THURSDAY, SEPTEMBER 23, 1909.

PHILOSOPHY AND HISTORY OF SCIENCE.

(1) *Das Prinzip der Erhaltung der Energie.* By Dr. Max Planck. Zweite Auflage. Pp. xvi+278. (Leipzig: B. G. Teubner, 1908.) Price 6 marks.

(2) *Vererbung, Gedächtnis und Transzendentale Erinnerungen vom Standpunkte des Physikers.* By Dr. Gustav Eichhorn. Pp. x+116. (Stuttgart: Julius Hoffmann, 1909.) Price 2.50 marks.

(3) *De la Méthode dans les Sciences.* By Profs. H. Bouasse, &c. Pp. 412. (Paris: Félix Alcan, 1909.)

(4) *Materialistische Epoche und monistische Bewegung.* By Paul Volkmann. Pp. 30. (Leipzig: B. G. Teubner, 1909.) Price 1 mark.

(5) *Das Theorem des Pythagoras.* By Dr. H. A. Naber. Pp. xii+240. (Haarlem: P. Visser, 1908.) Price 7*s*.

(6) *Essai sur la notion de Théorie physique de Platon à Galilée.* By Pierre Duhem. Pp. 144. (Paris: A. Hermann and Son, 1908.) Price 5 francs.

(7) *Il passato ed il presente delle principali Teorie geometriche.* Terza editione. By Prof. Gino Loria. Pp. xxiv+476. (Torino: Carlo Clausen, Hans Rinck Succ, 1907.)

(1) IN 1887 the Göttingen Faculty of Philosophy offered a prize for the best essay, historical and critical, on the physical concept of energy, and the principle of conservation of energy. The prize was awarded to Dr. Max Planck, and his essay now, in its second edition, finds a fitting place in the series which the Teubner Press are issuing bearing the title of the first volume by Poincaré, "Science and Hypothesis."

The volume is divided into three sections. The first is historical; the second deals with statements and proofs of the principle; while the third discusses the various forms of energy and their symbolic representations.

"The Principle of Conservation of Energy" is a somewhat elastic title for a thesis. Had Prof. Planck included every application of the principle or every investigation in which the principle plays an important part, his work would have swelled out into a treatise containing pretty well the whole of physics and a large part of chemistry. The author has been wise in restricting his inquiries to a narrow field. He excludes all reference to the less easily understood second law or principle of degradation of energy. That principle is far more difficult to understand than the first law, and it is doubtful whether at the time of writing the essay Prof. Planck could have been in a position to give a satisfying account of it. It teaches us that a community of molecules tends towards a state of socialism in which wealth in the form of energy is evenly distributed among the molecules, but that as the change takes place, this energy becomes less and less available for useful purposes, until the system comes to a deadlock, when all progress and activity ceases, and no further work is done by the system. The first law, which tells us that wealth in the form of energy cannot be created or destroyed, so that one molecule cannot grow richer without making another poorer, is much easier of comprehension, and gave Prof. Planck abundant material for discussion.

While the treatment can scarcely be described as exhaustive, this impression may be to a large extent attributed to the changes which have taken place in our knowledge of physical phenomena since the thesis was written. It would have been next to impossible for the author to have brought the book up to date by the inclusion of this later work; and, after all, what has happened in the interval? Have we not, as a general rule, taken the principle of conservation of energy for granted, and merely investigated fresh applications of it? Even in connection with the phenomena of radio-activity, no one has cast any very serious doubts on the validity of the principle. For critical writings on the subject, we must go back to the time of Clausius, Mayer, Joule, and the earlier works of Helmholtz and Lord Kelvin; and these are discussed in the first section. An attempt to draw in recent applications might have confused the issue rather than otherwise.

(2) While many attempts have been made to formulate a physical basis for the phenomena of life—for example, by Loeb in Germany and Dr. F. J. Allen in this country—considerable difficulty is experienced in explaining thought, memory, and the hereditary transmission of characters, none of which concepts appears easily reconcilable with the ordinary properties of matter, at any rate in its inert state. Dr. Gustav Eichhorn would now maintain that electric theories of matter open up new possibilities. For the discovery of electrons, the theory that matter is a complicated aggregate of electrons, and the existence of mutual relations between matter and æther, are fully consistent with the view that the phenomena of thought and heredity are caused by particular states of the æther associated with the molecules of the material organism. Part of the book, dealing with hallucinations and "transcendental memories," was written ten years ago. The author does not profess to give an exhaustive or complete study of the problems with which the book deals, and in view of the fact that the electron theory is comparatively recent, his claims to have treated the subject from a new standpoint are not without foundation; but isn't all this the old notion of spiritualism and "animal magnetism" merely served up under a different name? If not, the resemblance is very striking, and the difference not very obvious.

(3) The collection of articles edited by Dr. Thomas under the designation of "Method in the Sciences" owes its publication to the growing importance attached to philosophy of science, and in particular to methodology in French educational curricula following Auguste Comte. It is pointed out that both text-books and original articles leave a gap in such literature of the subject as is available for students, and this gap it has been the object of the present volume to assist in filling. In reviewing this book, one is tempted to enlarge on the fact that an educational system which tries to mould all teachers or students according to a common pattern can never be efficient. No better preventive against this deadly uniformity can be suggested than the publication of a book representing the combined experience of all sorts and con-

ditions of men each a specialist in his own particular department of science; and if it is found that doctors disagree on points of detail, it is claimed that an examination of their views will have the beneficial effect of making the student think for himself instead of merely taking what is written for granted. The mere learning machine, who is frequently devoid of powers of clear exposition, probably exists in every country, but he is not the kind of man to be encouraged. This volume consists of articles on science, by Émile Picard; pure mathematics, by Jules Tannéry; mechanics, by P. Painlevé; general physics, by H. Bouasse; chemistry, by A. Job; morphology, by A. Giard; physiology, by F. Le Dantec; medical sciences, by Pierre Delbet; psychology, by Th. Ribot; sociology and social science, by E. Durkheim; morale, by L. Lévy Bruhl; and history, by G. Monod, all under the editorship of Dr. P. F. Thomas.

(4) Prof. Volkmann's pamphlet is an address delivered at the graduation ceremony of the Albertus University on January 18. It deals with the materialistic philosophy of the nineteenth century, with phenomenology and monism, and with the idealism of Kant, whose connection with the university in question is too well known to require mention.

(5) Dr. Naber deals in a pleasant and chatty way with many points in the history of Greek and Egyptian geometry. The discussion is in no way confined to the proposition now more generally known as "One Forty-Seven," which forms the title of the book, but we have sections dealing with "Pi" and its supposed value $\sqrt{10}$, with spirals and limaçons and their applications to angle-trisection and cube-duplication, with the history of the "Golden" or median section, and finally with the "pentalpha," or pentagonal star, and the dodecahedron. "Spirals in nature and in art" receive considerable attention, and are illustrated by numerous figures. It would be impossible to dwell at length on the historic side of the book. If it has one fault, that fault is a certain diffuseness and lack of definiteness. By this we mean that in some places it is not very certain what conclusions the author is seeking to prove. But possibly that is because the author is endeavouring to give a general idea of what mathematical thought was like in the Pythagorean times, and to do this he reasons largely from conjecture where historic evidence is wanting. He cannot certainly be accused of being long-winded, his sections being very short and concise, and his language terse.

(6) "To save appearances" (*σωζειν τα φαινομενα* or to account for observed facts was the object of Greek philosophy, which forms the motto of Prof. Duhem's book. Not less is it the object of the modern physicist. In tracing the development of physics from the time of Plato to that of Galileo a good many points may be observed which have left their traces on modern physical theory. We notice, in Prof. Duhem's words, that where we now speak of physics, the Greek and Mussulman philosophers and the men of science of the Middle Age spoke of astronomy; that the laws of motion of celestial bodies were studied ages before anyone thought of applying similar methods to terrestrial (or "sublunary") bodies; that the first discussions of the phenomena of the material world were metaphysical, and that optics and statics were the earliest subjects to form the basis of mathematical theories. We observe with interest the division of physics into two branches, one dealing with celestial and the other with sublunary bodies, of which the first was regarded as infinitely more perfect than the second, and was for this reason wrongly supposed to be only accessible to divine intelligence, while the latter or terrestrial physics was supposed to be summed up in the work of Aristotle. And we reflect that even nowadays the once supposed easier task of "saving the phenomena" of sublunary matter is the one which physicists as a rule shirk. It is true that electricity and not astronomy is the subject now usually under investigation, but in either case the philosopher turns his thoughts to the ether as the seat of the phenomena under investigation, and finds that the hypotheses necessary to "save" these phenomena are greatly simplified owing to the omission of irreversible effects. It is not claimed by Prof. Duhem that his is the first attempt at a history of physics as distinct from mathematics, but as a general account of the subject in a moderate compass it would be difficult to write a better book.

(7) Prof. Gino Loria's book needs little comment. Its merits can be summed up in a few words. It is a book with which no geometer can afford to dispense. It is a bibliography of geometry classified under such headings as "Geometry up to 1850," "Algebraic Curves," "Differential Geometry," "Non-Euclidian Geometry," "Geometry of Multi-dimensional Space." Every page is filled with references, and the number of papers and memoirs which have been consulted in the preparation of the book must be counted by thousands; indeed, if we mistake not, the mere names of authors contained in the index number well into the four figures. The second edition appeared in 1896, and in this third edition the author has added an appendix of about 120 pages dealing with the progress of geometry during the last ten years. In the epilogue, the author compares geometry to a fertile region the vegetation of which still offers numerous prizes in the form of flowers and fruits to the explorer and cultivator. If this analogy be pursued a little further, the need had arisen for a flora of the new territory, and no better botanist could be found for the purpose than Prof. Gino Loria.

THE FLUIDS OF THE BODY IN HEALTH AND DISEASE.

(1) *The Mercers' Company Lectures on the Fluids of the Body.* By Prof. Ernest H. Starling, F.R.S. Pp. viii+186. (London: Archibald Constable and Co., Ltd., 1909.) Price 6*s.* net.

(2) *Studies on Immunisation and their Application to the Diagnosis and Treatment of Bacterial Infections.* By Sir A. E. Wright, F.R.S. Pp. xv+490. (London: Archibald Constable and Co., Ltd., 1909.) Price 16*s.* net.

ALL important as the cells and cellular tissues of the body are, the fluids of the body may claim an equal importance, both in physiological or normal

and in pathological or abnormal processes. In fact the one is a supplement to the other, and probably neither is able to exert its full activity without the simultaneous cooperation of the other.

(1) The first book under review comprises courses of lectures delivered by Prof. Starling at University College under the auspices of the Mercers' Company, at the Bellevue Hospital, New York, under the foundation of Dr. Herter, and at the Royal College of Surgeons. It is written in a simple and attractive style, and gives an admirable description of such subjects as the physical properties of protoplasm, the osmotic relationships of cells, the intake, exchange, absorption, and output of fluids in the body, and the production of lymph (the fluid which bathes the tissues), and the relationship of these normal processes to disease processes, such as dropsy. Many important physical and chemical conceptions, such as osmotic pressure, adsorption, the nature of colloids, surface tension, and the like, are here brought together and explained, and their relation to vital processes is examined. In the discussions of the connection between normal and pathological processes many suggestions of value to the medical practitioner are made. Thus the regeneration of the constituents of the blood after bleeding is considered to be due to the stimulus of lack of oxygen, and the value of occasional blood-letting is compared to that of a sojourn at high altitudes, the beneficial and recuperative effects of which are well recognised, and it is suggested that the practice of *occasional* blood-letting may be restored to the position of honour it once held in medical practice.

(2) The second book includes numerous papers contributed by Sir Almroth Wright, his co-workers, and friends to various journals and societies, and deals more or less directly with the problems of immunisation against disease-producing micro-organisms. The first part of the book deals primarily with the protective elements of the blood, agglutinins, bactericidins, and opsonins; in the second part the problem of fighting bacterial infections by those defensive agencies which the organism itself employs when it contends with microbic invasions, is discussed. The formation of a book by a collection of separate papers, collated together though they be to some extent by numerous foot-notes, necessarily leads to a certain amount of repetition, and to a somewhat irritating use of cross-references. Nevertheless, all workers in this field of research cannot but be grateful to Sir Almroth Wright for thus bringing together and rendering accessible a number of scattered papers.

Opsonins and vaccine therapy necessarily occupy a prominent place. Opsonins are substances present in the blood which act upon invading microbes, and render these susceptible to phagocytosis, that is, to ingestion by certain amœboid, wandering, and other cells, which brings about their destruction. By the injection of a certain quantum of a killed bacterial culture the production of opsonins specific for the particular organism injected tends to be increased; phagocytosis of the organism in question therefore is also rendered more active, and if an infection with the organism exists, it tends to be got rid of. The use of bacterial vaccines has been successful or useful in many infections; this is vaccine therapy. The present-day employment of vaccine therapy must in the main be ascribed to the work of Sir Almroth Wright, his co-workers and pupils, and to them all honour is due. At the same time we cannot help thinking that to some extent a balanced perspective is wanting in some of the statements. Thus the condemnations of the antiseptic system, and of the value of surgical extirpation of infective foci, are too wide and sweeping (pp. 280 and 318). The same criticism applies to the remarks on serum therapy (pp. 300 and 321).

Whatever be the failures of serum therapy, we cannot help thinking that neutralisation of the existing "poison" *at the moment* is a goal to be aimed at, however much we strive to reinforce the defensive powers of the body and render it later able to take care of itself. In very acute infections, such as some forms of septicæmia, which may prove fatal in twenty-four to forty-eight hours, or in cholera, in which the patient may be dead in a few hours after the commencement of the attack, the direct neutralisation of the "poison" would seem to be the only treatment that affords hope of success. The comparative failure of serum therapy should therefore be a stimulus to the elaboration of new methods of preparation of therapeutic serums rather than an argument for considering serum therapy futile.

TEXT-BOOKS OF PHYSICS.

(1) *Heat and other Forces.* By Colonel W. F. Badgley. Part i.: "Heat"; part ii.: "Physical Forces." Pp. 221+vi. (London: King, Sell and Olding, Ltd., 1907.) Price 5*s.* net.

(2) *An Elementary Course in Practical Science.* By C. Foxcraft and T. Samuel. Part i. Pp. 48. Part ii. Pp. 58. (London: G. Philip and Son, Ltd., n.d.) Price 6*d.* net each.

(3) *Horbare, Sichtbare, Elektrische und Rontgen-Strahlen.* By Dr. Friedrich Neesen. Pp. 132. (Leipzig: Quelle and Meyer, 1909.) Price 1.25 marks.

(4) *An Elementary Text-book of Physics.* By Dr. R. W. Stewart. Part ii.: "Sound," pp. iii+141. Part iii.: "Light," pp. vii+219. (London: C. Griffin and Co., Ltd., 1909.) Price, part ii., 2*s.* 6*d.* net; part iii., 3*s.* 6*d.* net.

(1) COLONEL BADGLEY'S book is an extraordinary production. The contents might be guessed from the title, which implies that heat is a force. The author has evidently read a great deal of current scientific work, to which he frequently refers, but has not the exact knowledge necessary for writing on the subject. Indeed, he suggests that the differences between work, energy, power, force, and motion are only mythical, and that the terms are really interchangeable. Typical, also, is the statement that "the heat given off by the spontaneous decomposition of radium is, perhaps, about a degree and a half centigrade." The preface is very cynical. It is questioned whether men of science believe in one

another's discoveries, and hinted that few of the latter are worthy of acceptance. The main object of the book is said to be to try to prove that "heat is not a vibration of material, not even of aether," but we search in vain for a clear alternative definition. It is a difficult book to follow because of the entire lack of order. The whole is an intricate mixture of simple experimental facts, quotations from books on many subjects, some of which are very remotely connected with heat, and a large amount of astounding new theory. Most of the ordinary phenomena in heat are dealt with, and a chapter in defence of the British systems of measurement is included. We can neither recommend the book to beginners—for it would confuse them—nor to those conversant with the subject—for it would waste their time.

(2) The two little books on practical science are for use in elementary schools, and the authors claim that the scheme has already been thoroughly tested with success. Part i. consists of a series of exercises in measurements of length, area, volume, weight, and density. Part ii. contains rather more advanced exercises on the same subjects, together with some on atmospheric pressure and heat, and a suggested course of woodwork. The exercises do not consist of detailed instructions of what to do and expect, but require some initiative on the part of the student. This is, indeed, the intention of the authors, who hold the view that the pupil should discover facts for himself. Thus, some of the exercises simply consist of a series of questions to be answered by making experiments. The books, although cheap, are clearly printed, and will probably be found to serve their purpose.

(3) Dr. Neesen has undertaken a difficult task in dealing with such a large subject in so small a volume. Nevertheless, most of the phenomena proper to the various subjects are referred to, although briefly. With a few exceptions, the book is non-mathematical, and deals rather with the experimental side. The reader, therefore, has no need of an advanced knowledge of physics, and it is doubtless advantageous for such to study the different kinds of wave motion together. Besides the subjects mentioned in the title, there are several paragraphs on radioactivity, in which the properties of the α, β, and γ rays are dealt with. Many of the diagrams are poorly drawn and printed. This is particularly unfortunate in a book dealing with wave motion and geometrical optics.

(4) Quite otherwise in this respect are the two text-books of physics by Dr. Stewart. That on sound especially should supply the much-felt need of an elementary treatment of that subject. Exception may be taken to the definition of simple harmonic motion as the projection on a diameter of the uniform circular motion of a point, because it leads students to believe in the existence of such a point in all cases of simple harmonic motion. It is rather surprising, also, to find Doppler's principle and the production of beats not referred to, especially as the latter is so commonly used as a method of estimating frequencies. Omissions are the chief fault in these volumes, and they are even more frequent in the part on light. There is no treatment of microscopes and telescopes, nor the methods of measuring the velocity of light. These are surely not out of place even in an elementary text-book. In reading this part alone it is noticeable that the undulatory theory is not sufficiently insisted upon, but this is compensated for by the fact that the laws of refraction and reflection are proved according to this theory in the volume on sound. On the whole, however, the books are distinctly good, and the large number of experiments suggested will no doubt serve to demonstrate the principles involved.

VOLUMETRIC CHEMICAL ANALYSIS.

A Manual of Volumetric Analysis. For the Use of Pharmacists, Sanitary and Food Chemists, as well as for Students in these Branches. By Dr. H. W. Schimpf. Fifth edition, revised and enlarged. Pp. xx+725 (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1909.) Price 21*s.* net.

THE plan of this work is as follows:—First, the general principles of volumetric chemical analysis are explained and illustrated. Next, the knowledge thus gained is applied to practice-work upon the commoner inorganic elements and their chief compounds, and upon certain organic acids. Finally, two branches of specialised work are taken up—namely, the analysis of various food-stuffs and pharmaceutical products—and the book concludes with a few examples of gasometric analysis applied to articles met with in pharmacy and medicine.

The treatment is generally fairly exhaustive, and the descriptions lucid. Often, indeed, the author gives almost a superabundance of detail in explaining the principles of the methods used. For example, he supplies not only the equations involved, but frequently the arithmetic as well. In the early part of the book he appears to have in mind the very elementary student, and is at some pains to explain such matters as the law of definite proportions. This seems hardly necessary in a book of this character. Knowledge of the elementary principles on the part of the student might well be taken for granted. In fact, the author is scarcely consistent; a page or two later on we find ourselves talking of univalent and divalent compounds, monobasic and dibasic acids, without previous explanation of the terms. A reader who knows what they mean would not be likely to want an exposition of the law of definite proportions.

A very useful description of the properties of indicators is contained in the fourth chapter. The reactions involved are dealt with mainly as ionisation phenomena, but a brief explanation is given of the chromophoric theory also.

The special feature of the volume, however, is the amount of attention devoted to the assaying of pharmaceutical preparations, particularly alkaloidal drugs. No fewer than a hundred and fourteen pages are taken up with these, and the sections appear to have been brought well abreast of modern practice. One division treats of the general volumetric estimation of alkaloids, explaining the principles, and describing some of the newer methods, as well as those which are older and better known. Afterwards comes a

chapter dealing with the extraction of alkaloids from the various crude drugs—seeds, leaves, roots—in which they occur, and the determination of the proportion present. This is followed by sections which treat of the individual drugs and the galenical preparations containing them. The alkaloids of gelsemium, hyoscyamus, stramonium, coca, colchicum, conium, hydrastis, ipecacuanha, physostigma, pilocarpus, tobacco, strophanthus, and veratrum are included, as well as the commoner alkaloids, and this part of the work should be a boon to chemists or students interested in the examination of these products.

The space allotted to the analysis of water and food-stuffs does not allow of the articles being discussed at any length. Milk, butter, oils and fats, starch, and sugar are dealt with, and the outlines of principles and processes given are trustworthy as far as they go.

For the sake of the numerous references which the author supplies, one can readily forgive him his occasional lapses into slipshod English. The book contains a wealth of information, and considered as a whole is an excellent production. C. S.

OUR BOOK SHELF.

Geologischer Führer durch Dalmatien. By Dr. R. Schubert. Pp. xxiv+176. (Berlin: Borntraeger, 1909.) Price 5.60 marks.

THERE are few portions of the map of Europe more attractive to the eye of the geographer and the geologist than the coast of the northern Adriatic. On the one hand we have the coast of deposition, starting from the Apennine foothills north of Pesaro, and more and more emphasised in the swampy flats of Ravenna and Venice, until we reach the jungle-like woods of Monfalcone. Beyond this we come against steeply descending limestone hills, with a "karst" character already manifest. The blue water at Trieste speaks of the coast of subsidence that stretches to the south-east, with chains of islands parallel with the tectonic features of the land.

Dr. Schubert sums up the geological features of Dalmatia in a work intended for the instructed traveller. Cretaceous limestones play a large part in the country, but are concealed over much of the north by fresh-water and marine Eocene strata. The marine limestones of Middle Eocene age are here overlapped by the brackish-water marls and fluviatile conglomerates of the Promina series, which were laid down in Upper Eocene, and possibly finally in Oligocene, times, after a general uplift of the area (p. xvii). The Eocene sea itself had represented a return to marine conditions after a terrestrial and lagoon stage which closed the local Cretaceous system. The folding from north-east to south-west, which has determined the salient features of modern Dalmatia, took place in Oligocene times (p. 173).

While the corresponding depression of the Adriatic may have begun, through the production of faults, soon after the Oligocene period, the sea did not invade the northern part of its present basin until what we may call human times. The Po and its tributaries, dependent on the growth of the Alpine chain, carried detritus across this area, and the sinking that has separated the alluvial Italian region from the rocky shore of Istria began in the Glacial and continued into the Roman epoch. The chains of islands off the Dalmatian coast have thus a very modern origin.

Dr. Schubert guides the traveller on a series of excursions, with useful notes as to the accommodation on the way. He wisely points out that a knowledge of either Italian or Croatian, preferably the latter, is essential for those who go beyond the tourist routes. The price of his compact volume, with its numerous references to other literature, will not seem high, when one considers how long it will be before any large number of visitors will venture far from the comfortable steamers on the coast. The desire for luxury during travel fortunately leaves many European districts, like Dalmatia, free for those who prefer to study and observe at their own leisure.

G. A. J. C.

Entwickelung und Untergang des Kopernikanischen Weltsystems bei den Alten. By O. T. Schulz. Pp. 143. (Stuttgart, Verlag: Neue Weltanschauung, 1909.)

THIS essay is the first of a series entitled "Weltanschauungs-Fragen." It deals with the ideas of the Greeks about the construction of the world, but, notwithstanding the title, the standpoint of the author is that of an historian of geography, and not that of an historian of astronomy. He is evidently quite at home when sketching the gradual rise of geographical knowledge and illustrating it by maps. But when he comes to the astronomical part of his subject he has apparently only Zeller's "Philosophie der Griechen" and Schiaparelli's memoir on the precursors of Copernicus to build on, while Schiaparelli's later paper on the very subject indicated by the title of the present essay, as well as the writings of Tannery, Hultsch, and others, are unknown to him.

The author makes no attempt to point out how Aristarchus may have been led to the idea of the earth's motion round the sun, and tells the reader nothing about the systems of movable excentrics or epicycles. He states that Aristarchus at first believed in the motion of the sun round the earth, and that he says so in his little book on the distances of the sun and moon. But there is not a word in this book as to whether the sun or the earth is in motion. As regards the failure of the heliocentric idea to secure acceptance, the only reason given by the author is that Hipparchus considered it not to be based on sufficiently lengthy observations. We cannot imagine where the author got this piece of information from, as there is no allusion to the system of Aristarchus in the preserved writings of Hipparchus and Ptolemy. What Hipparchus did say was that he did not himself possess sufficient observations to work out the theory of the orbital inequalities of the five planets. But these have nothing to do with the motion of the earth. The author adds that there is no original research in the Almagest!

When dealing with the views of Plato, the author repeats the statements current sixty years ago about Plato's doctrine respecting the rotation of the earth and about his change of opinion in his old age as to which body was in the centre of the world. One cannot help wondering whether it really is of any use to try to kill historical errors. They seem to be immortal. At least, popular writers on the history of science are generally not aware that they are dead and buried long ago. J. L. E. D.

Excursionsbuch zum Studium der Vögelstimmen. By Prof. Voigt. Pp. 326. (Leipzig: Quelle und Meyer, n.d.) Price 3 marks.

THIS is the fifth edition of an excellent manual of the songs and other notes of birds, suitable for carrying in the pocket during walks and excursions. As a matter of fact, it is better for the learner to find out for himself

what bird it is to the voice of which he is listening, for in the process, even if it be a long one, he will learn a good deal about the bird and its habits. But some learners are less gifted than others with a capacity for listening carefully, and have little or no musical ear, and a book like this may be of good service to these. Dr. Voigt's method is a very sensible one; he makes no great use of musical notation, but has invented a notation of his own which is likely to be much more useful to the ordinary observer. By a series of dots and dashes, inclining or curving up or down if necessary, he contrives to give a very fair idea of the character of the notes he wishes to represent, and also of their tendency to rise and fall. In some cases, *e.g.* in that of the swallow, he does not make use of either kind of notation, simply because neither would be any real help. His descriptions of the songs seem remarkably accurate. We have tested them in the case of many of the small warblers, which are among the most difficult to describe, and have invariably found them excellent, and the tendency of particular individuals of a species to vary the utterance is also duly noted. Thus of the marsh warbler (*Acrocephalus palustris*), Dr. Voigt says that it has troubled him more in the way of variation than any other species. In writing of this species he seems to have omitted the peculiar alarm-note uttered when an intruder is near the nest, but as a rule something is said of alarm- and call-notes. On the whole, we consider this book the most useful practical manual we have met.

W. W. F.

The Force of the Wind. By Prof. Herbert Chatley. Pp. viii+83; illustrated. (London: C. Griffin and Co., Ltd., 1909.) Price 3*s.* net.

Prof. Chatley has evidently devoted himself to a study of hydrodynamics and of its literature. He has attempted to boil down into an inordinately small compass, so as to be useful to engineers, an exposition of one of the most difficult and elusive subjects with which either the engineer or the mathematician has to deal. Explanation of principles which might be useful to a novice is replaced by a multiplicity of formulæ, which are flung at the reader with but little regard to dimensions or units. Numerical examples which, even in the case of clear exposition, always assist the student who wishes to apply a formula to any case in which he is interested are entirely absent. Much information is collected, and numerous authorities are cited, but the result can hardly be considered satisfactory.

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.*]

Stability of Aëroplanes.

I have recently been occupied with a comparative study of the theories of stability of aëroplanes deduced by Prof. Bryan, Captain Ferber, and Mr. F. W. Lanchester, and have just noticed a parallelism between the formulæ of Ferber and Lanchester which is strongly corroborative of the practical application of both.

In Ferber's "Les Progrès de l'Aviation par le vol Plane" (*Revue d'Artillérie*, November, 1905) he deduces from an extension of Prof. Bryan's analysis a formula for the conditions of longitudinal stability

$$\frac{P^2 b}{2Bg^2 k S} > 0{\cdot}8,$$

where P is the total mass of the machine, B is the moment of inertia about a transverse axis through the *cg*, S is the area of the supporting surfaces, *b* is the distance of the centre of pressure from the centre of area of the supporting surfaces, and K is an aërodynamic constant (0·7) kilometre-second system.

Lanchester's equation for longitudinal stability is

$$\Phi = \frac{4lH_n^2 \tan\gamma}{I\left(\frac{1}{K}+\frac{1}{\varepsilon C p a \beta}\right)} > 1,$$

where *l* is the distance from the centre of pressure on a tail plane to the Cg, H_n is the kinetic head of the machine corresponding to its normal velocity, γ is the normal gliding angle, I is the moment of inertia about a transverse axis through the Cg, $K = \frac{\text{weight}}{(\text{normal velocity})^2}$, and the denominator of the second term in the expression within brackets is the lift on the tail plane (ft.-lbs.-sec.-units) divided by the square of the velocity.

Now the mass varies as the lifting force, which again varies as the square of the velocity, so that $P^2 \propto H_n^2$.

The torque which restores the machine to equilibrium depends in the case of a machine without a tail plane on *b*, and with a tail plane on *l*, so that if Lanchester's form is to refer to a machine without a tail plane *b* must be substituted for *l*.

B and I are identical in kind.

K varies as the lift ÷ square of the normal velocity, and since the lift varies as the product of the area and the square of the velocity, $K \propto S$.

The term relating to the tail plane is peculiar to that type studied by Lanchester, so that it can be omitted from our comparison.

Tan γ is a constant for any one type of surface.

Hence it will be seen that the two formulæ are exactly of the same form, and it only remains exactly to determine the appropriate constants to discover if the two expressions can be made identical.

As has been pointed out by Prof. Bryan, everything (except for a machine with a tail) depends on *b*, and unless $db/d\alpha$, where α is the angle of attack, is negative, the torque will not produce equilibrium. The Government's committee is, I believe, giving this attention.

I would further point out that the variations in velocity leading to Lanchester's "phugoid oscillations," and the oscillations due to the variation of *b* with α, will serve to explain the two types of oscillation, respectively of long and short periods, observed by Prof. Bryan and Mr. W. E. Williams, and shown by the former to be deducible from the equations of motion.

Herbert Chatley.
Imperial Railways of North China, Engineering and Mining College, August 24.

It is dangerous to draw conclusions from half-finished investigations, and anything I may now say must be subject to confirmation or modification when I have completely disposed of the mathematical theory of stability, both longitudinal and lateral, as I hope to do in a very few months unless any further pressure of professorial duties necessitates again hanging the matter up indefinitely. But results which I have recently obtained seem rather to corroborate instead of contradicting Lanchester's equation as holding good, subject to suitable assumptions and for the types of machine to which such a formula is applicable. I may state that I have already obtained expressions for the conditions that the quick or slow small motions may be subsident or oscillatory, and for their coefficients of subsidence in the first case and their periods and moduli of decay in the second. This applies to longitudinal stability, and a similar investigation is in progress regarding lateral stability.

It will, I believe, be easy to explain also *why* Lanchester's method, which to a mathematician certainly appears wanting in rigour, may lead to a correct result. But the matter will, I hope, be cleared up very shortly.

In the meanwhile, Prof. Chatley's comparative studies appear to indicate that we are within measurable distance of obtaining consistent results from widely differing methods.

G. H. Bryan.

Chinese Names of Colours.

THE correspondence on the above subject, started by Mr. A. H. Crook in NATURE of January 11, 1906 (p. 246), was lately recalled to me when I heard, for the first time, the phrase "hsüeh ch'ing" (Cantonese sut_0 ts'eng)—snow-blue—used in conversation. It was used in this case in naming the colour of a flower, and struck me as particularly appropriate; the colour might well be described as one of those termed "ch'ing" diluted to a pale shade with white snow.

It hardly seems likely that any natural colour of snow itself should be the origin of the phrase, or how would one account for "shui hung"—water-red? The latter means pink, or, as one might say, a watery and "washed-out" red. Natural water of a pink colour is scarcely common.

Independently of the foregoing, though perhaps bearing on it, I should like to point out how the origin of some Chinese phrases may well have been obscured; this is by the substitution of one character for another nearly like it in sound, but not in sense. This may be illustrated by a case in which the change appears to be now taking place.

"Wang^4 pa^1"—forget eight—is a term denoting a person of infamous occupation, and also a kind of tortoise. This looks already sufficiently obscure, but is fully accounted for to the satisfaction of dictionary-makers and their kind.

It happens, however, that illiterate persons frequently wish to write this name. In many cases they may not know the character for "forget," but they well know that for "king" (wang^2), and the slight difference in sound is easily overlooked. The practice is being copied among the more literate, and it seems likely that in the end "wang^2 pa^1"—king eight—will entirely supplant the original (and now less common) form, and when this process is complete a sensible derivation will be impossible without reference to an older literature.

The process is almost parallel to some changes of spelling in English, but results in more complete obscurity.

ALFRED TINGLE.

Pei Yang Mint, Tientsin.

Percentages in School Marks.

MR. CUNNINGHAM'S inquiry (August 5) is aimed, apparently, at obtaining a kind of *index mark* for each candidate in an examination containing several papers. In getting a boy's percentage mark in any one paper there is no trouble; but the question is, By what law are percentages in different papers to be combined in order to get an index mark? Percentages may be combined in an infinite number of ways; which is the way Mr. Cunningham desires?

Consider three papers:—(1) looking at all the questions in the three papers as a whole, if marks have been assigned to each question with due relativity to all the other questions, (2) if the boys have each been properly prepared for all these questions, and (3) if fair time has been allowed for each of the papers, then each boy's index mark is clearly his total marks gained in the three papers divided by the total maximum marks of the three papers. The whole matter may be expressed more easily thus:—Let a boy gain marks x, y, z in three papers the maximum marks of which are a, b, c; his index mark may be expressed by $px+qy+rz$, and will depend on the constants p, q, r. For example, if $p=1/a$, $q=1/b$, $r=1/c$, the index mark is $x/a+y/b+z/c$ (or this divided by 3, the mean of the averages). Again, let $p=l/(la+mb+nc)$, $q=$&c., $r=$&c., then the index mark will be $(lx+my+nz)/(la+mb+nc)$, which reduces to the first example when $l=m=n$. In this case we have still the ratios $l:m:n$ in our power. For example, suppose papers set in Latin, French, and Greek, and take Mr. Cunningham's numbers for them respectively, namely, 37 out of 50, 50 out of 50, 71 out of 100, and suppose, on comparing the papers, that Latin is reckoned half as hard again as French, and Greek a quarter harder than Latin, then their difficulties would be Latin, French, Greek as 12 : 8 : 15, and it would seem fair to take these values for $l:m:n$. Thus the index mark for this boy would be $(12.37+8.50+15.71)/(12.50+8.50+15.100)$, or 1909/2500, or 0·7636 (per cent. 76·36). If, however, each one of the questions has had marks assigned to it relatively fair when compared with the marks of all the other questions of the three papers, and if the time allowed for each paper is proportionate to the work required by an average boy to answer the paper, then would $l=m=n=1$, and the index mark would be 158/200 (or per cent. 79·00). Thus, Mr. Cunningham must settle for himself, *in accordance with the circumstances of each case*, the values of the ratios $l:m:n$. The above includes the cases of Mr. Whalley and Mr. Abegg, and, I believe, will cover Mr. Pickering's case too, but I have tried unsuccessfully to understand his numerical table.

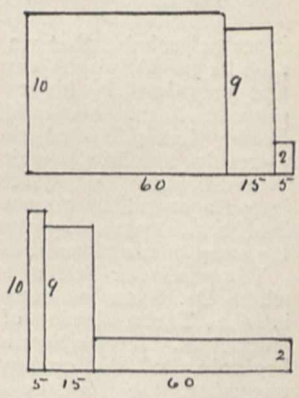
A kindred question is sometimes asked, What is the master-average of a set of averages? For example, thirty schools send in candidates for a paper; each school gets its own average of the marks gained by its pupils in the paper (this is the mark of value for the school); but the examining body wants some information as to how the paper has been done in general, for the sake of comparison with similar papers in other years, hence a master-average, or some equivalent, has to be determined. Assuming all the candidates from the whole thirty schools to be equally prepared for the paper, obviously the examining body will obtain its desired result by dividing the total sum of all gained marks by 100 N, if N be the total number of candidates and 100 be the maximum marks of the paper. This amounts to putting

$$l=m=n=\ldots\ldots=1;$$

but if it be known that very bad work has come from a certain school, and if in fairness its marks should be valued at (say) one-third of the general run of the schools, then in this case we should put

$$l=m=\ldots\ldots=3$$

for twenty-nine of the schools, and $n=1$ for the school in question. To add the thirty averages and take one-thirtieth of the result is of no value at all. This is easily seen from the adjacent diagrams; in the first, sixty boys have an average of 10 marks, fifteen an average of 9, and five an average of 2; the mean of the averages is $(10+9+2)/3$, or 7; in the second case, five boys have an average of 10 marks, fifteen of 9 marks, and sixty of 2 marks; the mean of the averages is still only 7. Hence the same mean of averages is derived from two obviously different and even independent cases. Is it not fairer, in the absence of any other information, to take



$$(600+135+10)/80=9.31 \quad \text{and} \quad (50+135+120)/80=3.81$$

as the means of the averages, or rather as the representative index marks of the two groups of candidates? In other words, is not one group about two and a half times better than the other? Hence, for a single paper in a number of schools, the apparently easiest plan is to treat all candidates as equally well prepared, and to take the index mark required by the examining body as equal to the total marks gained by all the candidates in the thirty schools divided by 100 N as before; and this seems also fair. This index mark may be got as the quotient $(fu+gv+hw+\ldots.)/100(f+g+h\ldots.)$, where u, v . . . . are school averages, and f, g, h . . . . are the numbers at each school, so that $f+g+h+\ldots\ldots=N$. The same problem is presented to the headmaster of a school who wants to get an index mark either of a form, or of the work of a master, or of the whole school, for comparison from year to year.

J. D. HAMILTON DICKSON.

Peterhouse, Cambridge.

EXPLORATIONS IN CENTRAL ASIA.

THE detailed results of Dr. Stein's latest achievement in the world of scientific exploration are awaited with the deepest interest by all who concern themselves with the problems of Asiatic research, and it seems probable that we may sit expectant for many months yet before the extraordinary mass of information contained in his collections can be reduced to concrete form. Meanwhile, the Royal Geographical Society has published the text of the lecture (considerably amplified) which he delivered before it last March, and has issued a neat little map which is in itself a most necessary illustration to the story of his adventures.

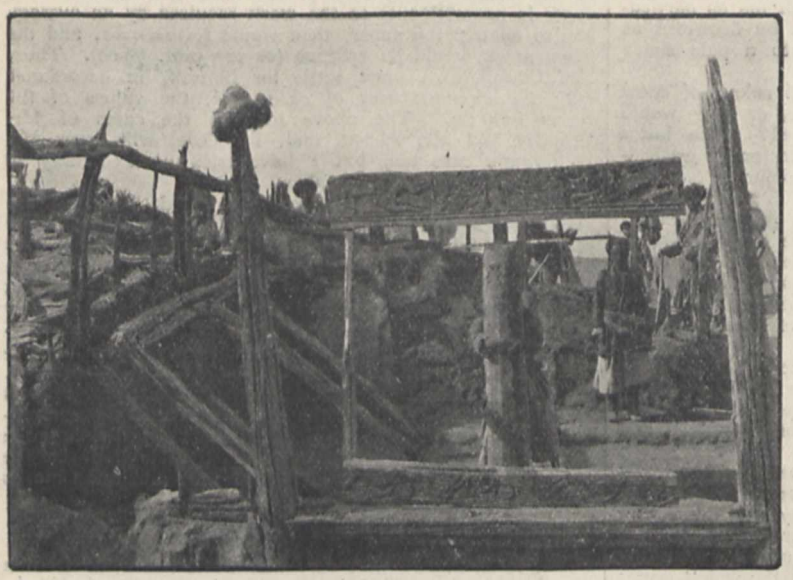


FIG. 1.—Hall of Ancient Dwelling (Third Century A.D.) after Excavation, Niya Site.

The particular field of exploration which Dr. Stein has made his own is the Tarim basin of Chinese Turkestan. It was here at the very beginning of the century that he unearthed the first relics of an ancient civilisation, which, under the joint influence of India and China, had flourished in the oases of the Takla Makan desert and surrounded the shores of that elusive lake, Lop-nor, some fifteen or twenty centuries ago. It has been usual to think and to write of these buried Buddhist cities of the past as if the gradual encroachment of a great sand-sea, sweeping in huge progressive waves from the westward, had in the course of ages irresistibly engulfed them, and driven forth their ancient population to seek for more profitable fields elsewhere. To a certain extent this is true, but the movement of the sand-drifts was frequently the result rather than the cause of the desertion of these ancient sites. It was the failure of the water supply, the universal process of desiccation which now almost ranks as a geological feature recognisable throughout the world, that permitted the sand-waves. Yet there are points in Dr. Stein's systematic investigation of cause and effect which might lead us to believe in a return swing of the climatic pendulum; another beat in the "pulse of Asia" of which Mr. Huntington writes so convincingly. Here and there were found a people pushing gradually outward from the narrow ring of cultivation which borders the desert back again towards the old-world sites, although, in Dr. Stein's opinion, the sources of water supply once dried up will never again reopen.

However that may be, the important part of Dr. Stein's work in the field was the collection of those archæological relics of the past, including miscellaneous records (some of which are far older than any which have as yet come to light in Central Asia or China), bearing inscriptions in Indian Kharosthi and Brahmi, and specimens of early Buddhist art in moulding and in painting, the classification and interpretation of which will certainly prove to be the work of several years. Undoubtedly Dr. Stein has added a new chapter to Indian history, a chapter which deals with the period of Indo-Chinese religious affinity, when Buddhism, still rooted in the land of its birth, had spread outwards to the older civilisations of Central Asia and a never-resting tide of pilgrims passed to and fro, seeking inspiration at every wayside fount of knowledge that marked the weary road from the Chinese frontier through Khotan to Kashmir, or, striking farther west, refreshed the devotee in Badakshan and Kabul.

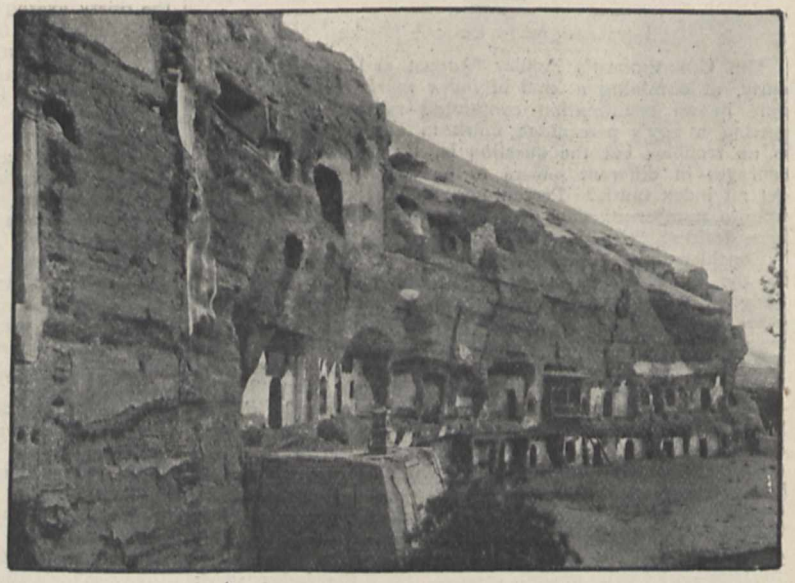


FIG. 2.—Southern Series of Cave Temples at the "Halls of the Thousand Buddhas."

The bourne of pilgrimage was ever the same. It was northern India and the cradle of Buddha on the borders of Nepal that was the end of all endeavour; and the marvel of our present knowledge (derived chiefly from the results of Dr. Stein's researches) is that the way was made so plain and the facilities for

travel were so great in the early centuries of our era. We read of regular posts and connected lines of open route which must have been furrowed by the feet of thousands where never a soul passes in these later days.

With new history we have also to welcome a broad expanse of new geography. Dr. Stein's methods are nothing if not thorough. We have no uncertainty as to whereabouts he found this or that most ancient site; and when he records his remarkable discovery of a long extension of the time-worn wall of China he is able to define, not only its exact position, but its geographical significance as a defensive work with regard to surrounding topography. He does ample justice to the ability of his geographical assistant, Rai Sahib Ram Singh, but Ram Singh would never have effected such results without Dr. Stein's effective guidance and active help. One hundred and thirty sheets of the standard degree size, on the scale of four miles to the inch (which is what has been secured for the records of the Indian Survey), is a solid addition to our geographical knowledge which ranks well even with his vast store of accumulated archæological lore. Perhaps the most noteworthy discovery made by Dr.

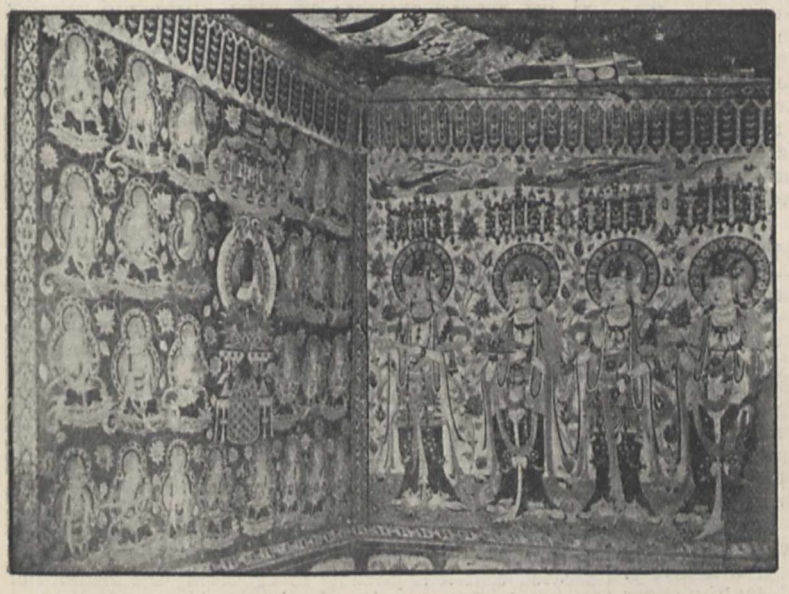


FIG. 3.—Frescoed Wall in Cave Temple at "The Ten-thousand Buddhas."

Stein during his investigations was the extension of the Turkestan basin eastwards to a point some seven degrees farther east than had been previously recorded. From the Chinese frontier town of Suchau a clearly defined line of drainage follows a course parallel to the extension of the Great Wall towards the central depression at Lop-nor; nor can there be much doubt that in the early days of Buddhist settlements in this region this now partially desiccated line of drainage marked the main trade-route from China to Turkestan. That route now hugs the foothills of the Altyn Tagh to the south between Anshi and Lop-nor, but it is a desolate and forsaken route, untrodden by the trader and unsanctified by the pilgrim.

It may be long yet ere we are able to appreciate as they deserve the discoveries and collections of Dr. Stein in relation to their bearing on the history of India; for the mass of raw material which has yet to be classified is so great as to have proved almost an embarrassment to its owner. In the meantime the short and instructive booklet on the subject now issued by the Geographical Society is well worth careful study.

THE SIXTEENTH INTERNATIONAL CONGRESS OF MEDICINE.

MEDICINE is so self-centred, and its practice is conducted so largely in private, that an international congress, where men meet on a level, rub shoulders, and part again once in three or four years, is an excellent corrective. It serves the same function in the profession as is answered by a public school for the only son of wealthy parents. It is not so much what is taught as what is seen and heard. The knowledge which is obtained by conversing with men brought up in different schools of thought, under various forms of civilisation, and often with wholly divergent ideals, is in itself remarkable, and is sufficient to start new trains of thought in many lines of research. In a great gathering like the International Congress of Medicine, where five or six thousand medical men are gathered together at fixed intervals, old friendships are cemented, new ones are formed, and whilst the scientific reputation of some falls to the ground, others are exalted. The quack is taken at his true value, for his work is judged by those who know the truth, whilst the humble and earnest worker in the difficult paths of research goes home strengthened by the encouragement which he has received from fellow toilers.

The sixteenth International Congress of Medicine was held at Budapest during the first week of September. The seventeenth congress will be held in 1913 at some town in Great Britain. Budapest lends itself especially to a large gathering of foreigners. It is a splendid city, magnificently placed on the Danube, easy of access both to the northern and eastern races of Europe. The inhabitants are active, intensely patriotic, eager to show the progress that has been made, and to prove that the youngest civilised State in Europe has not much to learn, and is in some respects already ahead of the older civilisations the best points of which it has endeavoured to copy. It is, indeed, very difficult to realise that Budapest was a Turkish possession little more than two hundred years ago, though the vigilant observer will notice the very faintest trace of orientalism as he walks amongst the people and through the smaller streets of the town. For a medical congress, Budapest is ideal, because it is full of springs and baths which would in themselves have brought it fame, the Hunyadi and Apenta springs being known throughout the world.

The congress was excellently organised, and the greatest credit is due to the president, Prof. Kálmán Müller, and the general secretary, Prof. Emil de Gròsz, for the manner in which they brought things to a successful issue. His Royal and Imperial Highness the Archduke Joseph, acting on behalf of the King of Hungary, was indefatigable in the cause of the congress, for he not only attended the inaugural meeting in the municipal buildings, where 5000 persons were gathered together on one of the hottest days in the year, and remained throughout the whole sitting of three hours, but later in the week he welcomed the members to the palace and spoke personally to a very large number of the more important official

delegates. He was ably assisted throughout by Count Albert Apponyi, the Hungarian Minister of Education, who made several important and statesmanlike speeches showing that he was in touch and in full sympathy with the work of the medical profession throughout the world.

The work of the congress was divided into official, sectional, and general. The official work was of unusual importance. It was decided that in future a meeting should be held once in four years instead of once in three years, as has been the case hitherto; that a permanent committee should be formed, with a president, a paid secretary, and a fixed office. Dr. F. W. Pavy, F.R.S., the president of the National Committee for Great Britain and Ireland, was nominated president, and it was determined that the office of the paid secretary should be at The Hague. By these means it is hoped that there will be a continuity of policy in the affairs of the congress which has hitherto been impossible, because there has been no permanent board to which difficulties and questions of policy could be referred.

The work of the sections did not prove of much interest, although many members attended and the papers were exceptionally numerous. The subjects chosen for discussion, like appendicitis, malignant disease of the larynx, the tuberculin treatment of tuberculosis, and uterine myomata, did not lend themselves to the expression of very novel views, and if the speakers who took part in them were not very inspiring, they were not belligerent, and the congress was spared the painful scenes which have occasionally turned the arena into a veritable battlefield.

Puerperal infection was selected appropriately as a subject of discussion. It was a tardy tribute to the memory of Semmelweis, the pioneer of modern obstetric prophylaxis, who died broken-hearted in the town where he had spent the best years of his life in declaiming against the fearful mortality of childhood and showing some of the means by which it might be avoided. He remained a voice crying in the wilderness until the end, but the statue erected by international effort, and placed in the gardens of the Ergebet-teren, was visited by every member of the congress, and was duly decorated with tributes from every nation.

The general addresses were excellent, and drew very large audiences, who listened most attentively. Prof. Holländer showed by means of lantern-slides some of the diseases and mutilations depicted in the records of the Incas and Huacos. Dr. Bashford, director of the Imperial Cancer Research in London, explained by similar means the present state of the cancer question, whilst Prof. Loeb, of Berkeley, made a remarkable communication upon artificial parthenogenesis.

The net outcome of the congress was the hold which the doctrine of immunity has gained upon the whole of the scientific side of the medical profession. Evidence of its importance was forthcoming from every side. There was a general discussion upon the subject. Dr. Bashford laid much stress upon it in his general address, and it formed an important factor in the work done by Prof. Loeb. It is evident that a great future lies before those who are working at the subject. At the present time there is much confusion and overlapping, a jargon of confusing terms masks the principles, but it is clear that before long the whole theory will be simplified and a most important agent will be added to the practice of medicine.

THE INTERNATIONAL SEISMOLOGICAL ASSOCIATION.

THE third meeting of the permanent committee of the International Association of Seismology was held at Zermatt on Monday, August 30, and the three succeeding days. Out of twenty-two States which now belong to the association, seventeen were represented. In his presidential address, Prof. Schuster directed attention to the importance of determining the movement of the soil in a seismic disturbance, and laid stress on the conditions which seismographs must satisfy, in order that the components of the displacements should be capable of being deduced from the records obtained.

A number of committees, which had been appointed at the previous meeting, now presented their reports. Perhaps the most important of these referred to the microseismic oscillations, which have lately attracted attention in many places. Two kinds of oscillations are to be distinguished, one having a period varying between four and nine seconds, and the other a period of about half a minute. The short-period microseism is often observed simultaneously over large portions of the earth's surface; its most interesting feature, which was independently discovered by Prince Galitzin in Pulkowa, by Hecker in Potsdam, and by Omori in Japan, is that there is a direct relationship between the amplitude of the oscillation and the period, the larger amplitude corresponding to the longer period. Dr. Klotz, the representative of Canada, has also investigated the subject, and found that whenever a centre of low barometric pressure, after traversing the continent, reaches the ocean, these microseismic waves of short period appear. Though we cannot at present give a quite satisfactory explanation of these waves, Prof. Wiechert's suggestion that they are caused by the impact of ocean waves on land areas deserves further investigation. For this purpose the committee intends to set up, probably on the west coast of Ireland, an instrument capable of registering the number and height of the waves. The microseismic disturbances, which have a period of about half a minute, have been found to depend on the intensity of local winds. They seem due to a wave-motion set up on land in a similar manner to that in which waves are set going on the ocean.

Probably the most important communication made to the meeting was that in which Prince Galatzin showed that it is possible to determine the azimuth of the seat of an earthquake by combining the indications of two seismographs, set up so as to give displacements in two directions at right angles to each other. The coincidence of the azimuth determined in this way for a number of earthquakes with that known independently was quite remarkable, the difference in many cases being less than a degree. As the distance of the earthquake can be determined from the interval elapsing between the arrivals of the forerunners and surface waves, Prof. Galitzin's investigations show that it is possible to fix the locality of an earthquake by observations at one distant station only; but such a result could only have been achieved by means of a perfection of instrumental appliances consequent on a complete mastery of the problems involved. Mr. H. F. Reid, of Baltimore, unable, unfortunately, to be present himself, sent a communication, in which he summarised his experiences gained by a study of the San Francisco earthquake. After directing attention to various instrumental matters, notably the absence of damping in many of the American instruments, which rendered the investigation difficult, he suggests the theory of a slow secular displacement as a pre-

liminary condition leading to a seismic catastrophe, and shows how, if this theory be true, a certain class of earthquakes might be predicted.

Prof. Omori communicated a report on the Messina earthquake, in addition to his report on microseismic waves.

Communications were also made, among others, by Prof. Palazzo, of Rome; M. Angot, of Paris; M. Rosenthal, of Tiflis; M. Choffat, of Lisbon; while Prof. Hecker, of Potsdam, gave an account of his more recent results of tidal displacements in the earth. The meeting concluded with a lecture by Prof. Heim, in which an historical summary of the subject was given from the geologist's point of view.

At previous meetings the desire had been expressed that a complete bibliography of the subject should be published annually; a committee was appointed which reported in favour of coming to an arrangement with the International Catalogue of the Royal Society, all papers on seismology in that catalogue to be joined together in one volume, instead of, or perhaps in addition to, their being classified, as at present, partly under geology, partly under physics, and partly under applied mathematics. There is good ground for believing that such an arrangement could be made, and the meeting adopted the committee's report.

A report on the arrangements for an annual catalogue of earthquakes was presented by Prof. Forel, of Morges. The method to be adopted in such a catalogue, in order to make it most generally useful, gave rise to a good deal of difference of opinion; but after discussion in committee a compromise between different views was effected. Prof. Forel having completed his tenure of office as vice-president, M. Hipites, of Bucarest, was elected to be his successor.

The Federal Council of the Swiss Republic had entrusted the arrangements for the meeting to the Schweizerische Naturforschende Gesellschaft, and, with the assistance of Mr. Seiler, the delegates and their families were cared for in a most excellent manner. At the conclusion of the meeting satisfaction was expressed both at the success of the scientific results, and at the hospitable reception accorded to the members present.

BRONZE-AGE INTERMENTS IN SWITZERLAND.

UNDER the title of "Le Cimetière du Boiron de Morges," M. F. A. Forel has issued a report on some remarkable prehistoric interments in Switzerland, and though it occasionally lacks the lucidity of arrangement and grace of style which characterise French work of this kind, it will still be found full of interest.

These interments are attributed to the Bronze age, or, as the author terms it, "le bel-âge du bronze des Palafitteurs." The graves are flat, without mounds or stone pedestals, the latter, he thinks, having been probably replaced by wooden posts which have now decayed. They lie in no definite order or in lines one behind another; nor is there any rule of orientation in the graves themselves. It is remarkable that earth burial and cremation are found side by side; in fact, the two methods of disposal of the dead seem to be contemporary, if the evidence of identity in the style of vases and bronzes deposited with the corpse be accepted as conclusive. It may be noted that M. Forel treats as cases of inhumation those in which the teeth are found intact; those of incineration when the roots of the teeth alone survive. There is nothing in the shape of a regular cist, only a slab laid in a horizontal position over the head and upper part of the body. The slab graves of this class contained funeral plates and dishes, or piles of urns and bowls, three or four in number, laid one above another. Only one tomb which held a cremated corpse contained a cinerary urn; in the others the bones lay in the mass of charcoal and other remains of the cremation. In such interments only a single corpse was discovered; hence it is supposed that the custom of sacrificing slaves or animals in the belief that their spirits would accompany the dead to the other world did not prevail. There are occasional remains of some kind of coffin; and in the cremation graves the jars probably contained offerings of food to the dead, meat in some cases forming part of such deposits. It is thus obvious that the people who used this cemetery believed in the survival of the spirit after death. M. Forel seems to imagine that this custom of providing food for the dead implies the existence of a sacerdotal class; but this is not confirmed by the analogy of the customs of modern savages, among whom the head of the household or some tribal elder performs the death rites.

The paper is accompanied by photographs of the graves and their contents, and is, on the whole, a useful contribution to our knowledge of the Bronze Age on the continent of Europe.

NOTES.

WE learn from the *Pioneer Mail* that the Government of India has issued a resolution concerning malaria in India. The Governor-General has had under consideration a proposal of the sanitary commissioner that a permanent organisation should be formed to inquire systematically into the problems connected with malaria. The number of deaths ascribed to fever throughout India approximates to four and a half millions, representing a mean death-rate of nearly twenty per thousand, and though this total is greatly in excess of the actual figure, owing to the practice of ascribing to "fever" deaths which are in reality due to other causes, yet it has been estimated that the actual death-rate from malarial fever is about five per thousand. The Governor-General has decided to convene a conference to examine the whole question, and to draw up a plan of campaign for the consideration of the Government of India and of the local governments. The conference will assemble at Simla on October 11, and it is expected that it will last about a week. The following is a rough outline of the subjects to be discussed:—(1) the distribution of malaria in India as a whole and in various provinces, with special reference to the sickness and mortality to which it gives rise; (2) the measures of prevention which have been adopted in the different provinces—drainage, mosquito destruction, the distribution of quinine—and the measure of success which has attended each; (3) the improvement of schemes of prevention, including the question of the most suitable form of quinine and the agency by which it can most effectively be distributed.

THE International Aëronautical Congress at Nancy opened on Saturday last, and will conclude to-day. The programme included papers on dirigible airships, on light motors for airships and aëroplanes, on the history of aëroplanes, on cartography, on photographic topography from balloons, on the properties and uses of hydrogen, and on the theory and practice of aërodynamics.

AT the Brescia aviation meeting a record in altitude flight was made on Monday last by M. Rougier, who ascended to a height of 198·50 metres (645 feet), as com-

pared with the previous records made by Mr. Orville Wright in Berlin, 172 metres, and M. Latham at Rheims, 155 metres.

THE following is a list of the awards made in connection with the Brescia aviation meeting:—grand prize of Brescia (international) for a speed test over 50 kilometres: 1st, Mr. Curtiss, 2nd, Lieut. Calderara, 3rd, M. Rougier; Modigliani prize (international) for height: 1st, M. Rougier, 2nd, Mr. Curtiss; prize for carrying passenger (international): Lieut. Calderara; prize for starting in shortest time: 1st, Mr. Curtiss, 2nd, M. Leblanc; world's record for height: M. Rougier; Oldofredi prize (national) for 1 kilometre: Lieut. Calderara; prize given by the Corriere della Sera (national) for 20-kilometre flight: Lieut. Calderara; King's cup: Lieut. Calderara. The gold medal given by the King has been awarded to Buzio and Restilli, the engineers who constructed the Rebus engine of Lieut. Calderara's machine.

AVIATION meetings, according to the *Times*, are to take place at Johannisthal, Berlin, from September 26 to October 3, and at Issy-les-Moulineaux, near Paris, from October 30 to November 1.

ACCORDING to a New York correspondent of the *Times* great damage to property and some loss of life has been caused in the neighbourhood of the Mexican Gulf by a hurricane. On September 21 the waters of the Gulf and of the Mississippi were reported to be still rising, and trains were water-bound in many places.

THE thirteenth annual fungus foray of the British Mycological Society will be held at Baslow, Derbyshire, from Monday next until the following Saturday. In the evening of Wednesday the president of the society—Prof. M. C. Potter—will deliver an address on bacteria in their relation to plant pathology, and on Thursday Prof. R. H. Biffen will read a paper on the Laboulbeniaceæ, and Mr. A. D. Cotton will present some notes on new or critical British Clavariæ.

THE Allahabad *Pioneer Mail* announces that an agricultural association is in course of formation in Poona which has as its object the development of agriculture in the Deccan. The programme of work laid down by the promoters is a large one. It embraces an annual show in one of the Deccan districts, the publication of up-to-date agricultural information, chiefly, if not entirely, in the vernacular, the encouragement of better cattle breeding, the pressing of the importance of agricultural education, especially in the vernacular schools, and many other departments.

IN connection with the Hudson-Fulton celebration (September 25 to October 9), a list has been issued by the committee of the celebration commission of the museums, institutions, and societies which have prepared free exhibitions relating to Henry Hudson, Robert Fulton, and the history of steam navigation; paintings, objects of art, archæological specimens, and other things relating to the three centuries of New York's history; the discovery of the Hudson River and the introduction of steam navigation; plants, fish, and animals indigenous to the Hudson River valley.

AN expedition, consisting of members of the Utah Archæological Society, is reported to have made important discoveries along the Colorado River, in northern Arizona and southern Utah. The most important is a natural bridge, which spans 274 feet and is more than 300 feet high. On the top of it several fossils of remarkable size were found embedded.

ACCORDING to *Science*, the palæontological expedition of the University of Chicago to the Permian of northern Texas has returned from a successful trip. Numerous skulls and skeletons of small reptiles and amphibians were secured, giving to the University of Chicago, with its previous collections from that formation, an excellent representation of Permian vertebrates.

MR. HENRY ADAMS has been elected president of the Association of Engineers-in-Charge, in succession to Mr. James Swinburne, F.R.S.

LIEUT. SHACKLETON has been invited to deliver a lecture on October 9 before the Danish Royal Geographical Society.

DR. E. A. WILSON, who served under Captain R. F. Scott in that explorer's former Antarctic expedition, has accepted the post of medical officer for the projected expedition of Captain Scott to the South Pole.

QUESTIONED as to the truth or otherwise of the statement that he was to lead an expedition to the Antarctic regions, Commander Peary has replied:—"My work in the field of either the Arctic or the Antarctic is at an end, although my services will always be available if desired in promoting organisation or other work in those regions."

THE death of Mr. Bryan Cookson has robbed astronomy of one who, during but a short life, had already achieved much, and who gave promise of still further advancing our knowledge of that science. Mr. Bryan Cookson was a son of the late Mr. N. C. Cookson, of Wylam-on-Tyne. He was educated at Harrow, and at Magdalen College, Oxford. After some time spent in travelling he took up his residence at Cambridge, where he designed a new form of floating photographic zenith-telescope for the purpose of making original investigations on change of latitude and the constant of aberration. Later he worked for two years at Cape Town under Sir David Gill, His Majesty's astronomer at the Royal Observatory, Cape of Good Hope, and some of his results were published in a paper on the determination of the mass of Jupiter and the elements of the orbits of the satellites of that planet. On his return to Cambridge he erected his zenith-telescope, with which he continued his observations, many of which still await publication. About a year ago Mr. Cookson was appointed assistant at the Cambridge Observatory. He was a man of the highest character and of singular charm of manner, and his death, at the comparatively early age of thirty-six, is keenly felt amongst a large circle of acquaintances.

THE death is announced of Mr. T. Currie Gregory, a civil and mining engineer who was concerned in the building of the Great Western Railway of Canada, now merged in the Grand Trunk line.

THE death is announced, at the age of seventy-four, of Mr. Peter Barr, well known as a horticulturist, to whom in 1897 the Victoria medal of honour was awarded by the Royal Horticultural Society.

AN exceptionally cool September is being experienced this year, and the entire absence of really warm days is very unusual. At Greenwich during the first twenty-two days of the month the thermometer has only once exceeded 70°, the absolutely highest reading being 71°. The mean of all the maximum day temperatures is 64°, which is 5° below the average, and the mean of the minimum night temperatures is 48°, which is 2° below the average, the mean result for the first three weeks being 3·5° below the average. During the corresponding period last year there

were six days with the shade temperature above 70° at Greenwich, and in 1907 there were nine such warm days, whilst in 1906 there were as many as eleven days with the thermometer above 70°, and on each of the first three days the shade temperature exceeded 90°. The rainfall for September is so far generally somewhat below the average, and the duration of bright sunshine is about normal. During the greater part of the period the United Kingdom has been under the influence of a region of high barometer readings, and this has warded off very greatly the inroad of cyclonic disturbances from the Atlantic.

We have received from the editor (Dr. Ziegeler, Spandau Jagowstrasse 4) a copy of the *Wochenschrift für Aquarien- und Terrarien-kunde*, containing several articles of interest. The chief of these refers to the successful importation into Germany from Mexico of that rare Cyprinodont fish Xiphophorus, so called on account of the pointed process borne on the caudal fin of the male. A good description is given of the habits and appearance of both sexes. Notes on the common viper, on the reproduction of the frogs and toads of Germany, and sketches of fishing and of hunting make up an attractive number. In a covering letter the editor points out that his *Wochenschrift* is international in scope, and he invites those who are interested in the cult of the aquarium to assist him in realising this object by contributing to its pages. The subject is not merely one for amateur fanciers, but is capable of forwarding research in genetics.

The second number of vol. ii. of "Memoirs of the Indian Museum" is devoted to the first portion of an account of the Indian Cirripedia Pedunculata, by Dr. N. Annandale, the stalked barnacles of the family Lepadidæ, in its modern restricted sense, forming the subject of this section. The collection of Indian cirripedes of this group in Calcutta is unusually rich both in the matter of species and individuals, and since it has been supplemented by specimens from various European museums Dr. Annandale has had before him a wealth of material which ought to render his monograph well-nigh complete. In the author's opinion, the primitive cirripede was provided with a large number of calcareous plates or valves, and from this ancestral type evolution has taken place along several lines, both as regards the structure of the internal parts and the various appendages, and as regards the valves. In each division occur partially parasitic types in which the valves have undergone more or less complete degeneration.

To the September number of the *Popular Science Monthly* Dr. H. S. Colton contributes a specially interesting article on Peale's Philadelphia Museum. Charles Willson Peale, who was born in 1741, was at first a portrait-painter, but about the year 1785 set about the formation of a natural-history museum, which was, indeed, opened in Philadelphia, with the addition of grounds where a certain number of live animals were kept. In the exhibition-cases Peale attempted, with the aid of artistically painted backgrounds, to show his zoological specimens amid their natural surroundings, a practice which, after long disuse, has of late years come into favour in museums on both sides of the Atlantic. Peale's greatest achievement was the recovery and reconstruction of the first skeleton—or rather two skeletons—of the American mastodon. In the spring of 1801 Peale was informed that the bones of a mastodon had been discovered in a marl-pit near Newburg, in New York State, and he proceeded to the spot and purchased from the owner for 300 dollars the bones already disinterred, and the right to drain and excavate the morass for the purpose of endeavouring to recover the remainder of the skeleton. With the aid of pumps and other machinery lent by Government, the recovery of the missing bones was successfully carried out, and the skeleton, lacking the lower jaw and part of the crown of the skull, was eventually mounted, with additions in wood of the missing parts, from a second skeleton obtained in the neighbourhood and likewise mounted. These skeletons are noticed by Cuvier in his memoir on the great mastodon. At the sale of the Peale Museum in 1850 the second skeleton was probably bought by P. T. Barnum, and, if so, may have been burnt in the destruction of his museum by fire in 1851. The first skeleton, after having been taken by Peale and his brother to London in 1803, where it was exhibited before the Royal Society, eventually found a home in the American Museum of Natural History at New York, where it is known, from having been in the museum of the latter city, as the Baltimore mastodon.

In the *Journal of Morphology* for July (vol. xx., No. 2) Mr. O. P. Dellinger makes an interesting contribution to the discussion on the physical structure of protoplasm. There is still, in spite of the elaborate researches of Bütschli and others, much difference of opinion on this question. The present author makes the cilium the starting point of his investigations, and brings forward evidence to show that all contractile protoplasm has a fibrillar structure. He demonstrates, in an apparently satisfactory manner, that the cilia of Stylonychia are composed of spirally coiled fibrils, and that the flagella of Euglena, Chilomonas, and Spirillum consist each of four spiral filaments, which will account for the complexity of their movements. He finds that by using those methods and reagents by which cilia are best preserved it is possible to demonstrate the existence of a finely meshed reticulum in Amœba, and maintains that such a reticulum of contractile fibres would explain all the facts of amœboid movement. Osmic acid appears to be the most satisfactory reagent for fixing the contractile structures investigated.

An investigation of the epiphytic mycorrhiza that invests the roots of *Monotropa Hypopitys* forms the subject of a paper contributed by Dr. J. Peklo to the *Bulletin International*, Prague (1908). He points out that there is a marked difference between the amount of mycorrhiza investing Monotropa roots in clay or humic soils, and that specimens in clay soils may be entirely free from the fungal covering. As is generally known, the fungus penetrates only into the epidermal cells, and for this reason is termed epiphytic. The plant secretes tannin products in these cells, which serve, in the author's opinion, to prevent the fungus from penetrating further within the root.

The first of an announced series of pamphlets providing information on special Indian timbers deals with the timber yielded by *Diospyros Kurzii*, and known as Andaman marble or zebra wood. As the name implies, the wood is streaked in bands ranging from black to a brownish or pinkish grey, and it has been described as one of the handsomest timbers in the world. The pamphlet, compiled by Mr. R. S. Troup and published by the Government of India as Forest Pamphlet No. 7, supplies details regarding the qualities, available size, and amount of timber; it also contains an actual specimen of the wood.

Arising out of an inquiry addressed to the director of Kew Gardens, Dr. O. Stapf supplies in the *Kew Bulletin* (No. 7) an article on the identification and properties of

the wood known as "lignum nephriticum," which was regarded some three centuries ago as a valuable remedy for disorders of the bladder and kidneys; it was also known that an infusion of the wood was fluorescent. This property, together with a reference to the Mexican vernacular name "coatl," provided the clue to its identification as the product of the leguminous tree *Eysenhardtia amorphoides*. A chemical examination to ascertain the principles which give the wood its physical and possible therapeutical qualities is postponed until more material is available. Another determination by the same authority refers to the fodder grass which is making a reputation in Australia and Natal as *Phalaris commutata*, but which should be known as *Phalaris bulbosa*.

We have received a copy of "The Problem of Practical Eugenics," a lecture delivered by Prof. Karl Pearson at the Galton Laboratory for National Eugenics. Prof. Pearson directs attention to the falling birth-rate, particularly in a manufacturing city like Bradford, and the conclusion is arrived at that this is due mainly to factory legislation, which has destroyed the economic value of the child. A Bradford doctor assured him that in the days before the Factory Acts more care was taken of the children on this account. Prof. Pearson says "the mistake of most legislation is that it is carried by appeal to the sentiment and feelings of relatively small classes—the cultured and highly sensitive upper and middle classes. The biological and economic bases of life are disregarded, and the result is only manifest twenty or thirty years later. The whole trend of legislation and social action has been to disregard parentage and to emphasise environment." Various suggestions are offered to remedy this effect while still maintaining factory legislation. The lecture is one which should be carefully studied by the educated public and our legislators who have the well-being of the race at heart.

An important report, by Prof. W. J. Simpson, on the general state of sanitation and of public health in the West African colonies, has been issued by the Colonial Office. Prof. Simpson was sent to the Gold Coast with special reference to an outbreak of plague which occurred in Accra and the surrounding district in January, 1908. The outbreak lasted for six months; there were 344 cases with 300 deaths. Preventive inoculation was resorted to with conspicuous success, and was performed on 35,000 persons without a single accident or ill-effect. The general insanitary conditions existing in the colony are described by Prof. Simpson as being fraught with danger to the community. No real, effectual, and steady campaign against malarial fever in West Africa has yet been begun. There are no mosquito brigades maintained throughout the year, and it is no one's special duty to look after and to be responsible for the public health. No real progress is possible except by the formation of an organised health department completely distinct from the existing medical service of the colonies, and charged with the duty of advising the Government concerning improvements, and of seeing that they are effectively carried out. Owing to the absence of such a department towns are suffered to grow up from villages without any forethought, the result being often an insanitary condition that nothing but costly demolition will remedy. The report sketches an outline of the organisation and composition of the proposed sanitary service, and discusses its relations with the existing West African medical staff and with the Government.

The Bulletin of the Sleeping Sickness Bureau (No. 9) contains *résumés* of a number of papers on trypanosomes and sleeping sickness. Dr. Moffat reports on a sleeping-sickness-like disease in Bechuanaland. He concludes that the disease closely resembles sleeping sickness, but if it is this disease it is probably imported, and not indigenous.

The craniometrical evidence from India, which is at present scanty and in various respects unsatisfactory, has been usefully supplemented by the publication of the measurements of a series of skulls deposited in the Indian Museum, Calcutta, which have been carried out by Mr. B. A. Gupte under the supervision of Dr. Annandale. The collection contains 614 specimens, but many are broken and others do not indicate the caste or tribe of the subjects. Besides this, practically all come from the lowest strata of the population, from jails and hospitals, the more respectable members of the community being invariably cremated. The record is also vitiated by the impossibility of segregating the skulls of emigrants from other parts of India who happened to die in eastern India. These records, therefore, afford no safe basis for generalisation, but they may be useful to supplement measurements of the living subject, which are necessarily less trustworthy than those of skulls, because it is easier to arrange the position of the latter, and because the soft tissues of the head and face exhibit much individual variation and capacity for contraction and expansion. Mr. Gupte has good reason for appealing to persons throughout India who are in a position to collect skulls, the *provenance* and records of which can be accurately determined, to supplement the present collection, which is of little value for the classification of the multitudinous races and castes to be found within the Indian Empire.

The first annual report (1908) of the Liverpool Committee for Excavation and Research in Wales and the Marches, which has its headquarters in the Liverpool University Institute of Archæology, and is closely associated there with the School of Celtic Studies, contains valuable preliminary surface surveys and detailed reports of tentative excavations at the Roman camps of Chester and Caerleon. The discovery of a Palæolithic implement at the former site is of special interest. A list of the relative number of coins found at Caerleon indicates an occupation of the camp in, or soon after, the principate of Vespasian. Mr. Evelyn-White adduces literary evidence pointing to occupation under Claudius. Two excellent plans of the camp have, apparently, a true north bearing, though the fact is not stated, for the orientation indicated is about 51° N.W.-S.E., which on paper is near enough to the theoretical azimuth for the district of sunrise at the winter solstice. In the preliminary surveys of cromlechs there is not a single reference to their orientation, and the subject has yet to be formally recognised by a committee which, as the list shows, represents all the archæological societies of Wales and the Marches.

Dr. Georg von Smolenski, of Cracow, contributes to *Petermann's Mitteilungen* (v., p. 101) an interesting study of the causes of the asymmetrical form of the north-and-south river valleys in Galicia, which are characteristically steeper on the eastern side than on the western. A careful examination of the different theories which have been proposed from time to time leads Dr. von Smolenski to conclude that no single hypothesis can account for all the observed facts, and he divides the valleys into two groups, those in which the asymmetrical form is being developed and extended at the present time, and those in which it remains as the result of a former condition no longer in existence. In the first group the asymmetry is due to the normal action of "Hilber's law," the base-level of each tributary of the master stream (the Dniester) being lower than that of the tributary next it to the westward. The

second group is found to be due to the action of wind, and must have been formed at a time when the prevailing winds of the region were east and north-east. It appears independently that the formation did actually take place in late Pleistocene times.

THE report of the Meteorological Committee for the year ended March 31 presents several points of especial interest. The various publications containing statistical results have been grouped together under the title "British Meteorological Year-book"; it appears strictly up to date, which will be a great advantage with regard to the supply of information to inquirers, the number of whom have much increased in recent years. Several publications on interesting subjects are in course of preparation. The 7h. a.m. international service of telegraphic weather reports, which was brought into operation on July 1, 1908, has been found to work satisfactorily, and since the commencement of the present year the reports by radio-telegraphy hitherto received from H.M. ships have been supplemented by wireless telegrams from Atlantic liners. The observations and accuracy of transmission have been satisfactory, but only a small number of the messages were received in time for current use, and much remains to be done before they can be utilised in a day map of the ocean. The weather forecasts issued in the morning newspapers and those issued during the harvest season (June–September) have been very successful, the percentage of accuracy (complete and partial) amounting to 92 and 96 respectively. The committee contemplates making some important modifications in the practice of the office as regards marine observations. Instead of devoting attention almost exclusively to the compilation of average results, it is proposed to compare the current with the mean values. Monthly outline charts in suitable form, with the mean values of various elements, are being prepared as the ground-work for plotting the observations recorded on voyages. By this means it is hoped eventually to trace the meteorological relationships of changes in different parts of the world.

THE *Physikalische Zeitschrift* for September 1 contains a long illustrated article by Dr. Max Iklé on old and new little-known auxiliary apparatus for use in physical and chemical laboratories. The pieces of apparatus mentioned are taken from the catalogues of nineteen German firms of instrument makers, and are well worthy of the attention of instrument makers in general. Of special interest are the funnel holder of bent wire, the small instrument stand of adjustable height, the metal lens holder of the Schuster and Lees type, the Bunsen burner with the gas inlet at the side so as not to be stopped up by fused salts falling down the tube, the "emaille" insulated connecting wire for electrical work, and, finally, the list of monographs dealing with cements for physical and chemical work.

THE well-known paradox of twisting a strip of paper and joining its ends in such a way as to form a surface with only one face and only one edge gives rise to the cubic surface known as Möbius's surface. This is, in fact, a surface generated by a straight line which revolves about a point in its plane through an angle of 180°, while the plane revolves about a straight line in itself through 360°. A discussion of the properties of this surface, by Prof. C. E. Cullis, forms one of the papers in the first number of the new Bulletin of the Calcutta Mathematical Society.

THE Calcutta Mathematical Society has commenced the issue of a Bulletin which promises to be an important addition to our mathematical periodicals. In addition to original papers it contains a "summary of principal mathematical journals," with abstracts of many papers; a section headed "Societies and Academies," with full list of titles of papers read; "Reviews"; "Notes and News"; a bibliography of "New Publications," together with proceedings of the society itself, and lists of members and of books in the society's library. While the new bulletin thus assumes the cosmopolitan character of its American contemporary, several of the features which characterise it are distinctly new. The journal should fill a want which is felt no less by English than by Indian mathematicians. We had almost forgotten to mention another commendable feature—there are no "problems and solutions."

A PAPER on the liquefaction of clay by alkalis and the use of fluid clay casting in the ceramic industry, by Dr. E. Weber, which formed the subject of an interesting demonstration at the International Congress of Applied Chemistry, appears in full in German and in English in the eighth volume of the Transactions of the English Ceramic Society, before which society the paper had previously been read. The author shows that by the addition of a suitable quantity of alkali a stiff clay, containing not more than a normal quantity (15 to 20 per cent.) of water, can be made quite fluid; on pouring into plaster moulds the water and alkali are drawn out, and the clay quickly sets. The addition of the alkali does not affect the properties of the finished material, provided that it is only used in moderation, and the use of plaster moulds tends still further to neutralise its effects. In addition to the saving of labour-charges, it is claimed for the casting process that, by completely disintegrating the clay, it gives a very dense and uniform product free from all defects, and that when porous materials are admixed with the clay these become thoroughly impregnated, giving an absolutely dense, homogeneous, and strong mass. The method is in use on a considerable scale for the manufacture of glass furnaces, muffles for zinc distillation, gas retorts, and sanitary goods, as well as smaller articles. The same volume contains a description of a new casting machine, by J. G. Roberts, which is claimed to work with less manual labour than those previously in use, and to have an output of forty-five dozen articles per hour. The society is to be congratulated on the initiation of a series of abstracts from pottery journals, of which a first instalment, covering forty pages, and dealing with twenty journals, is now published.

THE Parseval airship has recently passed the stipulated tests, and has been accepted by the Prussian War Office. The conditions laid down were capability of remaining at a height of about 5000 feet for more than ten hours, of landing at any specified place, and, in addition, capability of being quickly taken to pieces, transported by rail or by two-horse vehicles, fixed up, filled again, and started from any place. At the trials the airship actually kept afloat for 11½ hours. We learn from a description in *Engineering* for September 10 that the ship has a cigar-shaped body about 190 feet long, and has a maximum diameter of about 31 feet. The balloon is charged with hydrogen, and has sufficient rigidity imparted to it by a slight excess of gas pressure—0·8 inch of water. To produce and maintain this gas pressure two *ballonets* or air-sacks have been provided within the balloon; these are charged with compressed air at a pressure of about 1¼ inch of water, and this supply is controlled by means of a system of valves. The motor develops from 100 horse-power to 120 horse-power, and the petrol tank contains nearly 100 gallons.

FEW present-day engineers are aware that Watt produced a steam tilt hammer some years before Nasmyth designed the type of hammer that bears his name. The works at Soho held at one time a great reputation for coppersmith work, and this class of work was done with a Watt tilt hammer, which continued to be in use until quite recently. A photograph of the hammer, together with many others showing machines used by Boulton and Watt, appears in an article in the *Engineer* for September 10. In examining the illustration of one of the Soho boring machines, we are reminded of Watt's early troubles in boring his cylinders—on one occasion we find him rejoicing over a finished cylinder which was nowhere more than $\frac{3}{8}$-inch from true circularity. We agree with our contemporary that it is greatly to be deplored that the history of machine tools has not been preserved. The ingenuity which has produced the development of machine tools has contributed in no small degree to the rise and progress of mechanical engineering.

A CONSIDERABLE extension of our knowledge of the electrical strength of air has been made by Mr. E. A. Watson, of the University of Liverpool, who has measured the potential difference necessary to cause a spark to pass between two small metal spheres at various distances apart in air at pressures between one and fifteen atmospheres. His paper, and the discussion which arose on it, will be found in the August number of the Journal of the Institution of Electrical Engineers. From it we gather that air compressed to fifteen atmospheres will stand an electrical stress of 40,000 volts per millimetre, and it is to be hoped that this fact will soon find its application in apparatus in which high insulation is required.

Erratum.—In NATURE of September 16, p. 339, second column, line twenty-two from bottom, the word satisfactory should be unsatisfactory. The sentence should read :—"With a sextant and artificial horizon, a low altitude, such as 10° or 11° or below, is very unsatisfactory."

OUR ASTRONOMICAL COLUMN.

HALLEY'S COMET.—From a Central News telegram published in Monday's *Daily Telegraph*, we learn that Prof. Burnham has obtained two photographs of Halley's comet, with instruments at Yerkes Observatory.

OBSERVATIONS OF PERRINE'S COMET, 1909*b*.—A further observation of Perrine's comet, made by Dr. Max Wolf on September 5, is recorded in No. 4355 of the *Astronomische Nachrichten* (p. 179, September 12). With the reflector, and a power of 140, the comet appeared as a round, nebulous mass, of about 10′ diameter, increasing in intensity towards the centre. The brightness of the whole comet is about equal to the fourteenth magnitude, while the nucleus is about equal to a star of that magnitude.

Dr. Ebell gives an ephemeris for this comet in the same journal showing that it should become about 1·5 magnitudes brighter than it is at present by October 17. The observation of September 5 shows that this ephemeris then required corrections of −1m. 39s. and −23′.

OBSERVATIONS OF MARS.—In No. 4354 of the *Astronomische Nachrichten* (p. 159) M. Jonckheere gives a drawing illustrating his observation of August 11–12. The peculiar interest of the observation was the aspect of the Novissima Thyle, which, although still covered with ice, was detached from the polar cap. This feature of the Martian landscape appeared oval, with its broad extremity in long. 330° and its narrow end in long. 310°, its apparent length being 1·42″.

Measures of the polar cap show that its apparent diameter decreased from 4·33″ on July 16 to 3·00″ on August 21.

Further changes are recorded by M. Jarry Desloges in No. 4355 of the same journal. Observations made with a 37-cm. refractor on the Revard plateau on September 3 showed that the white polar spot was divided completely by a crevasse and a greyish region in long. 80°. The region of the Lacus Solis and d'Auroræ Sinus, so pale during the previous rotations, showed considerable changes, the details now appearing very different in form, colouring, and position to what they did in 1907. Juventæ Fons is dark and easily visible, and the canal Coprates appears to have changed its position since 1907. Nectar is dark and broad, and Araxes is double and very complicated in its structure. Lacus Phœnicis is blackish and is doubled, the southern portion being the smaller. Lacus Tithonius has very indefinite edges, and two dark spots are seen within its area. The Solis Lacus presents a number of detailed features, and is much elongated in the direction east-west. A number of canals, single and double, were observed, and all the regions observed presented such a complicated structure that it was found impossible to make complete drawings.

WATER VAPOUR IN THE MARTIAN ATMOSPHERE.—According to a despatch published in the *Times* of September 17, spectrograms of Mars and the moon, secured by a party of Lick observers on the summit of Mount Whitney, indicate that there is no appreciable quantity of water vapour in the Martian atmosphere. Prof. Campbell suggests that the positive results obtained by Prof. Lowell and other observers may be attributable to water vapour in the earth's atmosphere, but further details should be awaited ere the recent negative results are accepted as final. The photographs are stated to have been taken when Mars and the moon were at the same altitude, and under similar conditions of the earth's atmosphere, yet the vapour bands in the Martian are no stronger than in the lunar spectra; hence it follows that, at the time the spectra were obtained, the quantity of water vapour on Mars was apparently no greater than that on the moon.

THE MAXIMUM OF MIRA IN OCTOBER, 1908.—Dr. Nijland's observations of the magnitude of Mira, made at the Utrecht Observatory during the period July, 1908, to February, 1909, showed that the maximum (mag.=3·5) occurred on October 6, 1908 (J.D. 2418221), five days before the time given by Guthnick's ephemeris (*Astronomische Nachrichten*, No. 4355, p. 165).

THE SPECTROHELIOGRAPH OF THE CATANIA OBSERVATORY.—In an extract from vol. xvii. of the *Rendiconti della R. Accademia dei Lincei*, Prof. Riccò describes the spectroheliograph now in use at the Catania Observatory, the first to be erected in Italy.

The instrument is made to attach to a telescope, and may be used with a prismatic, or a grating, dispersion. The regulation of the transit of the primary slit across the solar image is effected by a clepsydra containing water with 20 per cent. of glycerine added. The diameter of the solar image operated upon is 52 mm., but the primary slit is but 37 mm. long, therefore the whole disc takes two exposures. Some of the results obtained at Catania, in 1908, are reproduced with the paper, which is also printed in No. 8, vol. xxxviii., of the *Memorie della Società degli Spettroscopisti Italiani*.

Hα IMAGES ON SPECTROHELIOGRAMS.—In concluding a letter to the *Observatory*, M. Deslandres states that, on spectroheliograms taken in Hα light at Meudon, he has, this year, noted numerous instances where the spectro-register of velocities has revealed some very large radial displacements, similar to those observed by Young in 1872 and Hale in 1892. These were thought to be exceptional phenomena, but Mr. Buss, who calls them "horns," claims that he has seen them with relative frequency. The Meudon observations now confirm Mr. Buss's ocular observations.

DOUBLE-STAR MEASURES.—In Nos. 4353–4 of the *Astronomische Nachrichten*, Prof. Burnham continues the record of the observations of double stars made since the publication of his General Catalogue. The majority of measures refer to doubles otherwise neglected, and comparatively few of the Σ or OΣ are considered to require present attention. About 150 systems are included in the list of measures now published.

COPENHAGEN CONGRESS ON THE TESTING OF MATERIALS OF CONSTRUCTION.

THE fifth Congress of the International Association for the testing of engineering materials met at Copenhagen on September 7–11. The attendance at this congress was very much larger than that at the previous meeting, which took place at Brussels three years ago. There was a particularly marked increase in the British representation, which had risen from about fifteen at Brussels to more than forty at Copenhagen. Among the British representatives were Mr. G. C. Lloyd, British member of council of the International Association, Mr. J. E. Stead, F.R.S., and Messrs. B. Blount, F. W. Harbord, L. Robertson, E. O. Sachs, F. Tomlinson, W. Rosenhain, and A. G. Roberts. Among the Continental members, Profs. Martens and Heyn (Berlin), H. Le Chatelier and L. Guillet (Paris), Messrs. Webster, Moldenke, Hatt, and Windsor-Richards (U.S.A.), were some of the best known. The membership of the congress thus very fully represented both engineering science and practice.

The formal opening of the congress took place in the presence of the King of Denmark in the large hall of the University of Copenhagen. The opening ceremony was performed in a few graceful words by the Crown Prince of Denmark. In his presidential address the president, Mr. Foss, explained the general aims of the association, and pointed out the fact that the present year was the twenty-fifth anniversary of the first inception of the association. He referred specially to the increased interest displayed in the present congress by British engineers, and said he hoped that this might lead to the establishment of a better mutual understanding between the Continental and the English-speaking engineers. An address by Mr. P. Larsen on the development of the Danish cement industry completed the proceedings, which were, however, considerably enlivened by the spirited rendering of a typically Scandinavian cantata by a choir of students.

The actual business of the congress, which occupied the mornings of September 8, 9, and 10, was divided into three sections, the meetings of which took place simultaneously in various rooms set apart for the purpose in the splendid Town Hall of Copenhagen, where every possible provision for the comfort and convenience of members had been thoughtfully made. Section A, being devoted to subjects connected with metals, was the largest as regards attendance, although Section B, devoted to cement and reinforced concrete, also attracted many members and much attention. Section C, devoted to miscellaneous materials, proved less important.

The papers and reports submitted to the three sections occupy the closely printed pages of several voluminous pamphlets, and these, as well as the discussions upon them, can only be indicated here in the briefest outline.

Section A devoted its first sitting to the subject of metallography, an official report of the progress of that science being presented by Prof. Heyn, of Berlin. The extent of this report, in which a considerable number of British papers are referred to in abstract, is striking evidence of the great strides which this new science has made—the period covered by this report marking an epoch through the loss of Dr. Sorby, the actual founder of the science. Although the report of Prof. Heyn referred to a large number of papers, some of considerable importance which have appeared in England and America were, no doubt inadvertently, omitted; in the discussion, therefore, it was suggested by Dr. Rosenhain that it would be desirable in the preparation of future progress reports of this kind to obtain the collaboration of competent members from each country with the view of compiling a complete triennial bibliography. Out of the subject-matter of this report a discussion arose as to the nature of the constituents of steel, in which Benedicks, Le Chatelier, and Heyn took part. A further and very satisfactory outcome of this discussion, followed by a private conference of some of the delegates, was the formulation of a set of international definitions referring to the nomenclature of the constituents of iron and steel; this set of definitions was placed before the congress under the unanimous recommendation of Messrs. Le Chatelier, Guillet, and Charpy (France), Heyn (Germany), Benedicks (Sweden), and Stead and Rosenhain (England). The new term "meteral," suggested by Howe and Sauveur (U.S.A.), was accepted with the significance in the case of the constituent of a metal which attaches to the term "mineral" in the case of the constituents of a rock, complexes of two or more meterals to be known as "aggregates"; these terms having the great advantage of being of international applicability, and also fairly obvious in meaning, have met with general approval. The terms "martensite," "osmondite," "austenite," and "pearlite," as well as the already universal terms "ferrite" and "cementite," have received clear definitions; thus the new term "osmondite" is to denote that constituent which is present in partly hardened or tempered steels which no longer consist of either austenite or martensite, but contain an intermediate constituent which arises in the passage of martensite into pearlite; this constituent, which some authors have hitherto called "troostite," is now to be known as "osmondite," and it is hoped that the full definition adopted by the congress will free the term "osmondite" from the haze of controversy which has hitherto obscured the term "troostite." The two terms "troostite" and "sorbite" have been left entirely out of these international definitions in the hope that their use will either be entirely dropped or, at all events, accompanied in each case by a special definition.

The adoption of these definitions constitutes one of the few quite definite results attained by the congress; in most other matters the discussions either produced no definite conclusion or the questions under consideration were referred to international committees to be subsequently appointed by the council. Thus the question of slag-enclosures in steel, raised by a paper by Rosenhain, led to a discussion in which the general trend of opinion was strongly in the direction of attaching greater importance to these enclosures than has hitherto been done. Guillet proposed that in order to keep this matter before the congress a committee be appointed to consider the subject and to carry out investigations as to the nature of these slag-enclosures and their effect on the mechanical properties of steel, and this proposal was adopted.

The questions of hardness tests on the one hand and of impact tests on the other each occupied almost an entire day's session of Section A. In regard to hardness tests, the Brinell ball test found many ardent supporters, but, on the other hand, Dr. Ludwik, of Vienna, presented a paper emphasising the advantages of cone-indentation tests, and a cone-hardness testing machine of Swedish manufacture was shown which appeared to be a serious rival to the Brinell machine of Martens-Heyn, which is regarded as the standard machine in Germany. The British delegates directed attention to the "hardness" testing machines in which the rebound of a hardened falling weight is observed, as these appeared to be unknown on the Continent.

The importance of impact tests was recognised by all who took part in the lengthy discussion on this subject, but the importance of standardising what was still a purely empirical test was also insisted upon. After some opposition from the German section, the congress finally adopted a set of standard test-bars for notched bar single-blow impact tests, but although the Charpy impact tester appears to be widely recognised as a satisfactory machine, it was decided not to adopt definitely any one apparatus.

Perhaps the most difficult question with which the congress had to deal was that of the standardisation of specifications as between different countries; the acceptance of an international specification by the congress being a matter which would seriously affect the industrial interests of the countries concerned, much difficulty and some little friction inevitably arose. It was quite evident from the outset that the final adoption of any universal specification was not yet possible at the present congress, and in nearly every case the questions of unified specifications were referred back to their respective committees. Perhaps the largest amount of progress was reported by M. Guillet as chairman of the committee on specifications for copper; at a meeting of this committee, which took place just before the congress at Copenhagen, the members present were able to agree on most points of an international specification. Unfortunately, the attendance at this meet-

ing was not very large, but it is hoped that when the conclusions arrived at by this committee are circulated to all the members a universal agreement as to a specification very much on the lines of the British standard specification will be reached. In regard to iron and steel, the difficulties are much greater, but it is hoped that a nearer approach to agreement may be reached in time for the next congress; meanwhile, the only definite result in this direction is a carefully worded resolution indicating that the congress recommends the sale of pig-iron on a basis of chemical analysis alone, the old method of grading by fracture being discarded as too indefinite.

In Section B the papers dealing with reinforced concrete were first discussed, but the discussion was of a very general nature, the desire being widely expressed that methods of testing and experimenting should first of all be systematised and standardised. One of the subjects which received most attention was that of the action of sea-water on cement, the report by Poulsen describing the elaborate series of tests carried out on various points of the coast of Scandinavia from Esbjerg, in the south-west, to Vardö, at the extreme north of Norway, being very favourably received. Ultimately the section passed a resolution, combining one proposed by Mr. Sachs and another proposed by a French representative, setting up a committee to bring the whole question up to date for the next congress by preparing a summary of the papers already before the association, and also to carry out further experiments with specially prepared cements exposed to sea-water to test the influence of various percentages of sulphates.

In connection with cement-testing there was a good deal of heated discussion, principally as to the definition of a "standard sand," while Mr. Blount and his committee had to contend with some strong opposition in carrying their proposals in regard to volume-constancy tests.

A general business meeting of the congress took place on the concluding day (Saturday, September 11). After the formal business had been disposed of, Mr. J. E. Stead, F.R.S., was asked to deliver his lecture on the practical application of the microscopic examination of metals at the present time. So little time remained, however, that Mr. Stead could only give a very brief summary of his subject-matter, the lantern-slides being, however, shown in the afternoon by special request. While the report of Heyn on the progress of metallography had summarised the work of laboratories and investigators, Mr. Stead dealt with the use of the microscope in works practice, and was able to give an account of the manner in which microscopic methods were employed by a large number of firms both in England and in America. Examples of successful application of microscopic methods in the case of cast-iron, steel, copper, brass, and many other metals were given, the names of the firms in question being stated, including all those best known in their respective industries. The use of the microscope in the investigation of failures and breakages was finally described.

In addition to the actual business of the congress, the programme arranged by the reception committee included a large number of interesting visits and excursions; these included the new railway repair workshops, the works of Messrs. Burmeister and Wain, where shipbuilding is carried on, the Royal Danish Porcelain Works, and a number of municipal institutions, such as the electric power station, the refuse destructor, &c., as well as the newly organised State testing laboratories, the great breweries of Carlsberg and the fine museums endowed from their profits. The evenings of the congress week were occupied by a series of brilliant functions, including a reception by the Danish Society of Engineers, another by the Municipality of Copenhagen, a special performance at the Royal Opera House, and, finally, excursions to Sgodsborg and to Elsinore on the Oresund; the former, carried out by means of a steamer, which first took the party around the harbour of Copenhagen, was especially enjoyable, and it was followed by an informal dinner of huge dimensions (more than 900 sat down) at the beautifully situated Sgodsborg Hotel. Our Danish hosts were most warmly hospitable, and everything was done to make the impressions of Copenhagen as pleasant as possible—even the weather was favourable, so that the 500 visiting engineers saw Copenhagen at its very best. Although it may perhaps be said that no very striking decisions have been reached at this congress, it has undoubtedly served a very valuable purpose in bringing together a large number of scientific and technical workers who had hitherto known one another by correspondence only. Linguistic difficulties were, of course, of frequent occurrence, but willing interpreters were generally at hand; the discussions of the congress were, as a rule, translated into the three official languages—a difficult task, in which one or two of the British delegates displayed considerable activity. In fact, it was a widely expressed feeling—not a little gratifying to the British representatives—that at this congress there was much evidence of the fact that a great revival in matters of applied science had taken place in England since the last meeting of the congress. It is to be hoped that when the congress meets next—in America in 1912—still further evidence of this revival will make itself felt. Adequate British representation at these congresses is of great importance, not only in securing the due consideration of British interests, but also in securing due respect for British achievements and British capacity—respect which will help to promote the cause of universal peace.

GERMAN BOTANICAL CONGRESS.

A FEW years ago the three German societies specially interested in one or other branch of botany agreed to meet in the same district and at the same time each year, and the arrangement has proved so advantageous that it has become permanent. This year the societies met at Geisenheim, on the Rhine, in the Rheingau. The Botanical Institute at Geisenheim, where the meetings were held, is liberally supported by the Prussian Government, and in most respects seems ideal. Both staff and students are well housed on the spacious premises, and the courses are arranged to suit many different types of students. Owing, however, to the continuity of courses throughout the year, there is no regular vacation for the staff, the members of which must in time, one would think, lose somewhat in vigour and freshness of teaching. The institute exists for the promotion of the interests, scientific and practical, of the vineyard, and its wine, and of the fruit and vegetable industries.

There are separate buildings for chemistry, plant physiology, pathology, and fermentation, each fully equipped and under its own chief. The connection between science and practice is very intimate, and research is encouraged. From the fermentation station pure yeast cultures are sent all over the world. The whole institute is under the able administration of Prof. Wortmann, to whom the success of this year's meeting is largely due.

Naturally, several papers on the vine and on wine, too specialised for general notice, were contributed by experts. Attention was directed to the fungus *Rhacodium cellare*, which lives on cork, and causes the deterioration of wine in store. Sound sterilised corks, replaced unconditionally each year, are a necessary precaution against the damage wrought by this trouble.

Much of the time of the economic botanists was occupied by papers on the potato and its diseases. Particular attention was directed to the disease called "leaf-roll," not to be confused with "leaf-curl." Alarmist reports of the extent of the disease and of the injury it was inflicting appeared in the German Press last year. Though these reports have been shown to be exaggerated, the disease is clearly doing much harm. It is, as the writer noticed, widely spread in many parts of Ireland, but not yet recorded for Great Britain, or for France (judging from a conversation recently with M. Maublanc at the Pathological Institute in Paris). There are several features of striking interest in connection with leaf-roll. It is generally recognisable by the more or less dwarfed, stunted haulms, and the inrolled, often more or less coloured, leaflets. In leaf-curl the surface of the leaflets is crumpled. In the first year of attack the tubers may appear sound and of normal weight. The disease is, however, in them, as shown by the next year's diminished, diseased crop. Appel's view, that Fusarium is generally present in the

vessels of the stem, is not supported by others. One hypothesis is that the disease is due to degeneration of the particular variety attacked, another that manure and soil may have a disturbing influence on the metabolism and ferments of the plant. No one has yet succeeded in infecting healthy stock with leaf-roll. It is readily transmitted by tubers, and, Count Arnim thinks, possibly by seeds also. In spite of all the attention devoted to the investigation of this disease, its cause is still a mystery, and until this is solved it is impossible to suggest general preventive measures. On no account should the tubers from a leaf-roll plant be used as seed.

During the meeting Wittmack summarised his views on the tuber-bearing species of Solanum. He holds that all European potatoes come from one true species, *Solanum tuberosum*, that *S. Maglia* is also a true, closely allied species, and that both differ from *S. Commersonii*. He praised highly the drawings, made for Sutton and Sons, of the Solanums by Worthington Smith. Wittmack was sent by the German Government to inspect the plots of *S. Commersonii violet*, believed by Labergerie and Heckel to be a valuable disease-resisting variety, and, they think, derived from *S. Commersonii* by mutation. It appears, however, to be identical with Paulsen's Blue Giant, a variety of *S. tuberosum*, and, like all other varieties, liable to leaf-blight and other potato diseases.

Lindner directed attention to the difficulties of identification of fermentation organisms. He proposed the creation in Berlin of a central station where photomicrographs of such organisms from all parts of the world could be stored, named when necessary, and registered for consultation. He illustrated his views by three volumes of such photographs, and in the course of the meeting used them to name a soil organism exhibited by H. Fischer. Hosseus described the rice industry in Siam, and urged the claims of rice on the Germans as a cheap and nutritious food. Ewert described the over-wintering of the conidia of Fusicladium, the cause of apple and of pear spot. The systematists devoted one day to the reading of papers by Drude, Gilg, Diels, Ross, &c. Schwendener was elected honorary president of the Deutsche Botanische Gesellschaft, before which, at a morning sitting, two important papers were read, one by Senn on the movements of chromatophores, including a beautiful illustration of diatom cell-division, and another by Kniep on assimilation activity under different rays of light.

A special feature of this year's meeting, which ought not to go unrecorded, was the testing in different localities of the wine of the district. On the last day at Geisenheim the three bodies sat in common for three hours to test no fewer than thirty-five different kinds of wine, provided by the Rheingau Wine Society.

Some forty members subsequently spent several days in botanical excursions in the valleys of the Nahe and Mosel. At Bertrich fine specimens of *Buxus sempervirens* and *Acer monspessulanum* were to be seen growing in plenty on the rocky slopes. On the shores of the crater-lake (Pulvermaar) at Gillenfeld, *Pilularia globulifera* formed a regular sward.

It was agreed to meet next year at Münster in time to allow members to attend the International Botanical Congress, and also the Seed-testing Conference at Brussels at Whitsuntide. T. J.

THE BRITISH ASSOCIATION AT WINNIPEG

SECTION H.

ANTHROPOLOGY.

OPENING ADDRESS (ABRIDGED) BY PROF. JOHN L. MYRES, M.A., F.S.A., PRESIDENT OF THE SECTION.

The Influence of Anthropology on the Course of Political Science.

ANTHROPOLOGY is the Science of Man. Its full task is nothing less than this, to observe and record, to classify and interpret, all the activities of all the varieties of this species of living being. In the general scheme of knowledge, therefore, anthropology holds a double place, according to our own point of view. From one standpoint it falls into the position of a department of zoology, or geography; of zoology, since man, considered as a natural species, forms only one small part of the animal population of this planet; of geography, because his reason, considered simply as one of the forces which change the face of nature, has, as we shall see directly, a range which is almost world-wide. From another point of view anthropology itself, in the strictest sense of the word, is seen to embrace and include whole sciences such as psychology, sociology, and the rational study of art and literature; since each of these vast departments of knowledge is concerned solely with a single group of the manifold activities of man. In practice, however, a pardonable pride, no less than the weighty fact that man, alone among the animals, truly possesses reason, has kept the study of man a little aloof from the rest of zoology. Dogmatic scruples have intervened to prevent man from ever ranking merely as one of the "forces of nature," and have set a hard problem of delimitation between historians and geographers. And the pardonable modesty of a very young science—for modern anthropology is barely as old as chemistry—has restrained it from insisting on encyclopædic claims in face of reverend institutions like the sciences of the mind, of statecraft, and of taste.

Yet when I say that anthropology is a young science I mean no more than this, that in the unfolding of that full bloom of rational culture, which sprang from the seeds of the Renaissance, and of which we are the heirs and trustees, anthropology found its place in the sunlight later than most; and almost alone among the sciences can reckon any of its founders among the living. This was of course partly an accident of birth and circumstance; for in the House of Wisdom there are many mansions; a Virchow, a Bastian, or a Tylor might easily have strayed through the gate of knowledge into other fields of work, just as Locke and Montesquieu only narrowly missed the trail into anthropology.

But this late adolescence was also mainly the result of causes which we can now see clearly. Man is, most nearly of all living species, the "ubiquitous animal." Anthropology, like meteorology, and like geography itself, gathers its data from all longitudes, and almost all latitudes, on this earth. It was necessary therefore that the study of man should lag behind the rest of the sciences, so long as any large masses of mankind remained withdrawn from its view; and we have only to remember that Australia and Africa were not even crossed at all—much less explored—by white men, until within living memory, to realise what this limitation means. In addition to this, modern Western civilisation, when it did at last come into contact with aboriginal peoples in new continents, too often came, like the religion which it professed, bringing "not peace but a sword." The customs and institutions of alien people have been viewed too often, even by reasonable and good men, simply as "ye beastlie devices of ye heathen," and the pioneers of our culture, perversely mindful only of the narrower creed, that "he that is not with us is against us," have set out to civilise savages by wrecking the civilisation which they had.

Before an audience of anthropologists, I need not labour the point that it is precisely these two causes, ignorance of many remoter peoples, and reckless destruction or disfigurement of some that are near at hand, which are still the two great obstacles to the progress of our science. But it is no use crying over spilt milk, and I turn rather to the positive and cheering thought that the progress of anthropology has been rapid and sure, in close proportion to the spread of European intercourse with the natives of distant lands, and that its further advance is essentially linked with similar enterprises.

Anthropology and Politics in Ancient Greece.

Philosophy, as we all know, begins in wonder: it is the surest way to jostle people out of an intellectual groove into new lines of thought, if they can be confronted personally and directly with some object of that numerous class which seems uncouth only because it is unfamiliar. The sudden expansion of the geographical horizon of the early Greeks, in the seventh and sixth centuries B.C., brought these earliest and keenest of anthropologists face to face with peoples who lived for example in a rainless country, or in trees, or who ate monkeys, or grandfathers, or called themselves by their mothers' names, or did other disconcerting things; and

this set them thinking, and comparing, and collecting more and more data, from trader and traveller, for an answer to perennial problems, alike of their anthropology and of ours. Can climate alter character or change physique, and if so, how? Does the mode of life or the diet of a people affect that people's real self, or its value for us? Is the father, as the Greeks believed, or the mother who bore them, the natural owner and guardian of children? Is the Heracles whom they worship in Thasos the same god as he whose temple is in Tyre? Because the Colchians wear linen, and practise circumcision, are they to be regarded as colonists of the Egyptians? or can similar customs spring up independently on the Nile and on the Phasis? Here, in fact, are all the great problems of modern anthropology, flung out for good and all, as soon as ever human reflective reason found itself face to face with the facts of other human societies, even within so limited a region as the old Mediterranean world.

And I would have you note that these old Greek problems, like all the supreme problems of science old and new, were not theoretical problems merely. Each of them stood in direct relation to life. To take only cases such as I quoted just now from the Father of History—is there, for example, among all the various regions and aspects of the world, any real earthly paradise, any delectable country, where without let or hindrance the good man may lead the good life? Is there an ideal diet, an ideal social structure, or in general, an ideal way of life for men; or are all the good things of this world wholly relative to the persons, the places, and the seasons where they occur? I do not mean that the ancient Greeks ever found out any of these things, for all their searching; or even that all ancient seekers after marvels and travellers' tales were engaged consciously in anthropological research at all. I mean only this: that the experiences, and the problems, and the practical *end* of it all, were as certainly present to the minds of men like Herodotus and Hippocrates, as they have been in all great scientific work that the world had seen.

In the same way it has for some while been clear to me that neither Plato nor Aristotle, the great outstanding figures of fourth-century Greece, was constructing theories of human nature entirely in the air. Their conceptions both of the ideal state of society, and of the elements which were fundamental and essential in actual societies as they knew them, were determined to a very large extent by their observation of real men in Sparta, Persia, or Scythia. But it is also clear that much that had been familiar to the historians of the fifth century, and particularly to Herodotus, had fallen out of vogue with the philosophers of the fourth. Systematic clearness had been attained only by the sacrifice of historic accuracy. Thucydides, in fact, standing right in the parting of the ways between history and rhetoric, might fairly have extended his warnings to a dissociation of history from political philosophy, which was just as imminent.

Anthropology and the Renaissance.

At the Revival of Learning it was the same as in the great days of Greece. New vistas of the world were being opened up by the voyagers; new types of men, of modes of life, of societies and states, were discovered and described; new comparisons were forced upon men by new knowledge crowding thick into their minds; and new questions, which were nevertheless old as the hills, made eddies and rapids in the swift current of thought, and cried out for an answer. Take the central political problems, for example: What constitutes the right to govern, and what is the origin of law? In mediæval Europe this was simple enough. The duke, or the king, or the bishop governed by authority of the emperor, or the pope; and pope and emperor ruled (like Edward VII.) "by the Grace of God." Yet here, in Guinea, in Monomotapa, in Cathay, and in Peru, were great absolute monarchies which knew nothing of the pope or the emperor, and were mighty hazy about God. Yet their subjects obeyed them, and gave good reasons for their obedience, and chiefest of their reasons (as in all times and places) was this: "We should be much worse off if we didn't."

Unsocial Man and the Pre-Social State.

It would take me very far afield if I were to try to show how this universal answer came to change its ground from politics to anthropology, so that to the question—how men knew that they would be much worse off if they didn't—the answer came, that "once upon a time they *had been* much worse off, *because* they didn't." For my present purpose it is enough to note that, in all ages, philosophers who set out to define the *nature* of the State, have become involved in speculations about its *origin*; that historians in their researches into its origin have been forced into conclusions as to its nature; and that in both cases every belief about the Nature of the State has been found to involve a belief about a State of Nature; an answer of some kind, that is, to the question whether man was originally and naturally a social animal, or whether at some early period of his history he became social and domestic. In the latter event, how was domestication effected, and what sort of thing was undomesticated man? In the ancient world, after long controversy, Aristotle's definition of man as the "social animal" had carried the day, and ruled that question out of court. But at the Revival of Learning, the unnatural behaviour of certain actual societies towards their individual members had revived irresistibly the whole question whether society was part of the natural order at all, and not a "device of the heathen," a mistake or a *pis aller*; and whether, if society was not thus "natural," men would not really be better off if they returned to their natural, pre-social, *unsocial* state, and began again at the beginning, to work out their own salvation. This belief in a pre-social state played a large part in the political philosophy of the seventeenth and eighteenth centuries; and conversely it was the very fact that the pre-social state as a philosophical conception fell out of vogue at the beginning of the nineteenth, which has distinguished modern political philosophy so markedly from its predecessors.

The Patriarchal Theory.

All theories of a Social Contract as the starting-point of human societies presupposed that mankind had actually passed through a Pre-Social State; and the proof which had been offered of this supposition, though partly theoretical and *a priori*, had partly also been inductive and based on experience. Further, the experience of "primitive Man" which was actually open to the philosophers of the seventeenth and early eighteenth centuries had been, in fact, such as to force the conclusion not merely that a Pre-Social State had once existed, but that some barbarous peoples had not yet emerged from it. It was a sad error of observation, as we now know, which led to that conclusion; but given the travellers' tales, in the form in which we can read them in the "Cosmographies" and "Voyages" of the time, I do not see how that conclusion could have been avoided without culpable neglect of such evidence as there was. If blame is to be assigned in this phase of inquiry at all, it is to be assigned to the travellers and traders, for making such poor use of their eyes and ears. All, however, that I am concerned to establish at present is this, that one of the most important and far-reaching speculations of modern political philosophy, the speculation as to a Pre-Social Condition of Mankind, and a Social Contract which ended it and brought in Society and the State, arose directly and inevitably from the new information as to what primitive man *was* and *did*, when he was studied in the seventeenth century at Tombutum, or Saldanha Bay, or the "backwoods of America," or the "bank of the Orinoco river."

But the Social Contract Theory has long since passed out of vogue. Its political consequences are with us to-day, like the political consequences of the belief in the Divine Right of Kings; but the theories themselves are dead, and likely to remain so. Plato and Aristotle, with their belief in Man as a Naturally Social Animal, have come by their own again, for most of us, if not for all; and the search for an ideal State, which shall realise and fulfil Man's social instincts, is again in full cry.

What part, if any, has the direct study of barbarous people played at this fresh turn of the wheel? Let us look once again at the state of geographical knowledge, and more particularly, as before, at the regions in which

by transitory chance of circumstances, there was most to be learned at the moment. First, the British occupation of India was the occasion, on the one hand, of the discovery of Sanskrit, the creation of this science of comparative philology, and the demonstration of a new link of cultural affinity over the whole realm of Aryan speech. The same political event led no less directly to the discovery of the patriarchal structure of Hindoo society, and so through the comparative study of Indian, Roman, and ancient Celtic and Teutonic law to an inductive verification of Aristotle's doctrine of the "naturalness" of patriarchal society. This doctrine dominated political science for nearly fifty years. "The effect of the evidence derived from comparative jurisprudence," Sir Henry Maine could write in 1861,[1] "is to establish that view of the primæval conditions of the human race which is known as the Patriarchal Theory. There is no doubt, of course, that this theory was originally based on the Scriptural theory of the Hebrew patriarchs in Lower Asia. . . . It is to be noted, however, that the legal evidence comes nearly exclusively from the institutions of societies belonging to the Indo-European stock, the Romans, Hindoos, and Sclavonians supplying the greater part of it; and indeed the difficulty, at the present stage of the inquiry, is to know where to stop; to say of what races of men it is *not* allowable to lay down that the society in which they are united was originally organised on the patriarchal model." And he refers explicitly to the former controversy between Filmer and Locke, to point out how the tables had now been turned upon the latter.

Thus in the half-century which intervenes between Herder and Maine, the political philosophy of Europe seemed to have turned almost wholly from exploration to introspection; from the Pacific to early Rome and the German forests; and from the study of survivals in the modern practice of savages, to that of primæval custom betrayed by the speech and customs of the civilised world. It was Aristotle over again, with his appeal to custom, ancestral belief, and canonical literature, following hard upon the heels of the visionary revolutionary Plato. Maine's own words, indeed, about Rousseau[2] would be applicable almost without change to the course of Greek thought in the fourth century B.C. "We have never seen in our own generation," he says, "indeed the world has not seen more than once or twice in all the course of history, a literature which has exercised such prodigious influence over the minds of men, over every cast and shade of intellect, as that which emanated from Rousseau between 1749 and 1762. It was the first attempt to re-erect the edifice of human belief after the purely iconoclastic efforts commenced by Bayle, and in part by our own Locke, and consummated by Voltaire; and besides the superiority which every constructive effort will always enjoy over one that is merely destructive, it possessed the immense advantage of appearing amid an all but universal scepticism as to the soundness of all foregone knowledge in matters speculative. . . . The great difference between the views is that one bitterly and broadly condemns the present for its unlikeness to the ideal past, while the other, assuming the present to be as necessary as the past, does not affect to disregard or censure it."

I have devoted some space to these first steps of Linguistic Palæontology and Comparative Jurisprudence because the method of inquiry which they announced promised at first sight to make good a very serious defect in the instruments of anthropological research. Human history, outside of Europe and of one or two great oriental States like China, hardly went back beyond living memory; even Mexico had no chronicles beyond the first few hundred years, and the records of old-world States like China, which at first sight offered something, turned out on examination to have least to give. They had lived long, it is true, but their lives had been "childlike and bland," devoid of change, and almost empty of experience. Consequently there was no proof that the "wild men" of the world's margins and byways were really primitive at all. The Churches held them children of wrath, degenerate offspring of Cain; the learned fell back upon pre-Adamite fictions, to palliate, rather than to explain their invincible ignorance of Europe and its ways.

[1] Maine, "Ancient Law," pp. 127–3. [2] *Ibid.*, pp. 86–9.

Here, however, in the new light thrown by the history of speech, there seemed to be a prospect of deep insight into the history of human societies. Disillusionment came in due course, when doctors disagreed; but illusion need never have taken the form it did, had either the philologists or the philosophers realised that all the really valuable work was being done within the limits of a single highly special group of tongues; that the very circumstance that this group of tongues had spread so widely, pointed to some strong impulse driving the men who spoke them into far-reaching migrations; that one of the few points upon which linguistic palæontologists were really unanimous was that both the Indo-European and the Semitic peoples, in their primitive condition, were purely pastoral; and that this pastoral habit was itself an almost coercive cause for their uniformly patriarchal organisation. The last point, however, belongs so completely to another phase of our story that it is almost an anachronism to introduce it here. It serves however to indicate, once again, if that be necessary, how completely the philosopher, and even the man of science, is at the mercy of events in the ordering of his search after knowledge. It is, indeed, almost true to say that if the primitive Aryan had not had the good fortune not merely to live on a grass-land, but also to find domesticable quadrupeds there, there could no more have been a science of comparative philology in modern Europe than there could be among the natives of your own Great Plains or of the Pacific Coast: for in no other event would there have been any such "family of languages" to compare.

In the absence of warning thoughts like these, however, the comparative philology and the comparative law of the patriarchal peoples of the North-West Quadrant and of India went gaily on. What Maine had done for India, Maine himself, with Solm and von Maurer, in Germany; Le Play, de Laveleye, and d'Arbois de Joubainville in France; W. F. Skene in far-off Scotland; Whitley Stokes and others in Ireland; Rhys in Wales; and Mackenzie Wallace and Kovalevsky in Russia, had done for the early institutions of their respective countries: all emphasising alike the wide prevalence of the same common type of social structure, based upon the same central institution, the Patriarchal Family, with the *Patria Potestas* of its eldest male member as its overpowering bond of union; and Maine's own words do not the least exaggerate the beliefs and expectations which were evoked by this new aspect of the Study of Man.

The Matriarchate in Southern India, Africa, and North America.

The Patriarchal Theory lasted barely fifty years. It had owed its revival, as we have seen, to two fresh branches of research, comparative jurisprudence and comparative philology, both stimulated directly by the results of European administration in Northern India. It owed its decline to the results of similar inquiries in other parts of the world, stimulated no less directly by other phases of the great colonising movement, which marks, above all other things, the century from 1760 to 1860. Here again a small number of examples stand out as the crucial instances. British administration in India had, of course, been extended over the non-Aryan south, as well as over the north; and in Travancore, and other parts of the Madras Presidency, British commissioners found themselves confronted with types of society which showed the profoundest disregard of the Patriarchal Theory. Like the Lycians of Herodotus, these perverse people "called themselves after their mothers' names": they honoured their mother and neglected their father, in society, and government, as well as in their homes; their administration, their law, and their whole mode of life rested on the assumption that it was the women, not the men, in whom reposed the continuity of the family and the authority to govern the State. Here was a *parecbasis*, a "perverted type" of society, worthy of Aristotle himself. It is a type which, as a matter of fact, is widely distributed in Southern and South-eastern Asia, and had been repeatedly described by travellers from the days of Tavernier (in Borneo) and Laval (in the Maldive Islands), if not earlier still. It existed also in the New World, and Lafitau had already compared the Iroquois with the ancient Lycians. But it was Buchanan's account of the Nairs of the Malabar

Coast, published in 1807, which came at the "psychological moment," and first attracted serious attention. At the other extremity of India, also, analogous customs were being recorded, about the same time, by Samuel Turner in Tibet, which might have given pause at the outset to the speculators who hoped to base general conclusions on anything so special and peculiar as the customs of Aryan India.

Similar evidence came pouring in during the generation which followed; partly, it is true, as the result of systematic search among older travellers, but mainly through the intense exploitation of large parts of the world by European traders and colonists. Conspicuous instances are the Negro societies of Western and Equatorial Africa, first popularised by the re-publication of William Bosman's "Guinea" (1700), in Pinkerton's "General Collection of Voyages and Travels" (London, 1808, &c.), and by Proyart's "Histoire de Loango" (1776), which also reached the English public in the same invaluable collection. But it was from the south that the new African material came most copiously, in proportion as the activity of explorers, missionaries, and colonists was greater. Thunberg's account of the Bechuanas [1] takes the lead here; but for English thought the principal authorities are, of course, John Mackenzie [2] and David Livingstone.[3]

It was not to be expected that America, which had made such remarkable contributions to the study of Man in the seventeenth and eighteenth centuries, should fall behind in the nineteenth, when its vast resources of mankind, as of Nature's gifts, were being realised at last. From Hunter,[4] Gallatin,[5] and Schoolcraft,[6] in the 'twenties, to Lewis Morgan [7] in 1865, there was hardly a traveller "out West" who did not bring back some fresh example of society destructive of the Patriarchal Theory.

As often happens in such cases, more than one survey of the evidence was in progress simultaneously. Bachofen was the first to publish,[8] and it is curious that his great book on "Mother-right" appeared in the very same year as Maine's "Ancient Law." Lubbock's "Prehistoric Times," in the next year, represents the same movement of thought in England in a popular shape, but almost independently. In America, Lewis Morgan, whom I have noted already as an able interpreter of Iroquois custom, followed up his detailed studies of Redskin law by a Smithsonian monograph in 1871 on "Systems of Consanguinity and Affinity of the Human Family," and, in 1877, by his book on "Ancient Society." Meanwhile Post had published his great work on the "Evolution of Marriage" [9] in 1875, and J. F. McLennan his first "Studies in Ancient History" in 1876. It was the generation of Darwin and of the great philologists, as we have seen, and "survivals" were in the air: Dargan [10] pointed out traces of the Matriarchate in the law and custom of Germany, and Wilken [11] in those of early Arabia. The period of exploration, if I may so term it, closed on this aspect of the subject with Westermarck's "History of Human Marriage," which was published in London in 1891.

Australian Evidence: Totemism and Classificatory Kinship.

I have now mentioned India, South Africa, and North America, three principal fields of English-speaking enterprise during the nineteenth century, and have indicated the contribution of each to modern anthropology in its bearing on political science. Only Australia remains; and, though Australia's task has been shared more particularly with North America, I shall be doing no injustice to Lewis Morgan or to McLennan if I couple with their names those of Fison and Howitt,[1] as the discoverers of classical instances of societies which observe neither paternal nor maternal obligations of kinship as we understand them, but have adopted those purely artificial systems of relationships which in moments of elation we explain as "Totemic," or, in despair, describe as "classificatory."

Hermann Post: Comparative Jurisprudence.

Our retrospect, therefore, of the last fifty years shows clearly once again how intimately European colonisation and anthropological discoveries have gone hand in hand: first to establish a "Matriarchal Theory" of society as a rival of the Patriarchal; and then to confront both views alike with the practices and with the theories of "Totemism."

From the point of view of political science, all this mass of inquiries finds applications already in more departments than one; though it is probably still too early to appraise its influence adequately. The new Montesquieu has not yet arisen to interpret to us the "Spirit of the Laws." Most directly, perhaps, we can trace such influence in the "Comparative Jurisprudence" of Hermann Post, whose first work on the "Evolution of Marriage" appeared, as we have seen, in 1875. Post's general attitude is best seen in his "Introduction to the Study of Ethnological Jurisprudence," which was published in 1886, and in his "African Jurisprudence" of 1887.[2] As the result of a survey of social organisations, considered as machinery in motion, Post points out very justly that it is useless to attempt to explain social phenomena on the basis of the psychological activities of individuals, as is too commonly assumed, because all individuals whose conduct we can possibly observe have themselves been educated in some society or other, and presume in all their social acts the assumptions on which that society itself proceeds. "I take the legal customs of all peoples of the earth," so he wrote in 1884,[3] "the residual outcome of the living legal consciousness of humanity, for the starting-point of my inquiry into the science of law; and then, on this basis, I propound the question, What is law? If by this road I arrive eventually at an abstract conception of law, or at an idea of law, then the whole fabric so created consists, from base to summit, of flesh and blood." It is the same method, of course, which had already yielded such remarkable results to Montesquieu, and even to Locke. The point of view is no longer that of a Maine or a McLennan, students of patriarchal or of matriarchal institutions by themselves. It is that of a spectator of human society as a whole; and such a point of view only became possible at all when it was already certain that no great section of humanity remained altogether unexplored, however fragmentary our knowledge might still be, of much that we ought to have recorded. And its immediate outcome has been to throw into the strongest possible relief the dependence of the form and still more of the actual content of all human societies on something which is not in the human mind at all, but is the infinite variety of that external Nature which Society exists to fend off from Man, and also to let Man dominate if he can.

This was, of course, already the standpoint of Comte, with his emphasis on the *monde ambiant*. But Comte, the citizen of a State which except in Canada had failed to colonise, and therefore had little direct contact with non-European types of society, confined himself far too exclusively to European data. His strength is precisely where the science of France was so magnificently strong in his day, in the domain of pure physics; it is his analogies between politics and physics which are so illuminating in his work, as in that of his English compeer, Herbert Spencer;[4] and it is the weakness of both in the direction

1 Pinkerton, vol. xvi.
2 John Mackenzie, "Ten Years North of the Orange River" (1859–69). Edinburgh, 1871.
3 David Livingstone, "Narrative of an Expedition to the Zambesi and its Tributaries (1858–64)." London, 1865.
4 Hunter, "Manners and Customs of several Indian Tribes located West of the Mississippi." Philadelphia, 1823.
5 Gallatin, "Archæologia Americana." Philadelphia (from 1820 onwards).
6 Schoolcraft, "Travels in the Central Portions of the Mississippi Valley" (New York, 1825); "Notes on the Iroquois" (1846).
7 Lewis H. Morgan, Proc. Am. Acad. Arts and Sciences, vii., 1865–8.
8 Bachofen, "Das Mutter-recht." Stuttgart, 1861.
9 Hermann Post, "Die Geschlechtsgenossenschaft der Urzeit und die Entstehung der Ehe." Oldenburg, 1875
10 Dargan, "Mutter-recht und Raub-ehe und ihre Reste im Germanischen Recht und Leben." Breslau, 1883.
11 Wilken, "Das Matriarchat bei den alten Arabern." Leipzig, 1884.

1 Fison and Howitt, "Kamilaroi and Kurnai." Melbourne and Sydney, 1880.
2 Hermann Post, "Einleitung in das Studium der ethnologischen Jurisprudenz" (Oldenburg, 1886); "Afrikanische Jurisprudenz" (1887). His position is, however, already clear in his first synthetic work, "Dr. Ursprung des Rechts," 1876, as well as in his earlier book on Marriage For a good summary of Post's views see Th. Achelis, "Die Entwickelung der modernen Ethnologie" (Berlin, 1889), pp. 113–28, and the same writer s "Moderne Ethnologie" (1896).
3 Post, "Die Grundlagen des Rechts" (188
4 Compare Quetelet's "Essai de Physique sociale" (1841), as a symptom of the trend of French thought at this stage.

of anthropology which mainly accounts for the shortness of their respective vogues.

Friedrich Ratzel: Anthropo-geography.

At the point which we have now reached in this rapid survey of our science, it was obviously to Geography—the systematic study of those external forces of Nature as an ordered whole—that Anthropology stretched out its hands; and it did not ask in vain. But while English geography had remained exploratory, descriptive, and (like English geology) *historical* in its outlook, the new German science of *Erdkunde*—"earth-knowledge" in the widest sense of the word—had already come into being on the basis of the labours of Ritter and the two Humboldts, and under the guidance of such men as Wagner, Richthofen, and Bastian; the last named also an anthropologist of the first rank. It was, thus, to a distinguished pupil of Wagner, Friedrich Ratzel, that anthropology owed, more than to any other man, the next forward step on these lines. In Ratzel's mind, History and Geography went hand in hand as the precursors of a scientific Anthropology.[1] History to define *when*, and in what order, Man makes his conquests over Nature; Geography to show *where*, and within what limits, Nature presents a conquerable field for Man. Much of this, of course, was already implicit in the teaching of Adolf Bastian, whose monumental volumes on "Man in History" had appeared at Leipzig as early as 1860; his "Contributions to Comparative Psychology" in 1868; and his "Legal Relations among the Different Peoples of the Earth" in 1872[2]—three years before Post's first essay. But Bastian, inaccessible for years together in Tibet or Polynesia, was rather an inspiration to a few intimate colleagues than a great propagandist; and besides, it was not until the appearance of his "Doctrine of the Geographical Provinces" in 1886[3] that he touched on this precise ground, and by that time Ratzel's "History of Man" had already been out for a year.[4]

Epilogue.

These examples, I think, are sufficient to show how intimately the growth of political philosophy has interlocked at every stage with that of anthropological science. Each fresh start on the never-ending quest of *Man as he ought to be* has been the response of theory to fresh facts about *Man as he is*. And, meanwhile, the dreams and speculations of one thinker after another—even dreams and speculations which have moved nations and precipitated revolutions—have ceased to command men's reason when they ceased to accord with their knowledge.

And we have seen more than this. We have seen the very questions which philosophers have asked, the very questions which perplexed them, no less than the solutions which they proposed, melt away and vanish, *as problems*, when the perspective of anthropology shifted and the standpoint of observation advanced. This is no new experience; nor is it peculiar either to anthropology among the natural sciences, or to political science among the aspects of the Study of Man. It is the common law of the mind's growth, which all science manifests, and all philosophy.

And now I would make one more attempt to put on parallel lines the course of political thinking. It is not so very long ago that a great British administrator, returning from one of the gravest trials of statesmanship which our generation has seen, to meet old colleagues and classmates at a college festival, gave it to us as the need he had most felt, in the pauses of his administration, that there did not exist at present any adequate formulation of the great outstanding features of our knowledge (as distinct from our creeds) about human societies and their mode of growth, and he commended it to the new generation of scholarship, as its highest and most necessary task, to face once more the question: What are the forces, so far as we can know them now, which, as Aristotle would have put it, "maintain or destroy States"?

But if a young student of political science were to set himself to this life work, where could he turn for his facts? What proportion of the knowable things about the human societies with which travellers' tales and the atlases acquaint him could he possibly bring into his survey, without a lifetime of personal research in every quarter of our planet?

I have in mind one such student setting out this coming session to investigate, on the lines of modern anthropology, the nature of *Authority* and the circumstances of its rise among primitive men; and the difficulty at the outset is precisely as I have described. In the case of the "black fellows" of Australia such a student depends upon the works of some four or five men, representing (at a favourable estimate) one-twentieth even of the known tribes of the accessible parts of that continent. For British South Africa he would be hardly better served; for British North America, outside the ground covered in British Columbia by Boas and Hill-Tout, he would have almost the field to himself; and the prospect would seem to him the drearier and the more hopeless when he compared it with things on the other side of the forty-ninth parallel.

Now, our neighbours south of that line have the reputation of being practical men; in other departments of knowledge they are believed to know well "what pays." And I am forced to believe that it is because they know that it *pays*, to know all that can still be known about the forms of human society which are protected and supervised from Washington, that they have gone so far as they have towards rescuing that knowledge from extinction while still there is time. The Bureau of Ethnology of the United States of America is the most systematic, the most copious, and, I think, taking it all in all, the most scientific of the public agencies for the study of any group of men, *as men*. The only other which can be compared with it is the ethnographical section of the last census of India, and that was an effort to meet, against time, an emergency long predicted, but only suddenly foreseen by the men who were responsible for giving the order. Thus, humanly speaking, it is now not improbable that in one great newly settled area of the world every tribe of natives, which now continues to inhabit it, may at least be explored, and in some cases really surveyed, before it has time to disappear. But observe, this only applies to the tribes which now continue to exist; and what a miserable fraction they are of what has already perished irrevocably! It is no use crying over spilt milk, as I said to begin with; the only sane course is to be doubly careful of whatever remains in the jug.

An Ethnological Survey for Canada.

And now I conclude with a piece of recent history, which will point its own moral. When the British Association met first outside the British Isles, it celebrated its meeting at Montreal by instituting, for the first time, a section for Anthropology; and it placed in the chair of that section one of the principal founders of modern scientific anthropology, Dr. Edward Burnett Tylor, then recently installed at Oxford, and still the revered Professor of our science there. Through his influence mainly, but with the active goodwill of the leading names in other sciences in Canada, a research committee was formed to investigate the north-west tribes of the Dominion; and for eleven consecutive years expeditions wholly or partly maintained by this Association were sent to several districts of British Columbia. These expeditions cost the Association about 1200*l.* in all. I am glad to think that the chief representative of this Committee's work, Dr. Franz Boas, has long since realised, in his great contributions to knowledge, the high hopes which his early reports inspired.

When the Association met the second time on Canadian soil, at Toronto, the occasion seemed opportune for a fresh step. Dr. Boas had already undertaken work on a larger scale and under other auspices. But it was thought likely that if a fresh Committee of the Association were appointed, with wider terms of reference and further grants, it would be possible to select and to train a small staff of Canadian observers, and by their means to produce such a series of preliminary reports on typical problems of Canadian anthropology as would satisfy the Dominion Government that the need for a thorough systematic survey was a real one, and that such a survey would be practicable with the means and the men which

1 Ratzel, "Anthropo-geographie" Leipzig, vol. i., 1882; ii., 1891.
2 Bastian, "Der Mensch in der Geschichte" (Leipzig, 1860); "Beiträge zur vergleichenden Psychologie" (Berlin, 1868); "Rechtsverhältnisse bei verschiedenen Völkern der Erde" (Berlin, 1872).
3 Bastian, "Zur Lehre von den geographischen Provinzen." Berlin, 1886.
4 Ratzel, "Völkerkunde" (Leipzig, 1885). His *method* is best studied in the first volume of his "Anthropo geographie" (Leipzig, 1882).

Canada itself could supply. Among the leading members of this Ethnographic Survey Committee I need only mention three—the late Dr. George Dawson, Mr. David Boyle, and Mr. Benjamin Sulte, each eminent already in his own line of study, and all convinced of the great scientific value of what was proposed. The first year's enterprise opened well; workers were found in several districts of Canada; the Association sent out scientific instruments, and formed in London a strong consultative committee to keep the Canadian field-workers in touch with European students of the subject. But the premature death of George Dawson in 1901 broke the mainspring of the machine; the field-workers fell out of touch with one another and with the subject; the instruments were scattered, and in 1904 the Ethnographic Survey Committee was not recommended for renewal.

I need not say how great a disappointment this failure has been to those of us who believe that in this department of knowledge Canada has great contributions to make; and who know—as this meeting too knows perfectly well—that if this contribution to knowledge is not made within the next ten years, it can never be made at all. I am not speaking merely of the urgency of exact study of the Indian peoples. This indeed is obvious and urgent enough; and the magnificent results of organised effort in the United States are there to show how much you too can still rescue, if you will. But at the moment I appeal rather for the systematic study of your own European immigrants, that stream of almost all known varieties of white men with which you are drenching yearly fresh regions of the earth's surface, which if they have had experience of human settlements at all, have known man only as a predatory migratory animal, more restless than the bison, more feckless and destructive than the wolf. Of your immigrants' dealings with wild nature, you are indeed keeping rough undesigned record in the documents of your Land Surveys, and in the statistics of the spread of agriculture over what once was forest or prairie; and in time to come, *something*—though not, I fear, much—will exist to show what good (and as likely as not, also, what irremediable harm) this age of colonisation has done to the region as a whole. But what you do not keep record of is Nature's dealings with your immigrants; you do not *know*—and so long as you omit to *observe*, you are condemned not to know—the answer to the simple all-important question, *What kinds of men do best in Canada? What kind of men is Canada making out of the raw material which Europe is feeding into God's Mills on this side?*

Over in England, we are only too well aware how poor a lead we have given you. We, too, for a century now, have been feeding into other great winnowing chambers the raw crop of our villagers. We have created (to change the metaphor), in our vast towns, great vats of fermenting humanity, under conditions of life which at the best are unprecedented, and at their worst almost unimaginable. That is *our* great experiment in modern English anthropology—*What happens to Englishmen in City slums?* and we shall hear, before this meeting ends, something of the methods by which we are attempting now to watch and record the outcome of that experiment in the making of the English of to-morrow. We are beginning to know, in the first place, what types of human animal can tolerate and survive the stern conditions of modern urban life. We are learning, still more slowly, what modes of life, what modified structure of the family, of the daily round, of society at large, can offer the adjustment to new needs of life, which human nature demands under this new, almost unbearable strain. We are seeing, more clear in the mass, even if hopelessly involved in detail, the same process of selection going on in the mental furniture of the individuals themselves; new views of life, new beliefs, new motives and modes of action; new, if only in the sense that they presuppose the destruction of the old.

That is our problem in human society at home. And yours, though it has a brighter side, is in its essentials the same. Geographers can tell you something already of the physical "control" which is the setting to all possible societies on Canadian soil. Scientific study of the vanishing remnants of the Redskin tribes may show you a little of the effects of this control, long continued, upon nations whom old Heylin held to be "doubtless the offspring of the Tartars." Sympathetic observation and friendly intercourse may still fill some blanks in our knowledge of their social state; how hunting or fishing—or, in rare cases, agriculture—forms and reforms men's manners and their institutions when it is the dominant interest in their lives. But what climate and economic habit have done in the past with the Redskins, the same climate and other economic habits are as surely doing with ourselves. In the struggle with Nature, as in the struggle with other men, it is the weakest who go to the wall; it is the fittest who survive. And it is our business to *know*, and to record for those who come after us, what manner of men we were when we came; whence we were drawn, and how we are distributed in this new land. An Imperial Bureau of Ethnology, which shall take for its study all citizens of our State, as such, is a dream which has filled great minds in the past and may some day find realisation. A Canadian Bureau is at the same time a nearer object, and a scheme of more practicable size. In the course of this meeting, information and proposals for such a Bureau of Ethnology are to be laid before this section by more competent authorities than I. My task has only been to show, in a preliminary way, what our science has done in the past, to stimulate political philosophy, and to determine its course and the order of its discoveries.

"Some men are borne," said Edward Grimstone just three centuries ago, "so farre in love with themselves, as they esteeme nothing else, and think that whatsoever fortune hath set without the compasse of their power and government should also be banished from their knowledge. Some others, a little more carefull; who finding themselves engaged by their birth, or abroad, to some one place, strive to understand how matters pass there, and remaine so tied to the consideration of their owne Commonweale, as they affect nothing else, carrying themselves as parties of that imperfect bodie, whereas in their curiositie they should behave themselves as members of this world." It is as "members of this world," I hope, that we meet together to-day.

SECTION I.

PHYSIOLOGY.

OPENING ADDRESS BY PROF. E. H. STARLING, M.D., F.R.S., PRESIDENT OF THE SECTION.

The Physiological Basis of Success.

DURING past years it has been customary for the Presidents of Sections in their addresses either to give a summary of recent investigations, in order to show the position and outlook of the branch of science appertaining to the Section, or to utilise the opportunity for a connected account of researches in which they themselves have been engaged, and can therefore speak with the authority of personal experience as well as with that imparted by the presidential Chair. The growing wealth of publications with the special function of giving summaries and surveys of the different branches of science, drawn up by men ranking as authorities in the subject of which they treat, renders such an interpretation of the presidential duties increasingly unnecessary, and the various journals which are open to every investigator make it difficult for me to give in an address anything which has not already seen the light in other forms. The Association itself, however, has undergone a corresponding modification. Founded as a medium of communication between workers in different parts of the country, it has gradually acquired the not less important significance of a tribunal from which men of science, leaving for a time their laboratories, can speak to an audience of intelligent laymen, including under this term all those who are engaged in the work of the world other than the advancement of science. These men would fain know the lessons that science has to teach in the living of the common life. By standing for a moment on the little pinnacle erected by the physicist, the chemist or the botanist, they can, or should be able to, gain new hints as to the conduct of the affairs of themselves, their town or their State. The enormous advance in the comfort and prosperity of our race during the last century has been due to the application of science, and this meet-

ing of the Association may be regarded as an annual mission in which an attempt is made to bring the latest results of scientific investigation into the daily routine of the life of the community.

We physiologists, as men who are laying the foundation on which medical knowledge must be built, have as our special preoccupation the study of man. Although every animal, and indeed every plant, comes within the sphere of our investigations, our main object is to obtain from such comparative study facts and principles which will enable us to elucidate the mechanism of man. In this task we view man, not as the psychologist or the historian does, by projecting into our object of study our own feelings and emotions, but by regarding him as a machine played upon by environmental events and reacting thereto in a way determined by its chemical and physical structure.

Can we not learn something of value in our common life by adopting this objective point of view and regarding man as the latest result of a continuous process of evolution which, begun in far-off ages, has formed, proved and rejected myriads of types before man himself appeared on the surface of the globe?

Adaptation.

In his study of living beings, the physiologist has one guiding principle which plays but little part in the sciences of the chemist and physicist, namely, the principle of adaptation. Adaptation or purposiveness is the leading characteristic of every one of the functions to which we devote in our text-books the chapters dealing with assimilation, respiration, movement, growth, reproduction, and even death itself. Spencer has defined life as "the continuous adjustment of internal relations to external relations." Every phase of activity in a living being is a sequence of some antecedent change in its environment, and is so adapted to this change as to tend to its neutralisation and so to the survival of the organism. This is what is meant by adaptation. It will be seen that not only does it involve the teleological conception that every normal activity must be for the good of the organism, but also that it must apply to *all* the relations of living beings. It must therefore be the guiding principle, not only in physiology, with its special preoccupation with the internal relations of the *parts* of the organism, but also in the other branches of biology, which treat of the relations of the living animal to its environment and of the factors which determine its survival in the struggle for existence. Adaptation therefore must be the deciding factor in the origin of species and in the succession of the different forms of life upon this earth.

Origin of Life.

A living organism may be regarded as a highly unstable chemical system which tends to increase itself continuously under the average conditions to which it is subject, but undergoes disintegration as a result of any variation from this average. The essential condition for the survival of the organism is that any such disintegration shall result in so modifying the relation of the system to the environment that it is once more restored to the average in which assimilation can be resumed.

We may imagine that the first step in the evolution of life was taken when, during the chaotic chemical interchanges which accompanied the cooling down of the molten surface of the earth, some compound was formed, probably with absorption of heat, endowed with the property of polymerisation and of growth at the expense of surrounding material. Such a substance could continue to grow only at the expense of energy derived from the surrounding medium, and would undergo destruction with any stormy change in its environment. Out of the many such compounds which might have come into being, only such would survive in which the process of exothermic disintegration tended towards a condition of greater stability, so that the process might come to an end spontaneously and the organism or compound be enabled to await the more favourable conditions necessary for the continuance of its growth. With the continued cooling of the earth, the new production of endothermic compounds would probably become rarer and rarer. The beginning of life, as we know it, was possibly the formation of some complex, analogous to the present chlorophyll corpuscles, with the power of absorbing the newly penetrating sun's rays and of utilising these rays for the endothermic formation of further unstable compounds. Once given an unstable system such as we have imagined, with two phases, viz. (1) a condition of assimilation or growth by the endothermic formation of new material; (2) a condition of "exhaustion," in which the exothermic destructive changes excited by unfavourable external conditions came to an end spontaneously—the great principle of natural selection or survival of the fittest would suffice to account for the evolution of the ever-increasing complexity of living beings which has occurred in the later history of this globe. The adaptations, *i.e.* the reactions of the primitive organism to changes in its environment, must become continually more complex, for only by means of increasing variety of reaction can the stability of the system be secured within greater and greater range of external conditions. The difference between higher and lower forms is therefore merely one of complexity of reaction.

The naked protoplasm of the plasmodium of Myxomycetes, if placed upon a piece of wet blotting-paper, will crawl towards an infusion of dead leaves, or away from a solution of quinine. It is the same process of adaptation, the deciding factor in the struggle for existence, which impels the greatest thinkers of our times to spend long years of toil in the invention of the means for the offence and defence of their community or for the protection of mankind against disease and death. The same law which determines the downward growth of the root in plants is responsible for the existence to-day of all the sciences of which mankind is proud.

The difference between higher and lower forms is thus not so much qualitative as quantitative. In every case, whatever part of the living world we take as an example, we find the same apparent perfection of adaptation. Whereas, however, in the lower forms the adaptation is within strictly defined limits, with rise in type the range of adaptation steadily increases. Especially is this marked if we take those groups which stand, so to speak, at the head of their class. It is therefore important to try and find out by a study of various forms the physiological mechanism or mechanisms which determine the increased range of adaptation. By thus studying the physiological factors, which may have made for success in the struggle for dominance among the various representatives of the living world, we may obtain an insight into the factors which will make for success in the further evolution that our race is destined to undergo.

It is possible that, even at this time, objections may be raised to the application to man of conclusions derived from a study of animals lower in the scale. It has indeed been urged, on various grounds, that man is to be regarded as exempt from the natural laws which apply to all other living beings. When we inquire into the grounds for assuming this anomic, this outlawed condition of man, we generally meet with the argument that man creates his own environment and cannot therefore be considered to be in any way a product of it. This modification or creation of environment is, however, but one of the means of adaptation employed by man in common with the whole living kingdom. From the first appearance of life on the globe we find that one of the methods adopted by organisms for their self-preservation is the production of some artificial surroundings which protect them from the buffeting of environmental change. What is the mucilaginous envelope produced by micro-organisms in presence of an irritant, or the cuticle or shell secreted by the outermost cells of an animal, but the creation of such an environment? All unicellular organisms, as well as the units composing the lowest metazoa, are exposed to and have to resist every change in concentration and composition of the surrounding water. When, however, a body cavity or *coelom*, filled probably at first with sea-water, made its appearance, all the inner cells of the organism were withdrawn from the distributing influence of variations in the surrounding medium. The cœlomic fluid is renewed and maintained uniform in composition by the action of the organism itself, so that we may speak of it as an environment created by the organism. The formation of a body cavity filled with salt solution at once increased the range of adaptation of the animals endowed therewith. Thus

it enabled them to leave the sea, because they carried with them the watery environment which was essential for the normal activity of their constituent cell units. The assumption of a terrestrial existence on most parts of the earth's surface involved, however, the exposure to greater ranges of temperature than was the case in the sea, and indicated the necessity for still further increase in the range of adaptation. Every vital process has its optimum temperature at which it is carried out rapidly and effectively. At or a little above freezing point the chemical processes concerned in life are suspended, so that over a wide range of the animal kingdom there must be an almost complete suspension of vital processes during the winter months, and at all times of the year a great dependence of the activity of these processes on the surrounding temperature. It is evident that a great advantage in the struggle for existence was gained by the first animals which succeeded in securing thermal as well as chemical constancy of environment for their cells, thus rendering them independent of changes in the external medium. It is interesting to note that the maintenance of the temperature of warm-blooded animals at a constant height is a function of the higher parts of the central nervous system. An animal with spinal cord alone reacts to changes of external temperature exactly like a cold-blooded animal, the activity of its chemical changes rising and falling with the temperature. In the intact mammal, by accurately balancing heat loss from the surface against heat production in the muscles, the central nervous system ensures that the body fluid which is supplied to all the active cells has a temperature which is independent of that of the surrounding medium. These are fundamental examples of adaptation effected by creation of an environment peculiar to the animal. Numberless others could be cited which differ only in degree from the activity of man himself. In some parts of this country, for instance, the activity of the beaver in creating an artificial environment has until lately been more marked than that of man himself. We are not justified, then, in regarding mankind as immune to the operation of natural forces which have determined the sequence of life on the surface of the globe. The same laws which have determined his evolution and his present position as the dominant type on the earth's surface will determine also his future destiny.

We are not, however, dealing with or interested in simple survival. Lower forms of life are probably as abundant on the surface of the globe as they were at any time in its history. Survival, as Darwin pointed out, is a question of differentiation. When in savage warfare a whole tribe is taken captive by the victorious enemy, the leaders and fighting men will be destroyed, while the slaves will continue to exist as the property of the victors. Survival, then, may be determined either by rise or by degradation of type. Success involves the idea of dominance, which can be secured only by that type which is the better endowed with the mechanisms of adaptation required in the struggle against other organisms.

Among the many forms of living matter which may have come into being in the earlier stages of the history of the earth, one form apparently became predominant and must be regarded as the ancestor of all forms of life, whether animal or vegetable, viz., the nucleated cell. The almost complete identity of the phenomena involved in cell division throughout the living kingdom indicates that all unicellular organisms and all organisms composed of cells have descended from a common ancestor, and that the mode of its reproduction has been impressed upon all its descendants throughout the millions of years which have elapsed since the type was first evolved. The universal distribution of living cells renders it practically impossible for us to test the possibility of a spontaneous abiogenesis or new formation of living from non-living matter at the present time. We cannot imagine that all the various phenomena which we associate with life were attributes of the primitive life stuff. Even if we had such stuff at our disposal, it would be difficult to decide whether we should ascribe the possession of life to it, and there is no doubt that any such half-way material would, directly it was formed, be utilised as pabulum by the higher types of organism already abounding on the surface of the globe.

Integration and Differentiation.

An important step in the evolution of higher forms was taken when, by the aggregation of unicellular organisms, the lowest metazoon was formed. In its most primitive forms the metazoon consists simply of a cell colony, but one in which all individuals are not of equal significance. Those to the outer side of the mass, being exposed to different environmental advantages from those within, must even during the lifetime of the individual have acquired different characteristics. Moreover, the sole aim of such aggregation being to admit of cooperation by differentiation of function between the various cell units, the latter become modified according to their position, some cells becoming chiefly alimentary, others motor, and others reproductive. Cooperation and differentiation are, however, of no use without coordination. Each part of the organism must be in a position to be affected by changes going on in distant parts, otherwise cooperation could not be effected. This cooperation in the lowest metazoon seems to be carried out by utilisation of the sensibility to chemical stimuli already possessed by the unicellular organism. We have thus coordination by means of chemical substances ("hormones") produced in certain cells and carried thence by the tissue fluids to other cells of the body, a mechanism of communication which we find even in the highest animals, including man himself. To such chemical stimuli we may probably ascribe the accumulation of wandering mesoderm cells—*i.e.* phagocytes—in an organism such as a sponge, around a seat of injury or any foreign substance that has been introduced. By this mechanism it is possible for distant parts of the body to react to stimulation of any one part of the surface. Communication by this means is, however, slow, and may be compared to the state of affairs in civilised countries before the invention of the telegraph, when messengers had to ride to different parts of the kingdom in order to arouse the whole nation for defence or attack.

Foresight and Control.

Increased speed of reaction and therefore increased powers in the struggle for existence were obtained when a nervous system was formed, by a modification of the cells forming the outer surface of the organism. By the growth of long processes from these cells a conducting network was provided, running through all parts of the body and affording a channel for the rapid propagation of excitation from the surface to the deeper parts, as well as from one part of the surface to another. From this same layer were produced the cells which, as muscle fibres, would act as the motive mechanism of the organism. Thus, from the beginning, the chief means of attack or escape were laid down in close connection with the surface from which the stimuli were received. A further step in the evolution of the nervous system consisted in the withdrawal of certain of the sensory or receptor cells from the surface, so that a specially irritable organ, the central nervous system, was evolved, which could serve as a distributing centre for the messages or calls to action initiated by changes occurring at the surface of the body. At its first appearance this central nervous system would hardly deserve the epithet of "central," since it formed a layer lying some distance below the surface, and extending over a considerable area; though we find that very soon there is an aggregation of the special cells to form ganglia, each of which might be regarded as presiding over the reactions of that part of the animal in which it is situated. Thus in the segmental worm-like animals a pair of ganglia is present in each body segment, and the chain of ganglia are united by longitudinal strands of nerve fibres to form the ganglionated cord, or central nervous system.

Such a diffused nervous system, in which all ganglia were of equal value, could, however, only act for the common weal of the whole body when a reaction initiated by stimulation at one part was not counteracted by an opposing reaction excited from another part of the surface. For survival it is necessary that in the presence of danger, *i.e.* an environment threatening the life of the individual or race, the whole activities of the organism should be concentrated on the one common purpose, whether of escape or defence. This could be effected only by making one part of the central nervous system predominant over all other parts, and the part which was chosen for this

predominance was the part situated in the neighbourhood of the mouth. This, in animals which move about, is the part which always precedes the rest of the body, and therefore the part which first experiences the sense impressions, favourable or dangerous, arising from the environment. It is this end that has to appreciate the presence or approach of food material, as well as the nature of the medium into which the animal is being driven by the movements of its body. Thus a predominance of the front end of the nervous system was determined by the special development at this end of those sense organs or sensory cells which are *projicient—i.e.* are stimulated by changes in the environment proceeding from disturbances at a distance from the animal. The sensory organs of vision and the organs which correspond to our olfactory sense organs and are aroused by minute changes in chemical composition of the surrounding medium, are always found especially at the front or mouth end of the organism. The chances of an animal in the struggle for existence are determined by the degree to which the responses of the animal to the *immediate* environment are held in check in consequence of stimuli arising from *approaching* events. The animal, without power to see or smell or hear its enemy, will receive no impulse to fly until it is already within its enemy's jaws. It must therefore be an advantage to any animal that the whole of its nervous system should be subservient to those ganglia or central collections of nerve cells which are in direct connection with the projicient sense organs in the head. This subservience is secured by endowing the head centre with a power, firstly, of controlling and abolishing the activities (*i.e.* all those aroused by external stimuli) of all other parts of the central nervous system, and, secondly, of arousing these parts to a reaction immediately determined by the impression received from the projicient sense organs of the head and originated by some change in the surroundings of the animal which has not yet affected the actual surface of its body.

Education by Experience.

The factors which so far determine success in the struggle for predominance are, in the first place, foresight and power to react to coming events, and, in the second place, control of the whole activities of the organism by that part of the central nervous system which presides over the reaction. The animal therefore profits most which can subordinate the impulses of the present to the exigencies of the future.

An organism thus endowed is still, however, in the range of its reactions, a long way behind the type which has attained dominance to-day. The machinery we have described, when present in its simplest form, suffices for the carrying out of reactions or adaptations which are determined immediately by sense impressions, advantage being given to those reactions which are initiated by afferent stimuli affecting the projicient sense organs at the head end of the animal. With the formation of the vertebrate type, and probably even before, a new faculty makes its appearance. Up to this point the reactions of an animal have been what is termed "fatal," not in the sense of bringing death to the animal, but as inexorably fixed by the structure of the nervous system inherited by the animal from its precursors. Thus it is of advantage to a moth that it should be attracted by, and fly towards light objects—*e.g.* white flowers—and such a reactivity is a function of the structure of its nervous system. When the light object happens to be a candle flame the same response takes place. The first time that the moth flies into and through the candle flame, it may only be scorched. It does not, however, learn wisdom, but the reaction is repeated so long as the moth can receive the light stimuli, so that the response, which in the average of cases is for the good of the race, destroys the individual under an environment which is different from that under which it was evolved. There is in this case no possibility of educating the individual. The race has to be educated to new conditions by the ruthless destruction of millions of individuals, until only those survive and impress their stamp on future generations whose machinery, by the accumulation and selection of minute variations, has undergone sufficient modification to determine their automatic and "fatal" avoidance of the harmful stimulus.

The next great step in the evolution of our race was the modification of the nervous system which should render possible the education of the individual. The mechanism for this educatability was supplied by the addition, to the controlling sensory ganglia of the head, of a mass of nervous matter which could act, so to speak, as an accessory circuit to the various reflex paths already existing in the original collection of nerve ganglia. This accessory circuit, or upper brain, comes to act as an organ of memory. Without it a child might, like the moth, be attracted by a candle flame and approach it with its hand. The injury ensuing on contact with the flame would inhibit the first movement and cause a drawing back of the hand. In the simple reflex mechanism there is no reason why the same series of events should not be repeated indefinitely, as in the case of the moth. The central nervous system, however, is so constituted that every passage of an impulse along any given channel makes it easier for subsequent impulses to follow the same path. In the new nerve centre, which presents a derived circuit for all impulses traversing the lower centres, the response to the attractive impulse of the flame is succeeded immediately by the strong inhibitory impulses set up by the pain of the burn. Painful impressions are always predominant. Since they are harmful, the continued existence of the animal depends on the reaction caused by such impressions taking the precedence of and inhibiting all others. The effect therefore of such a painful experience on the new upper brain must far outweigh that of the previous impulse of attraction. The next time that a similar attractive impression is experienced the derived impulse traversing the upper brain arouses, not the previous primary reaction, but the secondary one, viz. that determined by the painful impressions attending contact with the flame. As a result, the whole of the lower tracts, along which the primary reaction would have travelled, are blocked, and the reaction—now an educated one—consists in withdrawal from or avoidance of the formerly attractive object. The burnt child has learnt to dread the fire.

The upper brain represents a nerve mechanism without distinct paths, or rather with numberless paths presenting at first equal resistance in the various directions. As a result of experience, definite tracts are laid down in this system, so that the individual has the advantage not only of his lower reflex machinery for reaction, but also of a machinery which with advance in life is adapted more and more to the environment in which he happens to be. This educable part of the nervous system—*i.e.* the one in which the direction of impulses depends on past experience and on habit—is represented in vertebrates by the cerebral hemispheres. From their first appearance they increase steadily in size as we ascend the animal scale, until in man they exceed by many times in bulk the whole of the rest of the nervous system.

We have thus, laid down automatically, increased power of foresight, founded on the Law of Uniformity. The candle flame injures the skin once when the finger is brought in contact with it. We assume that the same result will follow each time that this operation is repeated. This uniformity is also assumed in the growth of the central nervous system and furnishes the basis on which the nerve paths in the brain are laid down. The one act of injury which has followed the first trial of contact suffices in most cases to inhibit and to prevent any subsequent repetition of the act.

The Faculty of Speech.

If we consider for a moment the vastness and complexity of the stream of impressions which must be constantly pouring into the central nervous system from all the sense organs of the body, and the fact that, at any rate in the growing animal, every one of these impulses is, so to speak, stored in the upper brain, and affects the whole future behaviour of the animal, even the millions of nerve cells and fibres which are to be found in the human nervous system would seem to be insufficient to carry out the task thrown upon them. Further development of the adaptive powers of the animal would probably have been rendered impossible by the very exigencies of space and nutrition, had it not been for the development of the power of speech. A word is a fairly simple motor act and produces a correspondingly simple sensory

impression. Every word, however, is a shorthand expression of a vast sum of experience, and by using words as counters it becomes possible to increase enormously the power of the nervous system to deal with its own experience. Education now involves the learning of these counters and of their significance in sense experience; and the reactions of the highest animal, man, are for the most part carried out in response to words and are governed by past education of the experience-content involved in each word.

The power of speech was probably developed in the first place as a means of communication among primitive man living in groups or societies; as a means, that is to say, of procuring cooperation of different individuals in a task in which the survival of the whole race was involved. But it has attained still further significance. Without speech the individual can profit by his own experience and to a certain limited extent by the control exercised by the older and more experienced members of his tribe. As soon as experience can be symbolised in words, it can be dissociated from the individual and becomes a part of the common heritage of the race, so that the whole past experience of the race can be utilised in the education—*i.e.* the laying down of nerve tracts—in the individual himself. On the other hand, the community receives the advantage of the foresight possessed by any individual who happens to be endowed with a central nervous system which transcends that of his fellows in its powers of dealing with sense impressions or other symbols. The foresight thus acquired by the whole community must be of advantage to it and serve for its preservation. It is therefore natural that in the processes of development and division of labour, which occur among the members of a community just as among the cell units composing an animal, a class of individuals should have been developed, who are separated from the ordinary avocations, and are, or should be, maintained by the community, in order that they may apply their whole energies to the study of sequences of sense impressions. These are set into words which, as summary statements of sequence, are known to us as the Laws of Nature. These natural laws become the property of the whole community, become embodied by education into the nervous system of its individuals, and serve therefore as the experience which will determine the future behaviour of its constituent units. This study of the sequence of phenomena is the office of Science. Through Science the whole race thus becomes endowed with a foresight which may extend far beyond contemporary events and may include in its horizon not only the individual life, but that of the race itself as of races to come.

Social Conduct.

I have spoken as if every act of the animal were determined by the complex interaction of nervous processes the paths of which through the higher parts of the brain had been laid down by previous experience, whether of phenomena or of words as symbolical of phenomena. The average conduct, however, of the individual, determined at first in this way, became by repetition automatic—*i.e.* the nerve paths are so facilitated by frequent use that a given impulse can take only the direction which is set by custom. The general adoption of the same line of conduct by all the individuals of a community in face of a given condition of the environment gave in most cases an advantage to those individuals who were endowed with a nervous system of such a character that the path could be laid down quickly and with very little repetition. Thus we get a tendency, partly by selection, largely by education, to the establishment of reactions which, like the instincts of animals, are almost automatic in character. As MacDougall has pointed out, the representations in consciousness of automatic tendencies are the emotions. Moral conduct, being that behaviour which is adapted to the individual's position in his community, is largely determined by these paths of automatic action, and the moral individual is he whose automatic actions and consequent emotions are most in accord with the welfare of his community, or at any rate with what has been accepted as the rule of conduct for the community.

Rise in Type dependent on Brain.

Thus, in the evolution of the higher from the lower type, the physiological mechanisms, which have proved the decisive factors, can be summed up under the headings of integration, foresight and control. In the process of integration we have not only a combination of units previously discrete, but also differentiation of structure and function among the units. They have lost, to a large extent, their previous independence of action and, indeed, power of independent action, the whole of their energies being now applied to fulfilling their part in the common work of the organism. At first bound together by but slight ties and capable in many cases of separating to form new cell colonies, they have finally arrived at a condition in which each one is absolutely dependent for its existence on its connection with the rest of the organism and is also essential to the well-being of every other part of the organism.

This solidarity, this subjection of all selfish activity to a common end, namely, preservation of the organism, could only be effected by a gradual increase in the control of all parts by one master tissue of the body, the actions of which were determined by impulses arriving from sense organs which themselves were set into activity by coming events. We thus have with the rise in type a gradually rising scale in powers of foresight, in control by the central nervous system, and in the solidarity of the units of which the organism is composed.

In the struggle for existence the rise in type has depended therefore on the central nervous system and its servants. Rise in type implies increased range of adaptation, and we have seen that this increased range, from the very beginning of a nervous system, was bound up with the powers of this system. Whatever opinion we may finally arrive at with regard to the types of animals which we may claim as our ancestors on the line of descent, there can be no doubt that Gaskell is right in the fundamental idea which has guided his investigations into the origin of vertebrates. As he says, "the law for the whole animal kingdom is the same as for the individual. Success in this world depends upon brains." The work by this observer which has lately appeared sets forth in greater detail than I have been able to give you to-day the grounds on which this assertion is based, and furnishes one of the most noteworthy contributions to the principles of evolution which have been published during recent years.

We must not, however, give too restrictive or common a meaning to the expression "brains" used by Gaskell in the dictum quoted above. By this word we imply the whole reactive system of the animal. In the case of man, as of some other animals, his behaviour depends not merely on his intellectual qualities or powers, to which the term "brain" is often in popular language confined, but on his position as a member of a group or society. His automatic activities in response to his ordinary environment, all those social acts which we ascribe in ourselves to our emotions or conscience, are determined by the existence of tracts in the higher parts of his brain, access to which has been opened by the ruthless method of natural selection and which have been deepened and broadened under the influence of the pleasurable and painful impressions which are included in the process of education. All the higher development of man is bound up with his existence as a member of a community, and in trying to find out the factors which will determine the survival of any type of man, we must give our attention, not to the man, but to the tribe or community of which he is a member, and must try to find out what kind of behaviour of the tribe will lead to its predominance in the struggle for existence.

Political Evolution.

The comparison of the body politic with the human body is as old as political economy itself, and there is indeed no reason for assuming that the principles which determine the success of the animals formed by the aggregation of unicellular organisms should not apply to the greater aggregations or communities of the multicellular organisms themselves. It must be remembered, however, that the principles to which I have directed your attention are not those that determine survival, but those which determine rise of type, what I have called success. Evolution may be regressive as well as progressive. Degeneration, as Lankester has shown, may play as great a part as evolution of higher forms in determining survival. The world still contains myriads of unicellular

organisms as well as animals and plants of all degrees and complexity and of rank in the scale of life. All these forms are subordinate to man, and when in contact with him are made to serve his purposes. In the same way all mankind will not rise in type. Many races will die out, especially those who just fall short of the highest type, while others by degradation or differentiation may continue to exist as parasites or servants of the higher type.

Mere association into a community is not sufficient to ensure success; there must also be differentiation of function among the parts, and an entire subordination of the activity of each part to the welfare of the whole. It is this lesson which we English-speaking races have at the present time most need to learn. In the behaviour of man almost every act is represented in consciousness as some emotion, experience or desire. The state of subordination of the activities of all units to the common weal of the community has its counterpart in consciousness as the "spirit of service." The enormous value of such a condition of solidarity among the individuals constituting a nation, inspired, as we should say, by this spirit of service, has been shown to us lately by Japan. In our own case the subordination of individual to State interests, such as is necessary for the aggregation of smaller primitive into larger and more complex communities, has always presented considerable difficulty and been accomplished only after severe struggle. Thus the work begun by Alexander Hamilton and Washington, the creation of the United States, is still, even after the unifying process of a civil war, incomplete and marred by contending State and individual interests. The same sort of difficulties are being experienced in the integration of the units, nominally under British control, into one great nation, in which all parts shall work for the good of the whole and for mutual protection in the struggle for survival.

The Lesson of Evolution.

Just as pain is the great educator of the individual and is responsible for the laying down of the nervous paths, which will determine his whole future conduct and the control of his lower by his higher centres, so hardship has acted as the integrator of nations. It is possible that some such factor with its attendant risks of extermination may still be necessary before we attain the unification of the British Empire, which would seem to be a necessary condition for its future success. But if only our countrymen can read the lesson of evolution and are endowed with sufficient foresight, there is no reason why they should not, by associating themselves into a great community, avoid the lesson of the rod. Such a community, if imbued by a spirit of service and guided by exact knowledge, might be successful above all others. In this community not only must there be subordination of individual to communal interests, but the behaviour of the community as a whole must be determined by anticipation of events—*i.e.* by the systematised knowledge which we call Science. The universities of a nation must be like the eyes of an animal, and the messages that these universities have to deliver must serve for the guidance and direction of the whole community.

This does not imply that the scientific men, who compose the universities and are the sense organs of the community, should be also the rulers. The reactions of a man or of a higher mammal are not determined immediately by impulses coming from his eyes or ears, but are guided by these in association with, and after they have been weighed against, a rich web of past experience, the organ of which is the higher brain. It is this organ which, as the statesman of the cell community, exercises absolute control. And it is well that those who predicate an absolute equality or identity among all the units of a community should remember that, although all parts of the body are active and have their part to play in the common work, there is a hierarchy in the tissues—different grades in their value and in their conditions. Thus every nutritional mechanism of the body is subordinate to the needs of the guiding cells of the brain. If an animal be starved, its tissues waste; first its fat goes, then its muscles, then its skeletal structures, finally even the heart. The brain is supplied with oxygen and nourishment up to the last. When this, too, fails, the animal dies. The leading cells have first call on the resources of the body. Their needs, however, are soon satisfied, and the actual amount of food or oxygen used by them is insignificant as compared with the greedy demands of a working muscle or gland cell. In like manner every community, if it is to succeed, must be governed, and all its resources controlled by men with foreseeing power and rich experience—*i.e.* with the wisdom that will enable them to profit by the teachings of science, so that every part of the organism may be put into such a condition as to do its optimum of work for the community as a whole.

At the present time it seems to me that, although it is the fashion to acquiesce in evolution because it is accepted by biologists, we do not sufficiently realise the importance of this principle in our daily life, or its value as a guide to conduct and policy. It is probable that this doctrine had more influence on the behaviour of thinking men in the period of storm and controversy which followed its promulgation fifty years ago, than it has at the present day of lukewarm emotions and second-hand opinions. Yet, according to their agreement with biological laws, the political theories of to-day must stand or fall. It is true that in most of them the doctrine of evolution is invoked as supporting one or other of their chief tenets. The socialist has grasped the all-importance of the spirit of service, of the subordination of the individual to the community. The aristocrat, in theory at any rate, would emphasise the necessity of placing the ruling power in the hands of the individuals most highly endowed with intelligence and with experience in the affairs of nations. He also appreciates the necessity of complete control of all parts by the central government, though in many cases the sense organs which he uses for guidance are the traditions of past experience rather than the science of to-day. The liberal or individualist asserts the necessity of giving to each individual equal opportunities, so that there may be a free fight between all individuals in which only the most highly gifted will survive. It might be possible for another Darwin to give us a politic which would combine what is true in each of these rival theories, and would be in strict accord with our knowledge of the history of the race and of mankind. As a matter of fact the affairs of our States are not determined according to any of these theories, but by politicians, whose measures for the conduct of the community depend in the last resort on the suffrages of their electors—*i.e.* on the favour of the people as a whole. It has been rightly said that every nation has the government which it deserves. Hence it is all-important that the people themselves should realise the meaning of the message which Darwin delivered fifty years ago. On the choice of the people, not of its politicians, on its power to foresee and to realise the laws which determine success in the struggle for existence, depends the future of our race. It is the people that must elect men as rulers in virtue of their wisdom rather than of their promises. It is the people that must insist on the provision of the organs of foresight, the workshops of exact knowledge. It is the individual who must be prepared to give up his own freedom and ease for the welfare of the community.

Whether our type is the one that will give birth to the super-man it is impossible to foresee. There are, however, two alternatives before us. As incoherent units we may acquiesce in an existence subordinate to or parasitic on any type which may happen to achieve success, or as members of a great organised community we may make a bid for determining the future of the world and for securing the dominance of our race, our thoughts and ideals.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

ST. ANDREWS.—At a meeting of the University Court held on Saturday last, Dr. Arnold Hartley Gibson, senior demonstrator and assistant lecturer in engineering and lecturer on hydraulics at Manchester University, was appointed to the chair of engineering at University College, Dundee, in the room of Prof. Fidler, resigned.

Mrs. Edwin Neave was appointed lady warden of University Hall, St. Andrews, in the room of Miss Melville, who was recently appointed to Queen Margaret's College, Glasgow.

Mr. F. M. Milne was appointed lecturer in clinical pathology, and Mr. Charles Kerr clinical medical tutor.

THE eighty-seventh session of Birkbeck College will be begun on Monday next, when an address will be delivered by Principal H. A. Miers, F.R.S.

HARVARD UNIVERSITY has received the sum of 3000*l.* from Mrs. J. A. Rumrill in memory of her late husband. It will be used to establish three scholarships.

MR. T. MATHER, F.R.S., has been appointed professor of electrical engineering at the City and Guilds Central Technical College in succession to the late Prof. Ayrton, F.R.S.

THE new buildings of the Nicol Russell Engineering School and the Fisher Library (in connection with the University of Sydney, New South Wales) were opened by Lord Chelmsford on September 20.

THE inaugural address of the session 1909–10 of the University of Bristol will be delivered on Thursday evening, September 30, by the Vice-Chancellor of the University, Sir Isambard Owen, who will take as his subject "The Significance of a University."

THE Tulane University of Louisiana has during the past year come into possession of the following amounts:—400,160*l.* from the Newcomb estate, which sum will go to the Newcomb College—the women's department of the University—founded by Mrs. J. L. Newcomb as a memorial to her daughter; 10,000*l.* from Mrs. I. A. Richardson towards the establishment of a chair of botany; and 1000*l.* from the late Miss L. Miles for the purchase of books for the library.

THE Home Secretary has signified to the council of the Royal College of Surgeons his decision to approve the by-laws regarding the admission of women to the examinations for the diplomas of the college. He has further expressed his willingness to sign the formal document which is to be submitted after the next meeting of the council of the college on October 14. It is understood, however, that meanwhile it will be possible to complete the necessary formalities in time for women to enter for the examinations of the Royal College to be held in January next.

MR. W. BUCHANAN has been appointed lecturer on electrotechnics and the design of electrical machinery to Faraday House, London. Mr. Buchanan had a distinguished college career, first at the Royal College of Science, London, and subsequently at Glasgow University, where he was "Thomson experimental scholar" in Lord Kelvin's laboratory. He has been for fifteen years with the Electric Construction Company, Wolverhampton, first as designer of alternating current machines and subsequently as chief engineer.

THE calendar of the Merchant Venturers' Technical College, Bristol, is now available. It will be remembered that in connection with the inauguration of the University of Bristol it was arranged that this college should provide the faculty of engineering in the University. A preliminary prospectus has been issued of the lectures and courses of practical work in the laboratories and workshops, designed, amongst other things, to prepare students for the various degrees in engineering to be conferred by the University. In addition to this university work the college is to continue to provide the continuous and complete preparation for an industrial career which it has hitherto done. Day and evening classes in a great variety of technological subjects have been arranged for the coming winter. It is satisfactory to find from the calendar that earnest efforts are being made by the governors and principal of the college to secure the active cooperation of employers in their endeavours to provide suitable technical education for the men and women engaged in the industries of Bristol and neighbourhood.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 13.—M. Bouchard in the chair.—H. Deslandres communicated a telegram from P. **Lowell,** stating that the presence of free oxygen has been proved in the atmosphere of Mars. The oxygen band B is clearly stronger in the Mars spectrum than in that of the moon.—The movements of the upper solar atmosphere above and round the faculæ. The cellular vortices of the sun: H. **Deslandres.** Details of the work done with the new spectrograph at the Observatory of Meudon. A diagram is given showing the radial movements of the upper K_3 layer of the solar atmosphere above and round a facula.—The study of sea temperatures: A. Bouquet **de la Grye.** A knowledge of the temperatures of the sea over a wide area is an important factor in weather forecasts.—The trypanolytic power of the blood of some cold-blooded vertebrates with respect to *Trypanosoma evansi*: A. **Laveran** and A. **Pettit.** The blood of some of the cold-blooded vertebrates contains active trypanolytic substances, and there seems to be a relation between the presence of these substances and the toxicity of the serum. Closely related vertebrates showed differences in the trypanolytic power, the case of *Rana esculenta* and *R. temporaria* being especially remarkable in this respect.—The problem of Sophus Lie: N. **Saltykow.**—Practical formulæ for the calculation of aërial helices: M. **Drzewiecki.**—The magnetic *rôle* of oxygen in organic compounds: P. **Pascal.** The constants given in this paper enable the value for the magnetic susceptibility of an organic compound containing oxygen to be used as a guide to its structure.—The estimation of phosphorus in combustible substances by the calorimetric bomb: P. **Lemoult.** If certain precautions are taken, details of which are given, the determination of phosphorus in organic compounds by combustion in the calorimetric bomb possesses advantages over the methods in general use both in rapidity and accuracy.—The law of the fading of mnemonic traces as a function of the time in *Limnaea stagnalis*: Henri **Piéron.**—The natural means of defence of certain cold-blooded vertebrates against the trypanosome of surra, *Trypanosoma evansi*: A. **Massaglia.** Phagocytosis appears to play no part in the destruction of the trypanosomes.

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