, and workshops with all possible speed, and, meanwhile, other institutions in Bristol are lending their lecture theatres and laboratories. Fortunately a large part of the newest machinery of the engineering department of the college, especially the experimental engines and dynamos, which cost more than 2500*l*., have been saved, as they were placed in a separate building containing many of the college workshops, and situated at some distance from the one injured by the fire; moreover, the basement of the main building has suffered comparatively little, and in this are the mechanical and electrical engineering laboratories and the engineering workshop.

THE new agricultural college and research institute for Madras is now in course of erection. In 1905 a grant to the Presidency by the Government of India of 10,000*l*. per annum, which was subsequently increased to 20,000*l*., added to the allotments made by the Government of Madras, removed all financial difficulty experienced by the Madras Agricultural Department, and will in time provide the necessary staff. The result of this improved financial position was the decision of Government to close the agricultural college at Saidapet, and establish a new college and research institute adequately equipped with laboratories and class-rooms with a suitable farm near Coimbatore. The staff will consist of an expert agriculturist as the principal of the college, a superintendent of the central farm, a Government botanist, and an agricultural chemist. Ultimately an entomologist and mycologist may be added to the staff, which will combine teaching with research work. The institution is to fulfil a two-fold purpose. Problems connected with the agriculture of the presidency will be studied in the laboratory and the field, while students will be given a general education in all branches of agricultural science. The farm will afford a field for experience and for a test of laboratory research, as well as a training ground for students, in the practical application of science to agriculture.

AN addition to the University of Edinburgh Union was opened on October 19 by Mr. Haldane, the Lord Rector. Mr. Balfour, the Chancellor of the University, presided at the ceremony, and in the course of a speech delivered in calling upon the Lord Rector, directed attention to the true functions of a university. No university, he said, can be described as properly equipped which merely consists of an adequate professoriate, adequate lecture-rooms, adequate scientific apparatus, which only satisfies the needs, exacting though they are, of modern science and modern education. Something more than that is required if a university is to do all that it is capable of doing for the education of the young men of this country. A university life which consists only of the relation between the teachers and the taught, between the professor and the student, is but half a university life. The other half consists of the

intercourse between the students themselves in the day to day common life, the day to day interchange of ideas and friendships, of commentary on men and things, and on all the great problems which an opening world naturally suggests to the young. A university which is deficient in that is but half a university, and no mere scholastic equipment can satisfy the void which is thus left. Mr. Haldane delivered an address before opening the new Union buildings, and spoke of the value of the corporate life at the University. No university, he remarked, does its work adequately if it does it only by training in the paths of learning. What is wanted is the moulding influence of the spirit of the place—a *universitas* which is a *universitas*, not of the arts, not of the sciences merely, but one which, like the State, moulds the individualities of those who belong to it. It is the spirit of the university as much as the abstract theories that are discoursed of there that tell in the composition of character; and what a significance the university has for the moulding of character. Leaders, he continued, are wanted in the great struggle of the nations to-day, and there is no school for training in leadership so fruitful, so complete, as that training of the university which bases science and art alike on the foundation of the widest culture. It is science and learning that form the true function of the professor; and it is the spirit of the men who are penetrated with the desire to absorb science and learning as things in themselves that communicates itself to those who come in contact and who live with them. That is why it always will be that the spirit of a university, the contact of its fellow-students, the influences which the corporate whole of university life exercises, will be the dominating influence in moulding the character and the quality of the students.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, October 8.—M. H. Poincaré in the chair.—The synthesis of amethyst quartz: researches on the natural or artificial colouring of some precious stones under radio-active influences: M. **Berthelot.** Natural amethyst was decolorised by heating to a temperature of 300° C., and then exposed to the action of radium chloride, the experiment being arranged so that the specimen was not in actual contact with the radium salt, and was not exposed to its emanations. The violet colour slowly returned. Similar results were obtained with violet fluor-spar, and the effects produced are attributed by the author to the reduction and oxidation of manganese compounds. Ordinary fused quartz tubes are also slowly coloured violet by the radium radiations. The bearing of these experiments on the coloration of minerals in nature is discussed.—The work done at the observatory at the summit of Mt. Blanc: M. **Janssen.** The season of 1906 was an exceptionally favourable one, and the work done included biological researches on rabbits and guinea-pigs by MM. Moog and Guillemard, heliometric researches by MM. Millochau and Féry, magnetic studies at different altitudes by M. Senonque, and studies of the surfaces of Venus and Jupiter by MM. Hansky and Stefanik. The results of these various researches will be communicated later to the academy.—The red colour of certain leaves and the colour of autumn leaves: Armand **Gautier.** The red colour developed in leaves which have been wounded, or in the autumn foliage, is not one and the same in all plants, as has been too hastily assumed. Anthocyanine has been regarded by botanists as the cause of the autumnal red in foliage, and as a uniform product derived from chlorophyll; in the case of the vine this is certainly not the case, since the colouring matter contains neither nitrogen nor phosphorus, two essential constituents of chlorophyll.—The principle of correspondence for an algebraic surface: H. G. **Zeuthen.**—Succinic pinacone: Louis **Henry.** This bi-tertiary alcohol is obtained in good yield by the action of methylbromide of magnesium on ethyl levulate. Both hydrochloric acid and acetyl chloride give the dichlorhydrin $(CH_3)_2C.Cl—(CH_2)_2—CCl(CH_3)_2$, and dilute sulphuric acid, even in the cold, gives the internal anhydride tetramethyl-tetramethylene oxide, the physical and chemical properties of which are given. Dry distillation gives an unsaturated tertiary alcohol.—The nature of the virtual sugar of the blood: R. **Lépine** and M. **Boulud.**—The perpetual secretary announced the death of M. Etienne Georges Sire, correspondant of the academy for the section of mechanics.—Contribution to the study of the calorific emission of the sun: Ch. **Féry** and G. **Millochau.** A thermocouple of the same type as those used in the commercial Féry pyrometers is placed at the focus of a silvered mirror, a total reflection prism and eye-piece being added so that readings can be made as in a Newtonian reflecting telescope. Observations were carried out in two ways: placing the centre of the sun in coincidence with the cross wires of the telescope at different hours of the day, and observations of the effects produced at different points of the solar disc. Measurements were carried out at four stations at different altitudes, Meudon (150 metres), Chamonix (1030 metres), Grands-Mulets (3050 metres), and the Janssen Observatory at the summit of Mt. Blanc (4810 metres). Details regarding the standardisation of the apparatus and discussion of the results will be given in a later communication.—Observations of the sun made at the Lyons Observatory during the first quarter of 1906: J. **Guillaume.** Observations were possible during forty-three days in this quarter, the results of which are summed up in three tables showing the number of sun-spots, their distribution in latitude, and the distribution of the faculæ in latitude.—Observation of the total eclipse of the moon on August 4, 1906, and remarks on the subject of a squall at Phu-Lien, Indo-China: G. **Le Cadet.**—The liquefaction of wheat starch and seeds: A. **Boidin.**—The detection of adulteration of butter with cocoa-butter and oleo-margarine: Lucien **Robin.** Details of a method of analysis based on the difference in the solubilities of the fatty acids of butter and cocoa-fat in dilute alcohol.—The complexes of pure albumen: André **Mayer.**—The direct action of light on the transformation of the sugars absorbed by the young plants of *Pinus pinea*: W. **Lubimenko.**—Some new views, morphological and biological, on the stinging Diptera: E. **Roubaud.**—A hitherto undescribed organ in the thorax of flying ants: Charles **Janet.** An account, with a diagram, of a mesonotal diaphragm and metanotal diaphragm in ants after the nuptial flight.—The distribution of the Trias in Greece: Fritz **Frech** and Carl **Renz.**—The earthquake in Chili of August 16, 1906: A. **Obrecht.**—The amount of carbonic acid in sea air: R. **Legendre.** The average result from thirteen localities was 3·35 parts of carbonic acid per 10,000 of air.

October 15.—M. H. Poincaré in the chair.—A new and rapid method for the determination of the errors of division of a meridian circle: M. **Lœwy.** The author gives an outline of a method, fuller details of which will be communicated later, for increasing the accuracy of calibration of a meridian circle. The method has the great additional advantage of much reducing the time necessary for the work. Fixing a probable error for the position of each graduation at $\pm 0''{\cdot}02$, the time required to fix the position of each degree is about 100 hours, for half degrees 170 hours, and for quarter degrees 330 hours.—The principle of correspondence for an algebraic surface: H. G. **Zeuthen.**—The dialysis of the sugar of the blood: R. **Lepine** and M. **Boulud.** Under the conditions of the experiments described, the sugar in normal blood serum is not dialysable, but in abnormal cases dialysis takes place, notably when the serum contains newly-formed sugar. These facts are in favour of the idea that in the normal state the sugar is not free in the blood.—The transformation of M. Darboux and the fundamental equation of isothermal surfaces: Rudolf **Rothe.**—The uniform solutions of certain functional equations: M. **Fatou.**—The mechanism of ionisation by solution: Gustave D. **Hinrichs.**—The chemical functions of textiles: Léo **Vignon.** Quite apart from their fibrous structure and resulting development of surface, textiles behave as specifically active chemical molecules. The animal textiles (silk, wool) possess both basic and acid functions; the vegetable

textiles are deprived of basic functions, and possess feebly acid functions comparable to those of the alcohols. Porous substances, such as animal charcoal, are inert from the chemical point of view.—The condensation of acetylenic nitriles with the amines. A general method of synthesis of β-substituted β-amino-acrylic nitriles: Ch. **Moureu** and I. **Lazennec.** Acetylenic nitriles of the type R—C≡C—CN unite directly with primary and secondary amines, giving substituted acrylic nitriles of the type

$$R—C(NX_1X_2)=CH—CN.$$

These are neutral bodies, easily hydrolysable by acids, regenerating the amines, and forming ketones of the general formula R—CO—CH_2—CN. Examples are given showing the generality of the reaction.—Helicoidal arrangement in crystallised bodies: Fred. **Wallerant.**—A third mandibular canal in the infant: R. **Robinson.** This third dental duct, which has not hitherto been noted, is always found in young children. From about eight years of age it appears to atrophy, and leaves as the only trace of its existence a more or less marked depression, corresponding to its outlet. This depression has been noted by other anatomists, and has been regarded as a rudimentary alveole.—The penetration of *Treponema pallidum* in the ovule: MM. **Levaditi** and **Sauvage.** A contribution to the study of the hereditary transmission of syphilis.

NEW SOUTH WALES.

Linnean Society, August 29.—Mr. Thos. Steel, president, in the chair.—Notes on the native flora of New South Wales, part v., Bowral to the Wombeyan Caves: R. H. **Cambage.** This paper deals with the vegetation over a distance of about fifty miles westerly from Bowral, special reference being made to the changes which take place on the different geological formations. The flora of the basaltic area is shown to differ from that of the sandstone, while that of the syenite hill known as The Gib comprises species common to both.—The Mollusca of Masthead Reef, Capricorn Group, Queensland, part i.: C. **Hedley.** On the east coast of Australia the best-known points, from the view of a marine zoologist, are Torres Strait and the neighbourhood of Sydney. To investigate an intermediate station, the author organised an expedition to the south end of the Barrier Reef. Masthead Island, just outside the tropic of Capricorn, was selected for examination. The island and surrounding reef are described and compared with the coral islands of the Central Pacific. The zonal distribution of coral-haunting mollusca is reviewed.—New Australian species of the family Libellulidæ (Neuroptera: Odonata): R. J. **Tillyard.** In this paper eleven new species are added to the list of Australian Libellulidæ, bringing the total up from fifty to sixty-one. All the new species were taken in the Cairns district of North Queensland during the summer of 1904–5. Of these, three only are new to science. The remainder are species already known in other parts of the world, but so far unobserved in Australia.—Note on the cerebral localisation in the bandicoot (Perameles): H. G. **Chapman.** The positions of the cortical motor centres in the brains of marsupials have been described in the opossum (*Didelphys virginiana*) by Ziehen, and by R. Cunningham, and in the native cat (*Dasyurus viverrinus*) by Flashman. The results of an investigation of the motor areas observed in *Perameles nasuta* and *P. obesula* are communicated in the present paper. The centres described have been found regularly in each animal and on both sides of the brain.

DIARY OF SOCIETIES.

FRIDAY, OCTOBER 26.

PHYSICAL SOCIETY, at 5.—The Strength and Behaviour of Ductile Materials under Combined Stress: W. A. Scoble.—The Behaviour of Iron under Small Periodic Magnetising Forces: J. M. Baldwin.—Fluorescence and Magnetic Rotation Spectra of Sodium Vapour, and their Analysis: Prof. R. W. Wood.

SATURDAY, OCTOBER 27.

ESSEX FIELD CLUB (at the Essex Museum of Natural History, Stratford), at 6.30.—On the Salinity of the Sea-water along the Coast of Essex: Dr. H. C. Sorby, F.R.S.—Sponges: their Life-history and Development: M. Y. Wolfe.

THURSDAY, NOVEMBER 1.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Nitrification of Sewage: Dr. G. Reid.—A General Consideration of the Subaërial and Freshwater Algal Flora of Ceylon: Dr. F. E. Fritsch.—The Anæsthetic and Lethal Quantity of Chloroform in the Blood of Animals: Dr. G. A. Buckmaster and Dr. J. A. Gardner.

CHEMICAL SOCIETY, at 8.30.—A Development of the Atomic Theory which correlates Chemical and Crystalline Structure and leads to a Demonstration of the Nature of Valency: W. Barlow and W. J. Pope.—The Explosive Combustion of Hydrocarbons, ii.: W. A. Bone, J. Drugman and G. W. Andrew.—Contributions to the Theory of Solutions: (1) The Nature of the Molecular Arrangement in Aqueous Mixtures of the Lower Alcohols and Acids of the Paraffin Series; (2) Molecular Complexity in the Liquid State; (3) Theory of the Intermiscibility of Liquids: J. Holmes.—The Hydrolysis of Nitro-cellulose and Nitro-glycerol: O. Silberrad and R. C. Farmer.—The Determination of the Rate of Chemical Change by Measurement of Gases Evolved: F. E. E. Lamplough.—Experiments on the Synthesis of the Terpenes Part IX., The Preparation of δ-Ketohexahydrobenzoic Acid (δ-Keto*cyclo*hexanecarboxylic Acid) and of γ-Keto*cyclo*pentanecarboxylic Acid: F. W. Kay and W. H. Perkin, jun.—Experiments on the Synthesis of the Terpenes, Part X., Synthesis of Δ'-*m*-Menthenol (8) and of Carvestrene: W. H. Perkin, jun., and G. Tattersall.—Some Derivatives of Catechol, Pyrogallol, Benzophenone and of Other Substances allied to the Natural Colouring Matters: W. H. Perkin, jun., and C. Weizmann.

LINNEAN SOCIETY, at 8.—The Structure of Bamboo Leaves: Sir Dietrich Brandis, K.C.I.E., F.R.S.—On a Collection of Crustacea Decapoda and Stomatopoda, chiefly from the Inland Sea of Japan, with Descriptions of New Species: Dr. J. G. de Man.—On *Hectorella caespitosa*, Hook. f., with Remarks on its Systematic Position: Prof. A. J. Ewart.—*Exhibitions:* Young Plaice Hatched and Reared in Captivity: the President.—Abnormal Specimens of *Equisetum Telmateia*, Ehrh.: George Talbot.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Bridge Work Design: P. J. Waldram.

CONTENTS.