THURSDAY, OCTOBER 2, 1902.

FUSILS DE CHASSE.

Tir des Fusils de Chasse. Par Journée, Lieut.-Colonel du 69e Régiment d'Infanterie. Deux: Edition. Pp. ii +387. (Paris: Gauthier-Villars et Fils, 1902.) Price fr. 12.

THIS volume on guns, rifles and explosives is divided into eight chapters. The first is devoted to general information about guns and ammunition; for example, the writer states that the *calibre* which we call 16 signifies that sixteen spherical lead balls of the calibre of the gun weigh one pound. The nominal calibres are then shown in a tabulated form reduced to millimetres, also some of the qualities of different powders and shot are described.

In chapter ii. the pressures of powder gases are considered, and a large amount of solid work on this subject has been collected together in section vii. of this chapter. The pressures due to Amberite, Cooppal and Valsrode are shown in a tabulated form.

The action of the gas of explosion was measured by the method of Sébert, by which the successive velocities and accelerations of recoil of a gun are measured during the passage of the shot through the barrel. When the writer comes to the subject of crusher gauges, for determining the pressure of powder gases, he quotes from the *Field*, in which the results obtained by M. Polain, of Liège, were published; the author might have cited with advantage the excellent work on this subject to be found in the *Proceedings* and *Transactions* of the Royal Society of London, vols. lii. and clxv. respectively. In chapter iii. the question of the velocity of the projectile is treated, and the author writes:—

"Mais le plus souvent, on déduit la vitesse initiale de la vitesse restante à une petite distance de la bouche, vitesse qui a été mesurée avec un chronographe électrique, dont le modèle le plus usité est le chronographe de Boulengé."

The Boulengé chronograph, now a rather antiquated instrument, has gained a far-reaching popularity from the fact that nearly anyone can read the results, but the instrument is not at all suitable for determining high velocities over short ranges, and in the case of a shot gun the range for finding the velocity is very short indeed.

The method of dealing with the question by MM. Billardon and Don is far better and exact; it consists of a moving target and a fixed one. The form of this instrument, referred to by the author, has been constructed by Mr. R. Griffith, the manager of the Schultze Powder Co. The moving target consists of a disc 12 feet in diameter, from which a central disc of 4 feet diameter has been removed, leaving a band carried on spokes, 4 feet wide. This is so rotated by a steam engine that the velocity of a point on its edge is 200 feet per second. The edge is marked with divisions, each representing 1/400 sec. From each division lines are drawn to the centre. The band is also ruled with fifteen concentric circles. Thus the whole surface of the band is divided into sections, which can be numbered for reference. In front of the target, and close to it, is a fixed screen covering the lower half of the circular target, except where it is perforated with a circular opening 4 feet in diameter, so placed as to coincide with the width of the band moving behind it. Across this opening a sheet of very thin paper is strained; this receives the stationary pattern of the discharged pellets, while the revolving band receives the pattern made by the pellets striking it in succession. Observations made with the instrument show the relative velocity of the pellets, so that from the observations a diagram may be constructed showing the actual position of the pellets at a given time.

In chapter iv. the recoil of guns is discussed, the velocities of recoil being measured by the method of Sébert; but the instrument employed was far more simple than that of Sébert, and gave results the limit of which is shown by the following quotation from the writer:—"Il permet d'obtenir la vitesse du recul à 1/5000 près." None of the modern methods of working experiments on recoil, such as the pneumatic and electrical methods of firing, are mentioned. Chapter v. is a long one of eighty-one pages, the subject being the dispersion of shot. The author has illuminated this portion of his book with one of the excellent spark photographs of Prof. C. V. Boys, F.R.S., in which the relative position of the pellets is clearly shown. Information on the subject of "choke bore" has been carefully collected, and exhibited in tabular form. The author devotes six pages to the vibration of the gun, and on p. 254 the supposed form of vibration is shown. The excellent and new work of Cranz and Koch on the vibration of gun-barrels does not appear to have been consulted, neither is the method employed in obtaining the results described.

In chapter vi. a large amount of matter respecting the form and nature of bullets has been collected. On p. 269 the name of the celebrated inventor W. E. Metford is wrongly spelt, "d" being written for "t." Alloys used in the manufacture of bullets, both of the heavy and light classes, are described. With respect to the latter, the author writes:—

"Les balles faites en aluminium pur se champignonnent trop facilement sur les os offrant quelque resistance."

Alloys are also mentioned, such as that of aluminium and tungsten, called partinium, and aluminium and magnesium, called magnalium. The latter alloy is becoming popular amongst Continental instrument makers on account of its lightness and tenacity. Bullets made of these alloys would be of great service as man-stoppers at close quarters because of the spread of the bullet.

The chapter concludes with a description of the method of applying the abacus for finding the remaining velocities of projectiles at different ranges, when the initial velocity is given. The abacus now used in calculations connected with technical matters in France is well described in "Le Calcul Simplifié," by Maurice d'Ocagne. By means of the abacus, solutions of many problems may be easily and rapidly found, when the law of the formula employed has been plotted in the form of a graph. The work concludes with a chapter on aiming the gun in sport, and the influence of the nervous condition of the sportsman and the skill of different individuals. The author has collected together a great mass of

valuable matter on the subject he has taken in hand, and he puts it before the reader with clearness and precision. Should another edition be called for, some of the valuable results obtained by Dr. Bashforth and the more modern work in ballistics, which has been carried on in the United States of America, in Germany and in England, might be introduced with advantage. F. J-S.

THE COMPLETION OF ROSCOE AND SCHORLEMMER'S ORGANIC CHEMISTRY.

Roscoe-Schorlemmer's Lehrbuch der Organischen Chemie. By Jul. Wilh. Brühl, Professor in the University of Heidelberg. Seventh Part, in conjunction with Eduard Hjett and Ossian Aschan, Professors in the University of Helsingfors; O. Cohnheim, O. Emmerling and E. Vahlen, Privatdocenten in the Universities of Heidelberg, Berlin and Halle. Pp. xxxii + 527. (Brunswick: F. Vieweg und Sohn, 1901.)

THE seventh part of the above text-book, which forms the ninth volume of the entire work, brings to a close the publication of that standard treatise of which two of the earlier volumes were reviewed in these columns on a former occasion (November 14, 1901, Supp. iii.). Beyond an indication of the contents of the present volume, there is not much to add in the way of general remarks to the statements already made. The whole work of translating and editing the early volumes and of writing the later ones has cost Dr. Brühl and his coadjutors five years' labour. As one result of the task which the editor first took in hand in 1896, chemical literature has been enriched by a series of valuable monographs written by specialists, these monographs, some of which were noticed in NATURE at the time of their appearance, being separate issues of certain sections of the present and former volumes. Chemists are no doubt familiar with the works on five- and six-membered heterocyclic systems (1898 and 1899), on vegetable alkaloids (1900) and on albuminoid substances (1900), all of which have originated in the manner indicated.

This concluding volume of the great treatise which first saw light in this country is one which appeals most particularly to physiologists. The four groups of compounds with which it deals are all, strictly speaking, and in the narrow sense, "organic," *i.e.* of vital origin. Dr. Cohnheim's contribution, "Die Eiweisskörper," is already known in its separate form; it occupies more than 300 pages of the volume. The same author contributes a section of some twenty pages on the compounds found in animal gall secretion. The third section, of more than 100 pages, comprises Dr. Emmerling's monograph on enzymes, and the concluding section, which is by Dr. Vahlen, deals with the ptomaines and toxines. It must be stated also that the present volume, in addition to its own subject-matter, contains a general synopsis of the contents and a general index for the whole seven volumes of the treatise on organic chemistry.

As regards the treatment of the subjects dealt with in this concluding instalment of the work, it need only be repeated that the names of the writers are vouchers for their completeness and accuracy. As compared with this and the volumes formerly noticed in these columns, the earlier volumes are, of course, now much behind our actual state of knowledge. But as standards fixed by the dates on the title-pages, these seven volumes represent the most complete and coherent descriptive treatise on the chemistry of the carbon compounds as yet offered to the scientific world. We shall be curious to see how our German colleagues will grapple with the literary difficulty of keeping a work of this exhaustive character *au courant* of the rapid progress which is being made in this department of science. As the editor reminds us in the preface, organic chemistry as a distinct branch of our science was born and has grown to its present magnitude during the nineteenth century. In congratulating Dr. Brühl and his collaborators on the completion of their task, we can assure him that there is every prospect of his wish that organic chemistry should develop as much during the twentieth as it has during the preceding century being fulfilled. We may further assure him that his hope that the work which he has been instrumental in giving to chemists may contribute towards this future development is amply justified. Of the original authors, one is happily still with us; to the memory of the other, this treatise will serve as an enduring monument. R. MELDOLA.

JAPANESE MYTHOLOGY.

Japanische Mythologie. Nihongi "Zeitalter der Götter." Von Dr. Karl Florenz. Pp. ix+341; mit Illustrationen. (Tokyo, 1901.)

DR. FLORENZ is well known as a writer on Japan, and in his present work he adds one more volume to the many which he has published on that interesting subject. Some years ago he gave to the world the translation of a part of the "Nihongi," one of the earliest productions of Japanese literature, and in his present volume he takes the mythological portion of that work and by the aid of notes helps to throw considerable light on the very dark places of Japanese mythology.

The "Nihongi" yields in antiquity to only two other works, viz. the "Kiujiki," which was compiled in A.D. 620, and the "Kojiki," which was completed in 712. Eight years later the "Nihongi" was laid before the Empress Gemmiō as a complete work. The "Nihongi," or the "Records of Japan," is said to have been written by Shōtoku Daishi, and it is certain that only an author as well versed in Buddhist lore and Chinese classical literature as he was could possibly have written it.

To both of these wells of learning constant references are made, and throughout its pages the influence of Chinese thought is everywhere apparent. The opening sentence in the book contains the Chinese philosophical terms *Yin* and *Yang*, the male and female principles of Nature, which form a strange introduction to the mythology of a foreign land. The Chinese metaphor for the State, the temples of "The Earth and of Grain," also find frequent mention in its pages, and even a long dying speech originally uttered by the Chinese Emperor Kaotsu is put into the mouth of the Japanese sovereign Yūriaku. As Dr. Florenz says:—

"The little which European inquiry has hitherto been able to teach us of the real condition of Japan in the ancient times shows that the historical representation of this period in the 'Kojiki' and 'Nihongi' (upon which rest all the later statements of the Japanese) is most profoundly penetrated by false principles. The newer relations, partly developed from later material, partly influenced by Chinese culture, are reflected back upon the oldest without due distinction, and the result is a confused picture in which the critical inquirer can, it is true, frequently separate what is original from subsequent additions, but must often let fall his hands in despair."

The earliest part of the "Nihongi" consists of myths, pure and simple, and while it is necessary to sift the mass of legendary tales which it recounts for the grains of truth which it contains—and the grains are there—its value is enhanced by the poems of undoubted antiquity which are constantly introduced. This mythological period extends to the fifth century, and it is upon this portion of the history, with extracts from the "Kojiki," that Dr. Florenz has based his present work.

Japan is a land of myth. Of a more imaginative race than the Chinese, and enriched with the stores of legend gathered from the Malay Peninsula and the northern mainland of Asia, the Japanese have through all history revelled in the weird conceptions of the imagination, and even at the present day, unchecked by the veneer of civilisation which they have adopted, they see elves and fairies on every hill and in every valley, and recognise elfin foxes in moments of heightened fancy.

According to the "Nihongi," the creation of the world was after this wise, and here again we trace the influence of Chinese thought. In the beginning the universe was in a state of chaos, out of which by a process of disintegration the lighter and finer portions separated themselves from their surroundings and rising upwards formed the skies, while the more substantial constituents resolved themselves into the world. These two elements formed the male and female principles of Nature and begat certain deities, two of whom, Izanaki and Izanami, were the first to divide the land from the waters. We are told that these deities

"stood on the floating bridge of heaven and held counsel together, saying 'Is there not a country beneath?' Thereupon they thrust down the jewel spear of heaven and groping about therewith found the ocean. The brine which dripped from the point of the spear coagulated and became an island, which received the name of Onogoro," *i.e.* self-curdled.

This legend is interesting as reminding us of the Greek myth of Dêlos, *i.e.* Manifest, which was so called from its suddenly emerging from the sea. Dêlos was, as will be remembered, the centre or hub of the Cyclades, which derived their name, ἀπὸ κύκλου, from the wheel. Another and a still more striking parallel is furnished by the account which relates that "Poseidon with one blow of his trident made the island surge from the bottom of the ocean." In other lands besides Greece we recognise this legend under varying forms, and, indeed, on almost every page of Dr. Florenz's work we find traces of world-wide myths. One of the most widely spread of these is that of St. George and the Dragon. Sosa no wo no Mikoto in this case represents the Christian St. George and Kushi-nada-hime is the lovely maiden whom he rescues from the fangs of the serpent or dragon.

To the comparative mythologist Prof. Florenz's work will be invaluable. But, as it professes to be, it is essentially a book for the student of folk-lore. By such it will be found full of suggestive matter, while it is much to be feared that to the ordinary reader it will be but a weariness to the flesh.

OUR BOOK SHELF.

An Introduction to Chemistry. By D. S. Macnair, Ph.D., B.Sc. Pp. xii + 187. (London: George Bell and Sons, 1902.) Price 2*s.*

WHATEVER may be thought of the use of text-books in teaching elementary science, there can be no doubt as to the improvement which has taken place in the character of such books in recent years. The change is particularly noticeable in volumes dealing with the rudiments of chemistry and physics. Instead of the descriptive style formerly in vogue, we have now courses of practical work connected with a few explanatory paragraphs, and the whole constructed upon a plan which aims at making the pupil do things for himself and so far as possible arrive at his own conclusions.

Dr. Macnair's book is based upon this method, and as a representative of a good type it deserves a welcome from teachers of science. Beginning with simple observations and experiments on solubility, the author paves the way to the study of the rusting of iron, the atmosphere, water, chalk and a few other common bodies, following in a general way the course suggested by Prof. Armstrong, which is now followed in many schools, with results encouraging both to teachers and pupils.

As to the educational value of work of the kind described by Dr. Macnair, no one who has tried it with young pupils desires to go back to the old method of teaching chemistry by test-tubing in the laboratory and startling experiments in the lecture room. Quantitative work which was formerly postponed until pupils were able to make an analysis of a simple salt is now taken up at the beginning of a course, and early use is made of squared paper for plotting results. Dr. Macnair, for instance, shows on his twelfth page how solubility curves should be constructed from results of experiments.

To anyone familiar with the excellent work now being done in schools, by the practical study of common properties of matter, the book adds little that is new, and many of the experiments will be recognised. But this does not make the book any the less useful as a practical manual containing a course of work suitable for introducing pupils to methods of scientific study.

A Tentative List of the Flowering Plants and Ferns for the County of Cornwall, including the Scilly Isles. By F. H. Davey. Pp. xvi+276. (Penryn: F. Cheg-widden, 1902.)

THE spirit in which Mr. F. H. Davey has taken up the task of preparing a "Flora of Cornwall," which shall rank with Druce's "Flora of Berkshire" and other similar handbooks bodes well for success. In two years and a half this tentative list has been formulated, and as one looks through the list of species and records there is ample proof of excellent work. The principle of the book is to give the first record for each species, besides a complete list of localities for species and varieties. Also it is sought to amplify the published list of plants found in Devon, but wanting in Cornwall, and to obtain details of local peculiarities of growth, as well as local names or any plant lore which can be unearthed. In the book

before us these features are not treated, but presumably in the "Flora" they will be incorporated. Also it would add to the interest of the book if a summary of the principal ecological features were presented. It is evident from the published list of contributors that Mr. Davey has been successful in enlisting the services of many well-known systematists; but more workers are required, especially residents in the districts just north and east of Truro, also in Camborne and the country lying south. To these and to botanists visiting the county Mr. Davey will gladly supply copies of "the tentative list," which is interleaved for notes, so that their records may be returned to him in November, 1903, when the accumulated data will be worked up.

Outer Isles. By A. Goodrich-Freer. Pp. xv + 448. (Westminster: Constable and Co., Ltd., 1902.) Price 12*s.* 6*d.* net.

THIS book contains much valuable information about the Outer Hebrides and their people, and it is good service to have it put on record in accessible and readable form. Specially good are the accounts of the *Ceilidh*, or custom of "assembling together during the long winter nights to pass them off in happiness and mirth," and of the process of "fulling" or dressing the Harris cloth. But the work as a whole is blemished by a want of perspective. The natives of the Outer Isles are, after all, not without faults, and even vices, and some of their virtues are shared by inhabitants of the "adjacent islands of Great Britain and Ireland." There is something to be said on the side of the landlord, the Free Kirk, and even the sporting Sassenach, and the reiteration of their enormities on all possible occasions becomes very tiresome. It is not true that the people of the Outer Hebrides are "practically less known to the average Englishman than the inhabitants of New Zealand or of Central Africa," or that "those who penetrate to their islands, so far at least as they are represented by comfortable inns in easily accessible places, come back knowing nothing of the life of the people, and only ready to condemn them as half-savage, extortionate, and above all, idle."

The Fauna of British India, including Ceylon and Burma. Published under the authority of the Secretary of State for India in Council. Edited by W. T. Blanford. Rhynchota, vol. i. (Heteroptera). By W. L. Distant. Pp. xxxviii + 438. (London: Taylor and Francis, 1902.)

THIS important work continues to make steady progress, and we have now the pleasure to notice the appearance of another volume devoted to entomology, in addition to those already published by Sir G. Hampson on "Moths," Col. C. T. Bingham on "Hymenoptera" and Mr. R. I. Pocock on "Spiders." Mr. W. L. Distant is so well known as a close student of Rhynchota, and also for his careful and accurate work, that we have no doubt that specialists will find the present volume to be one of the most complete and satisfactory that has yet appeared on the subject; and it should give a great impetus to the study of Rhynchota, especially in India and in the adjacent countries.

Following Severin, Mr. Distant accepts fifteen families, eleven of which are represented in India, the first volume including descriptions of the Pentatomidæ, Coccidæ and Berytidæ. We may point out that Dr. D. Sharp's estimate of about 18,000 species of Rhynchota, quoted by Mr. Distant on p. xxxv, is obviously much too low, the number given by Mr. W. F. Kirby as long ago as 1892, in the second edition of his "Elementary Text-book of Entomology" (p. 14), being already 18,300. The volume is illustrated by 249 excellent text illustrations by Mr. H. Knight, including a series of very clear illustrations of structure in the introduction.

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.*]

The Carnegie Institution of Washington, D.C.

SIR,—It gives me great pleasure to answer in writing some of the questions which you, and others who are interested in scientific research, have asked in respect to the scope of the institution lately founded in Washington by Mr. Andrew Carnegie.

To begin with, it may be well to recapitulate the facts already made known. The amount of his gift is ten million dollars (2,000,000*l.*), so invested that the annual income is five hundred thousand dollars (100,000*l.*). The control of this fund is invested in a board of twenty-seven trustees, selected from widely separated parts of the United States, and including many men who have won distinction and confidence by the service they have rendered in public life. It is not a board made up of specialists, but rather (if I may be allowed the expression) of generals—that is to say, of men accustomed to the administration of large affairs, political, financial, philanthropic and educational. Absolute power is given to this board to devise such methods and form such plans as may seem to them wise in order to carry out the purposes of Mr. Carnegie. These purposes he has clearly defined in the deed of trust and, with less formality, in the remarks which he addressed to the trustees when they first came together on January 29, 1902, under the chairmanship of the Hon. John Hay, Secretary of State, and recently the Ambassador of the United States in London.

In one general phrase, which reads as follows, Mr. Carnegie thus lays down the principle which has guided him:—"It is proposed to found in the city of Washington an institution which, with the co-operation of institutions now or hereafter established there or elsewhere, shall in the broadest and most liberal manner encourage investigation, research and discovery, show the application of knowledge to the improvement of mankind, provide such buildings, laboratories, books and apparatus as may be needed, and afford instruction of an advanced character to students properly qualified to profit thereby."

There are six points upon which the munificent donor then proceeds to lay emphasis, and these are, namely, the promotion of original research; the discovery and encouragement of exceptional men; the increase of facilities for higher education; the assistance of those now engaged in research; the bringing to Washington of students qualified to profit by the work carried on in the several departments of the Government; and finally, the publication of scientific memoirs.

So far all was clear. Mr. Carnegie's part was performed. Now began the perplexities and responsibilities. The trustees, many men of many minds, must take the subsequent steps. Fortunately, there was no occasion for hasty action; at the outset no buildings were to be constructed, no faculty was to be brought together. Such considerations could be postponed indefinitely. The trustees decided to take time for reflection and for conference with the leaders of science at home and abroad, before the adoption of a programme. Letters were addressed to many persons who could not be reached in person. Confidential interviews were secured with those who could be seen in Europe and the United States. The experience of existing institutions was studied, such as the Royal Society, the Royal Institution, the Academies of Science in Berlin, Munich, Vienna, Paris and other cities. Attention was given to the conditions which have helped or retarded the progress of eminent men during the last generation

—Darwin, Pasteur, Helmholtz, Abel and Virchow for example, in Europe—Henry, Agassiz, Dana and Rowland in America—and also the encouragements and discouragements which are encountered by the men of to-day. Time will be required for the digestion of this material in order to discover the methods which are most efficacious in the advancement of knowledge.

Meanwhile, much co-operative counsel will be given by experts in various branches of learning. As soon as the general purposes of Mr. Carnegie's foundation were made known, hundreds of applications for assistance were received—the number of self-discovered "exceptional men" was large. The number of trivial applications for help in the prosecution of researches was surprising; but, on the other hand, the number of well-considered, important, fundamental inquiries suggested by men of the highest rank among the promoters of knowledge indicated that the entire income would all be absorbed at no distant day. Discrimination, therefore, became the paramount virtue—discrimination which should meet the approval and, if possible, the concurrence of the world's wisest men.

For this discrimination, the aid of specialists was indispensable. The astronomer was not the man to judge of biological claims, nor the chemist of economic problems. No board of "generals" could wisely act without the aid of a strong advisory staff of "adjutants." Accordingly, the authorities of the Carnegie Institution proceeded to select and enlist a number of advisory committees. Three, four, or five well-known authorities were chosen in each of the principal branches of science. All their expenses for travel and for clerical assistance were generously paid by the fund, but their services, like those of the trustees, were cheerfully given to the public without remuneration, and often at the sacrifice of time and convenience. Their hearty co-operation is a fresh illustration of the public spirit of men of science in our day, and their readiness to appreciate and help on the most deserving claims, irrespective of local or personal preference, augurs well for the efficiency of the Carnegie Fund and for the wisdom of the plans that will presently be adopted.

More specific announcements cannot be made until the trustees come together for their second meeting at the close of November next.

A careful perusal of Mr. Carnegie's language will bring out several points, to some of which I will venture to call attention. Here we have that special "endowment for research," which has been during the last thirty years and more the desire of so many men in England and America. This endowment is independent of any existing academy, university or school of technology; but it may co-operate with any that now exist or that may be established. It does not establish a university in Washington, which so many have advocated and so many have disapproved. Mr. Carnegie on this point is explicit and decided. The efficiency of the new institution is not restricted by any local, political or ecclesiastical fetters. Nor is there any attempt to decide what science includes. None of the progressive organised and systematic branches of knowledge are excluded. Economic, historical and archæological inquiries may be aided as well as those which are more obvious to the public—physical, chemical, biological, geological and astronomical researches. Education may be encouraged, but it must be by the personal development of uncommon talents,—the advanced student, the young professor, "the exceptional man." To the last clause of his deed of trust, Mr. Carnegie attaches the highest importance. It corresponds with a clause in his gift to the Scotch universities The trustees by a majority of two-thirds "may modify the conditions and regulations under which the funds may be dispensed"—if time, experience and changed conditions call for new arrangements.

I cannot close this letter without reference to the great interest which this gift has aroused in all scientific circles at home and abroad. During the past summer, spent upon the Continent and in Great Britain, I have had the honour of talking with many men of eminence, everywhere known as investigators, and their counsel, suggestions and co-operation are not only an indication of the international character of science, but they give an assurance that the most enlightened experience of the world can be enlisted in the plans of this new foundation. At home, "it goes without saying," that there is the heartiest response to Mr. Carnegie's generosity.

With a grateful appreciation of the work of NATURE in the persistent advocacy of research. DANIEL C. GILMAN,

London, September 9. President of the Carnegie Institution.

Re Vegetable Electricity.

WITH reference to Dr. Waller's letter in NATURE, September 18, I confine my reply, in the limited space courteously offered me, to the main issue, *i.e.* the priority of research on the electric response of ordinary plants under mechanical stimulus. My footnote to my Linnean Society paper gave the published dates which must determine, as usual, such a question. It would only obscure the issue were I to take up here assertions resting solely on Dr. Waller's personal affirmation.

My statement which Dr. Waller wishes to traverse is definite enough, and may be answered in a definite manner. He has not done this. I stated that five months before the communication of his paper to the Physiological Society (November 9, 1901), Dr. Waller *heard* me describe my results on the electric response of ordinary plants under mechanical stimulus. My paper on the "Electric Response of Inorganic Substances: Preliminary Notice," was communicated to the Royal Society on May 7, 1901 (*i.e.* six months before Dr. Waller's communication to the Physiological Society). I read it before the Society on June 6. From the concluding portion of this paper I quote the short summary of the results obtained with plants.

"An interesting link between the response given by inorganic substances and the animal tissues is that given by plant tissues. By methods somewhat resembling that described above, I have obtained from plants a strong electric response to mechanical stimulus. The response is not confined to sensitive plants like mimosa, but is universally present. I have, for example, obtained such response from the roots, stems, and leaves of, amongst others, horse-chestnut, vine, white lily, rhubarb and horse-radish. The current of injury is, generally speaking, from the injured to the uninjured part. A negative variation is also produced. I obtained both the single electric twitches and tetanus. (Two response curves given to exhibit this.) Very interesting also are the effects of fatigue, of temperature, of stimulants and of poison. Definite areas killed by poison exhibit no response, whereas neighbouring unaffected portions show the normal response."

Dr. Waller not only heard me describe these results, but took part in the subsequent discussion of my paper. It is indeed very strange that he should on that occasion have said absolutely nothing about his being engaged in this particular investigation. An eminent physiologist declared during the discussion that the electric response of ordinary plants under mechanical stimulus was an impossibility. Dr. Waller, who immediately followed him, it is again remarkable to note, had not one word to say for the possibility of such a phenomenon! These facts are as significant as the fact that Dr. Waller communicated his paper five months after he had discussed mine at the Royal Society.

The above will dispose of the question of priority. My Linnean Society paper and Dr. Waller's paper read before the Physiological Society are now before the public. From these, anyone interested in the subject will be able to determine the scope of the two investigations, the novelty of the appliances and methods employed, and the accuracy of the results obtained.

JAGADIS CHUNDER BOSE.

THE claim for priority comes from Prof. Bose—implicitly by the note to his paper at the Linnean Society, to which I had to demur—explicitly in his present reply. Prof. Bose bases his claim on the final paragraph of a paper of June 6, 1901, now in

the Archives of the Royal Society. If this be regarded as a valid document and date of departure, I shall have something more to say about Prof. Bose's methods. If this date and document be not valid, his claim rests upon a paper at the Linnean Society of July 21, 1902, which seems to me to be a very interesting instance of scientific mimicry. Anyone interested in the study of such phenomena will find it instructive to compare the papers mentioned by Prof. Bose, of November 9, 1901, and July 21, 1902, to the Physiological and Linnean Societies respectively. I think he should also, as regards the general method, consult my Lectures on Animal Electricity of 1897 at the Royal Institution, which have been adopted by Prof. Bose as his point of departure.

A. D. WALLER.

British Association Meetings.

THE gradual decrease in the number of those attending the recent meetings of the British Association might suggest that the popularity or the usefulness of these scientific gatherings is on the wane. The opportunity for an instructive comparison exists in the fact that on the last three occasions on which the Association has met, it has repeated its visits to well-known centres, widely distributed. It might have been anticipated that, owing to the growth of material prosperity and of the population of these towns, a continually increasing number would have availed themselves of the advantages of these meetings. The following figures show, however, that the contrary is the case :—

Year.	Place of Meeting.	Number attending.	Year of previous Meeting.	Number attending.
1900	Bradford	1915	1873	1983
1901	Glasgow	1912	1876	2774
1902	Belfast	1620	1874	1951

Naturally the amount of grants for scientific purposes shows a similar decline :—

Bradford,	1072*l.* against	1685*l.* in 1873
Glasgow,	945*l.* ,,	1092*l.* ,, 1876
Belfast,	960*l.* ,,	1151*l.* ,, 1874

The usefulness of the Association in one direction is apparently lessened, since it has distributed about 1000*l.* less in the three years, but it may be that there is not the same necessity for assistance as was the case a quarter of a century ago, and that consequently the amount applied for by the different sections has not been as large as on previous occasions. But this does not put aside the fact that there is a distinct falling off in the interest exhibited, as tested by the numbers attending.

Supposing there is any decrease in the popular favour, and the smaller figures are not due to temporary causes, it seems worth while to ask whether any portion of the decline is traceable to reasons connected with the Association itself. This is a question which can be answered only by those who are intimately connected with the management, but there was a feeling among some of the members that the business was unduly protracted, and it was asked, with some apparent show of reason, why the meeting must always begin on a Wednesday. If the President's address, it was urged, was given on Monday evening, it would allow four clear, uninterrupted days for the business of the sections, which in most cases would be found sufficient, and then the Saturday could be employed in the manner it now is, or in winding up the unfinished sections. There may, of course, be an insurmountable objection to altering the arrangements which have existed for so many years, but which scarcely seem to meet the conditions of modern life, and it is with the view of hearing from some authoritative source the object of maintaining the old order of things that I have ventured to trouble you with this note. W. E. P.

September 19.

Helmholtz on the Value of the Study of Philosophy.

THE opinions of Helmholtz, even as expressed in his *popular* scientific lectures, have such permanent weight that you may consider the following correction of sufficient general interest to publish it in your journal.

On p. 234 of Dr. Atkinson's "Popular Lectures on Scientific Subjects by H. von Helmholtz" (second series, new edition, Longmans, Green and Co., 1893), lines 7 to 11, we read :—

"And the physician, the statesman, the jurist, the clergyman, and the teacher, ought to be able to build upon a knowledge of *physical* processes if they wish to acquire a true scientific basis for their practical activity." (The italics are mine.)

What may have been Helmholtz's opinion of the value of a knowledge of *physical* science to the groups of specialists above named may be gathered from other parts of his writings, but in view of the surely unjust discredit into which the study of genuine philosophy (such as Helmholtz defines it) appears to have fallen in the eyes of the followers of the "Naturwissenschaften," it would appear just to quote the original passage, whereby it will be seen that what was perhaps a printer's error in the translation has altered the whole gist of the passage :—

"Und auf die Kenntniss der Gesetze der *psychischen* Vorgänge müsste der Arzt, der Staatsmann, der Jurist, der Geistliche und Lehrer bauen können, wenn sie eine wahrhaft wissenschaftliche Begründung ihrer praktischen Thätigkeit gewinnen wollten" (Helmholtz, "Vorträge und Reden," p. 189, fourth edition, second vol., Braunschweig, 1896). (The italics are mine.) That "psychischen" is *not* a printer's error for "physischen" in the original is evidenced by the context, which is so interesting that I venture to quote it. After a brief comparison of the relation of philosophy to metaphysics with that of astronomy to astrology, Helmholtz says :—

"Ebenso bleibt der Philosophie, wenn sie die Metaphysik aufgiebt, noch ein grosses und wichtiges Feld, die Kenntniss der Geistigen und seelischen Vorgänge und deren Gesetze. Wie der Anatom, wenn er an die Grenzen des mikroskopischen Sehvermögens kommt, sich Einsicht in die Wirkung seines optischen Instrumentes zu verschaffen suchen muss, so wird jeder wissenschaftliche Forscher auch das Hauptinstrument, mit dem er arbeitet, das menschliche Denken, nach seiner Leistungsfähigkeit genau studiren müssen. Zeugniss für die Schädlichkeit irrthümlicher Ansichten in dieser Beziehung ist unter Anderem das zweitausendjährige Herumtappen der medicinischen Schulen."

I have not access to earlier editions of the original German than 1896; relatively to my object, such reference seems unnecessary. B. BRANFORD.

The Technical College, Sunderland, September 23.

Trade Statistics.

DR. MOLLWO PERKIN repeats in NATURE, p. 443, Mr. Levinstein's statement that in foreign trade "we went back during the ten years 1891–1900" (*Journ.* Soc. Chemical Industry, pp. 893–4). The evidence given is that "in the year 1890 our total exports amounted to 328 millions sterling," whereas "the average amount during the decade 1891–1900 was only 300 millions." But why should 1890 be taken as the standard year? It happens that the exports in that year were unusually high—higher, indeed, than in any other year from 1880 to 1898. Had Mr. Levinstein been in a hopeful frame of mind, he might have chosen 1888 or 1892 as his normal year, or, much more rationally, he might have taken the average of five years, 1886–1890 (299 millions), or the average of ten years, 1881–1890 (297 millions). Any of these methods would have brought out the more pleasing conclusion that our foreign trade is advancing. My object is not to decide whether it is or not, but to protest against Mr. Levinstein's method of proof. Can we imagine a meteorologist contrasting the average rainfall of a series of years with the rainfall of a *single* preceding year and on that basis announcing a change in the climate?

The facts (often exaggerated and misunderstood) as to the more rapid advance of German exports are fully and clearly stated in "Comparative Statistics of Population, Industry and Commerce," recently issued by the Board of Trade at the price of 5½*d.* It is not clear why Mr. Levinstein makes use of the British "total" exports, including all the transit trade, while for Germany he takes the "special" exports, from which the transit trade is, as far as possible, excluded. This swells all the British amounts by something like 25 per cent. beyond what they would stand at if they represented native produce only. It does not, however, much affect comparisons of rates of progress. But it confuses abstractors—in Dr. Perkin's abstract the distinction is overlooked. F. EVERSHED.

Kenley, Surrey, September 9.

IT is quite true, as Mr. Evershed points out, that the exports for 1890 were unusually high, but those of 1899 and 1900 were also exceptional, owing largely to war exports; this, however, hardly alters Mr. Levinstein's contention—that the trade of the country shows a decline as compared to the trade of

Germany and the United States. But if, instead of using Mr. Levinstein's figures, we take the annual exports per head of population, which is after all the truest test, we find that in the period 1870–74 they were 7*l.* 7*s.* 3*d.* per head, but in 1895–99 they had fallen to 5*l.* 19*s.* 5*d.* In Germany during the same periods they were 2*l.* 16*s.* 7*d.* and 3*l.* 7*s.* 2*d.* respectively, while in the United States they rose from 2*l.* 9*s.* 11*d.* to 2*l.* 18*s.* 4*d.* These figures show that although per head of population we export more than either of these nations, yet during the last forty years they have been increasing their exports per head, but those of the United Kingdom have been declining. The figures are much more striking if at the same time we examine the increase of population which has taken place in the three lands during the same period. From 1871 to 1901, the population of the United Kingdom increased by 31·7 per cent., while that of Germany increased 37·3 per cent. and that of America 96·1 per cent.[1]

I will now take another comparison—the five years' averages of the annual exports at the beginning and end of the period 1880–1900. Here it will be seen that the increase of exports of the United Kingdom only amounted to 6·4 per cent. (234 to 249 millions), but that Germany showed an increase of 23·1 per cent. (156 to 192 millions) and the United States 42·8 per cent. (166 to 237 millions).

Again, we are unable to show such large increases in the quantity of pig iron produced as are Germany and America. In the years 1870–74, the United Kingdom was far and away ahead of all other nations, producing 6·4 million tons against 1·8 million tons by Germany and 2·2 million tons by America. But in 1896–1900, the amounts were for the United Kingdom 8·9, Germany 7·4, and America 11·5 million tons.

Mr. Evershed objects to Mr. Levinstein taking a "fat year" as the starting point for his statistics, but, as I have already pointed out, the years 1899 and 1900, which come within Mr. Levinstein's decade, were also exceptionally good years and thus help to bring up the average. But I think that although Mr. Evershed has taken exception to the use of the year 1890, he will agree with all scientific and broad-minded men in being glad that a man of Mr. Levinstein's experience should have the courage to speak out and try to wake the nation up to a sense of its responsibilities.

F. MOLLWO PERKIN.

Bipedal Locomotion of Lizards.

I KEPT for many years in a glass case some specimens of *Lacerta viridis*, and often observed them after a feed playing in the sunlight in a peculiar manner, first drinking water, which they lapped up with their wide forked tongues. The play was a sort of dance. The lizard stands on his hindlegs and, raising the fore part of his body, executes a rapid, playful waving of the forelegs. When both forelegs are used, they move in unison; sometimes, however, only one is employed. This action seemed to be meant as an attraction, the motions being performed facing another lizard, who often responded with answering waves of the forelegs; at times during the pastime, the pair would lick each other. I observed the females indulged oftenest in this coquettish dance, though the males would go through the same performance, strange to say, as often with each other as with a female for a partner to set to.

One female I kept for five years always, when excited, took a perpendicular position, progressing on her hindlegs with the fore part of the body lifted, and would play, running at my hand and biting, always in that erect pose.

The blue lizards of Capri, which I have kept for years in confinement, move along upright under excitement, also using bipedal action.

ROSE HAIG THOMAS.

September 23.

RUDOLPH LUDWIG KARL VIRCHOW.

"All that lives must die,
Passing through nature to eternity."

THE great master and founder of modern pathology, Rudolph Virchow, has passed away, full of years and full of honours, mourned, not only by his fellow countrymen, but by the whole scientific world. A fall early in January last resulting in a fractured thigh was the ultimate cause of his death, which occurred on September 5.

[1] In Germany and America, the census returns are for 1900.

Born at Schilvelbein in Pomerania in 1821, Virchow attended the public school of his native town until his thirteenth year, when he entered the gymnasium of Cöslin and early distinguished himself by his linguistic attainments. In 1839, he entered the Friedrich-Wilhelm Institut, a training college for army medical officers, having among his teachers Müller and Caspar and among his fellow students Helmholtz, and in 1843 proceeded to take his degree. He had already shown such promise that he was released from service with the army and was attached to the Charité Hospital as prosector of anatomy, acting as assistant to Froriep, whom he succeeded in 1846. About this time he founded, in collaboration with Reinhardt, the famous *Archiv*, and after the death of the latter continued to edit it himself. In 1848, he carried out an investigation into an epidemic of relapsing fever in Silesia, and so uncompromising were his strictures on the authorities, together with his alliance to the ultra-Radical party, that he was compelled to resign his appointment at the Charité. Already, however, his reputation as a pathologist was made, and he was immediately offered and accepted the chair of pathology at Würzburg, where for the next seven years he devoted himself to pathological research. In 1856, on the death of Hemsbach, the Faculty of the University of Berlin petitioned for his recall, and, in spite of bitter opposition, was successful in its application, and Virchow returned to his old University for the remainder of his life, founding the Pathological Institute and the Museum of Morbid Anatomy.

Virchow's life was a strenuous one, and being blessed with a wonderful constitution he was able to devote himself to, and to become a master in, many pursuits, any one of which is usually sufficient to fill the life of ordinary mortals. In addition to his pathological chair, the duties of which he fulfilled up to the time of his accident, he was ethnologist and anthropologist, archæologist and Egyptologist, politician, a member of the Berlin Municipal Council for forty years, a member of the Prussian Chamber from 1862 to 1878, where he was the recognised leader of the Radical party and for fifteen years chairman of the Finance Committee. In 1880, he was elected a member of the Imperial Reichstag, but took little active part in its debates. One of his most important public works was concerned with the introduction of a system of drainage and with the installation of sewage farms, whereby Berlin has become one of the healthiest cities of Europe.

Of the man it may be said that he was beloved by his family and by his intimates. Short of stature and spare of figure, with grizzled hair and piercing grey eyes covered with spectacles, his was not a striking personality. Nor was he an orator, having a somewhat thin and weak voice and impassive delivery, but what he said was always to the point and clothed in simple but logical language, and he compelled a hearing by his very earnestness and simplicity. His political views and his uncompromising manner of stating them unquestionably prevented a full measure of State recognition of his genius.

As a teacher he attracted students from all parts of the world. Until his time, autopsies had been performed in a very perfunctory manner, the supposed seat of disease alone being examined. Virchow, however, submitted all the organs and tissues to a careful scrutiny, thereby in course of time as data accumulated proving the interdependence of one condition upon another and showing how widespread might be the effects of a limited lesion. At his demonstrations, the specimens were subjected to a rapid description and criticism, rough sections were cut and placed under the microscope, which was mounted upon a trolley running on rails, and so could be submitted without disturbance to the scrutiny of each member of the class. Drawings of the specimens

were made upon the blackboard and the salient features indicated, and in the course of a demonstration six or eight specimens might thus be started on the tour of inspection.

Of his pathological work, the earliest was upon vascular disorders. He was the first to elucidate the true nature of phlebitis, thrombosis and embolism, to recognise the essential features of leukæmia and to distinguish this condition from pyæmia, so laying the foundation for the brilliant work of Ehrlich and others upon hæmatology. In 1858, his "Cellular Pathology" appeared, in which the theory that every cell arises from a pre-existing cell was enunciated and the cellular derivation of the connective tissues, bone and cartilage recognised. Up to this time, the humoral theory had dominated medicine, but these considerations revolutionised pathology by introducing the new conception that all pathological cell-formations must arise from pre-existing normal cells. He says in his lectures, "The question is whether the general types which we have established for the physiological tissues will also be found to hold good for the pathological ones. To this I unreservedly reply, yes; and however much I herein differ from many of my living contemporaries, however positively the peculiar (specific) nature of many pathological tissues has been insisted upon during the last few years, I will nevertheless endeavour to furnish you with proofs that every pathological structure has a physiological prototype and that no form of morbid growth arises which cannot in its elements be traced back to some model which had previously maintained an independent existence in the economy."

Harvey had enunciated the celebrated proposition *Omne vivum ex ovo*, subsequently found to be too narrow to apply to all living forms; to Virchow pathology and physiology are indebted for the not less striking dictum, *Omnis cellula e cellulâ*. By this his name will live through the ages. Another great work of his was that on tumours, unfortunately never completed. He showed that cartilaginous tumours of bone might start from islands of cartilage which had remained untransformed during the general ossifying process, and thus gave some support to Cohnheim's theory of the origin of tumours from embryonic remains. He further made contributions on tuberculosis and leprosy, trichiniasis, hydatid tumours of the liver, lardaceous disease, cholera and diphtheria, and animal pigments; in fact, it is no exaggeration to say that there is hardly any subject in pathology that has not been illumined by some important contribution of his. He was a pathological anatomist and histologist rather than an experimental pathologist, and pathological bacteriology was of too recent development for him to contribute to it extensively. It is true that he made mistakes—he was but mortal; for example, his theory of the dependence of chlorosis upon anatomical defects in the circulatory organs has been found untenable—but he was the first to recognise them, and as often as not himself destroyed the fabric he had previously erected.

Virchow's fame was world-wide, and honours of all kinds were showered upon him. In 1874, he became a member of the Royal Academy of Science of Berlin; at the centenary of the Institute of France he was made a Commander of the Legion of Honour, and the following year Foreign Associate of the French Academy of Sciences. A foreign member of our Royal Society, he was Copley medallist in 1892 (an honour he highly appreciated) and Croonian lecturer in 1893. The subject of his discourse, delivered in English, on this occasion was "The Position of Pathology among the Biological Sciences" (NATURE, vol. xlvii. p. 487). In 1898, his last visit to us, he delivered the Huxley lecture at Charing Cross Medical School, and he was afterwards entertained at a banquet, at which Lord Lister presided. The title of the Huxley lecture was "Recent Advances in Science and their Bearing on Medicine and Surgery," and to the last he retained his marvellous vitality of mind and kept abreast of the most recent advances in pathology. Last year, on the occasion of his eightieth birthday, he was the recipient of congratulatory addresses from all parts of the world, Lord Lister representing the Royal Society and other learned bodies of Great Britain and Ireland, and his reply, which occupied nearly two hours in delivery and was brimful of dates and facts, was given without a note.

His countrymen rightly accorded him a public funeral, and representatives of the State, the city, the university and of the learned societies accompanied his remains to their last resting place.

Space forbids anything but this brief sketch of Virchow's life, but as a writer in the *Lancet* well says, "His active work ceased only with his death, the world's appreciation of his worth remains." R. T. H.

THE ABEL FESTIVAL IN CHRISTIANIA.

THE centenary of the birth of the famous Norwegian mathematician Henrik Niels Abel was celebrated in Christiania by a festival, or rather a series of festivals, which lasted from September 4 to 7, to which delegates from all the more important scientific societies and universities of the world were invited. The festival aroused the interest of the people of Christiania in a very unusual degree and, indeed, appeared to be regarded in the light of an important national event; the presence of the King of Sweden and Norway, who made a special journey from Stockholm for the purpose, contributed in a high degree to emphasise the importance attached to the festivities by the whole population of the Norwegian capital. The festival was inaugurated by an informal reception of the delegates at a supper-party given on the evening of September 4 at St. Haushangen, a place of popular resort on the outskirts of Christiania. The company was received by the famous Arctic explorer, Dr. Nansen, president of the reception committee, by the Foreign Minister Lagerheim, the Ministers of State Blehr and Ovam, the president of the Storthing, and Prof. Mohn, president of the Christiania Academy of Science. In a bright and genial speech delivered in English, Dr. Nansen welcomed the foreign delegates and expressed the feeling of pride on the part of his own small nation in having through Abel made an important contribution to the essentially international work of the development of science and of civilisation. The formal part of the festival commenced at noon on September 5 in the Hall of the Municipality; the King and his son Prince Eugen arrived shortly after noon, and were received by a guard of honour, consisting of students of the University of both sexes. The ceremony consisted of the performance of a cantata written by the celebrated author Björnson, and of speeches which were made between the first and second parts of the cantata. Speeches were delivered by the Minister of State Blehr in French, by Prof. W. C. Brogger in German, and on behalf of the delegates by Prof. H. Weber, of Strassburg, and Prof. Volterra, of Rome. A detailed appreciation of Abel's work was given by Prof. L. Sylow. In the evening, the delegates had the honour of being invited by the King to a reception and supper at the Castle, when a large and distinguished company was present; many of the delegates were presented to the King, who conversed freely with them in their own languages. The second part of the festival was held on September 6, at noon, in the Hall of the University, the King and Prince Eugen being again present. The proceedings commenced with an address in French by Prof. Mohn. Speeches were then delivered by Prof. Forsyth on behalf of the English-speaking delegates; by Prof. Gravé on behalf of the Slav nations; by Prof. Picard, Prof. Schwarz, Prof. Zeuthen, Prof. Henzel

and Prof. Mittag-Leffler. The eloquent speech of Prof. Forsyth met with the special approval of the audience and of the Christiania Press. The addresses from the various universities and learned societies were then delivered by the delegates; these were so numerous that with a few exceptions the delegates handed them in with a simple statement of the name of the society or university from which they came.

The last stage of the proceedings consisted of the conferring of honorary degrees upon twenty-nine distinguished men of science, of whom ten were present as delegates. It was explained that the University of Christiania had hitherto not possessed the power of granting honorary degrees, but that by a special Act of the Storthing the power had been granted to the University with a view to the present occasion. Among the twenty-nine mathematicians who were created *Doctores Mathematicae*, there were six British subjects—Lord Kelvin, Lord Rayleigh, Dr. Salmon (provost of Trinity College, Dublin), Sir George Gabriel Stokes, Prof. G. H. Darwin and Prof. A. R. Forsyth. In the evening, the delegates and a large number of other guests were entertained at dinner by the Municipality of Christiania; after the dinner there was a torch-light procession of many hundreds of students, which produced a most imposing effect. The students were addressed from an open window by Dr. Nansen in an enthusiastic speech. The festival concluded with a special representation of Ibsen's *Peer Gynt* at the National Theatre on the evening of September 7, the King and a distinguished company being present. The University of Oxford was represented by Prof. A. E. H. Love, F.R.S., the University of Cambridge by Prof. A. R. Forsyth, F.R.S., the University of Dublin by Prof. Joly, the University of Durham by Prof. Sampson, the University of London by Prof. A. G. Greenhill, F.R.S., the University of Glasgow by Prof. Jack, the London Mathematical Society and the Cambridge Philosophical Society by Dr. Hobson, F.R.S.

MR. F. W. RUDLER AND THE MUSEUM OF PRACTICAL GEOLOGY.

MR. F. W. RUDLER retired under the age regulations at the end of last month from the post of curator and librarian of the Museum of Practical Geology. He entered the public service in 1860 as assistant to Trenham Reeks, who was then curator of the Museum and registrar of the School of Mines. For fifteen years Mr. Rudler was actively engaged in the Museum, acquiring an intimate knowledge of mineralogy and applied geology, and an expert knowledge of British pottery. He practically re-wrote the third and fourth editions of the "Descriptive Guide to the Museum," which was originally drawn up by Robert Hunt; and he almost wholly prepared the second and third editions of the "Catalogue of Specimens of British Pottery and Porcelain."

In 1876, Mr. Rudler was chosen professor of natural science in the newly-established University College of Wales at Aberystwyth. Here he was successfully occupied for three years, until on the death of Mr. Reeks he was besought by the late Sir Andrew Ramsay to apply for the post rendered vacant in the Museum of Practical Geology. Mr. Rudler's appointment was cordially assented to, and from 1879 onwards he has held office with increasing advantage to the Institution and to the many individuals who have constantly sought his advice. It is not too much to say that one might search the world over and fail to find anyone with a fuller knowledge of the subjects that have been connected with the Library and Museum of Practical Geology, or one who was more ready at all times to give to others the benefit of varied and accurate information.

NOTES.

A COMMITTEE has been formed, under the chairmanship of Prof. Waldeyer, for the erection in Berlin of a public memorial of the late Prof. Virchow.

DR. DAVID FERRIER, F.R.S., will deliver the Harveian oration before the Royal College of Physicians, London, on October 18.

WE are sorry to have to record the death, at the age of sixty-eight, of Mr. J. W. Powell, director, since 1879, of the United States Bureau of Ethnology, and from 1880 to 1894 director of the United States Geological Survey. Mr. Powell's death occurred on September 23.

THE death, at the age of eighty-six, is reported of M. Vincent Leche Chesnevieux, the French traveller and geologist; also of Signor Adolfo Targioni-Tozzetti, emeritus professor of comparative anatomy and the zoology of the invertebrates in the Medical School at Florence. Prof. Targioni-Tozzetti was in his eightieth year.

THE *Pioneer* (Allahabad) learns from its correspondent at Kashgar that a severe earthquake occurred at that place at 8 a.m. on August 22, resulting in the loss of 1000 lives and great damage to property. A pronounced rise in the temperature immediately followed the shock. This rise continued for a week, during which period there were repeated slight shocks. A Reuter telegram from Simla, dated September 26, gives the number of people killed as 667, and states that more than 1000 persons were injured.

REUTER'S agent at Mobile, telegraphing on September 30, states that information has been received by steamer that an earthquake of a serious character occurred in Guatemala and British Honduras on September 23. The shocks occurred simultaneously along the coast and lasted three minutes. It is believed that Guatemala City was the centre of the disturbances. The telegraph wires are down between Guatemala City and the coast.

A REUTER telegram from New York, dated September 24, states that the *New York Herald* has published the following telegram from Lima:—"Mount Chullapata, which is situated 18 miles from Celendin, has been throwing up dust and smoke for a fortnight. Loud noises have been audible at a distance of 30 miles from the mountain. There is no record that Mount Chullapata was ever believed to be a volcano."

A SEVERE cyclone visited the eastern Sicilian coast on Friday last from Taormina to Catania, and resulted in a heavy loss of life and very great damage to property. At Modica, two mountain torrents burst their banks and submerged the lower portion of the town as high as the second floor of the houses. The disaster was at first attributed to a waterspout, but subsequent accounts declared that it was due to torrential rains following on the prolonged drought. Throughout the day, Mount Etna sent up a thick column of steam from the vicinity of the scene of the eruption of 1892.

A SEVERE typhoon occurred at Yokohama on September 29, and a great wave broke over the adjacent district of Odawara, causing, it is feared, the loss of 200 lives; much shipping was also damaged.

AN Institute of Colonial Medicine has, says the *British Medical Journal*, recently been established in Paris. The scheme of instruction comprises courses on bacteriological and hæmatological technique, parasitology, tropical surgery, tropical ophthalmology, tropical pathology and hygiene, and tropical skin diseases. The Institute is open to foreign as well as to French medical practitioners.

THE official programme of the fourteenth International Medical Congress, to be held at Madrid from April 23 to April 30 next, has now been issued. The congress will be divided into the following sections :—Anatomy (including anthropology, comparative anatomy, embryology, descriptive anatomy, normal histology and teratology), physiology, general pathology, therapeutics, pathology, nervous diseases, children's diseases, dermatology and syphilis, general surgery, ophthalmology, oto-rhino-laryngology, obstetrics and gynæcology, military-naval medicine and hygiene, hygiene and epidemiology, and forensic medicine and toxicology.

AT the annual meeting of the Indian Association for the Cultivation of Science, held in Calcutta last month, it was decided to found a medal, to be known as the Temple medal, to perpetuate the memory of the late Sir Richard Temple for the invaluable services he rendered in the establishment of the Association.

A COURSE of four lectures is to be given at Gresham College, Basinghall Street, by Dr. E. Symes Thompson on "Food." The lectures will be delivered on October 7, 8, 9 and 10 at 6 o'clock ; no charge is made for admission.

IN connection with the Universal Exposition which is to take place at St. Louis, Mo., U.S.A., in 1904, there is to be an aëronautical competition and exhibition, the rules and regulations governing which have just reached us. From them we learn that the sum of one hundred thousand dollars is offered as a grand prize, and that fifty thousand dollars are to be appropriated for minor and subsidiary prizes for competition between airships, balloons, air-ship motors, kites, &c. Information concerning the competitions is obtainable from the Chief of the Department of Transportation Exhibits, Louisiana Purchase Exposition, St. Louis, Mo., U.S.A.

ACCORDING to the *American Electrician*, a commission was recently appointed by the New York State Legislature for the purpose of determining the advisability of establishing a State electrical laboratory to provide independent authoritative information on questions of electrical science and official standardisation of electrical measuring instruments, apparatus and standards. The commission is to report to the Legislature at the opening of its session in 1903, and if in its judgment the establishment of a laboratory is necessary, detailed plans and specifications for the construction and equipment of such a laboratory are to be prepared and submitted in connection with the commission's report.

ACCORDING to the Berlin correspondent of the *Times*, the German Government is afraid that the policy pursued by the Marconi Company, and the arrangements concluded between it and Lloyds, threaten an absolute monopoly which would be objectionable for both commercial and political reasons. Germany has therefore invited England, France, Russia, Italy, Austria-Hungary and the United States to make arrangements for a meeting of delegates to prepare a programme for an international conference to consider the subject. It is said that this suggestion has been favourably received by the States addressed, and that, as soon as a programme has been arranged, the co-operation of all maritime States will be sought in drawing up an international convention to settle the conditions under which the establishment of stations for wireless telegraphy shall be allowed. The *Electrician* suggests that the conference should take place at the International Telegraphic Conference to be held in London next year. It is to be hoped that the conference will be held soon and will be successful. We have already pointed out in these columns the growing necessity for some consolidation of the competing systems.

A NOVEL table, designed by Prof. E. C. Pickering, has been placed in the north building of the Harvard College Observatory. It is in two revolving sections, and takes the place of six separate tables which have hitherto been in use. In the upper section of the table, the annals of the observatory, magnifying glasses and reference books are kept, and the lower section is used for the storing of letters and files.

ACCORDING to the *Aëronautical World*, a new American periodical, Prof. Graham Bell has nearly completed his flying machine. It is being constructed under Prof. Bell's personal supervision, and is stated to be radically different from M. Santos-Dumont's machine. The machine will, it is reported, be 20 feet in length and composed of twenty-five distinct parts, and the principle of the kite will be utilised to a considerable extent.

THE *Athenæum* learns that steps are being taken by the Department of Prisons, New South Wales, to establish a new system of criminal identification on the lines of the combined Bertillon and Francis Galton methods, modified to suit local conditions. A comprehensive criminal register is now in course of compilation, and already the anthropometrical measurements of a large number of prisoners have been taken, together with finger impressions and other distinguishing records. The work has been entrusted to Mr. M'Cauley, Deputy Controller and Inspector of Prisons, who has recently personally investigated the systems of identification pursued in the prisons of France and of the United Kingdom.

WRITING from Yokohama on August 24, Captain H. J. Snow says :—"I have never known such a cool summer since 1869. Constant rain has been the rule in this part of the country, and I think it has been similar all over Japan. Floods everywhere. The neighbourhood of the Philippines has sent us along a string of storms of small area, not one of which has come along the Pacific side of Japan. They have all either gone through the Korean Straits or across the south-western part of Japan and the Japan Sea. They have followed each other so often that the whole weather of the country has been kept in an unsettled state. Winds from north to east have prevailed nearly all the summer so far. We certainly have not had six days of southerly winds all told. The thermometer has ranged between 62° and 75° F. nearly all the time. On four or five days only it reached 84° to 86°."

THE eruption of Mont Pelée appears to have been heard as far away as Maracaibo, Venezuela, a distance of about 830 miles. In a report abstracted in the last number of the *Monthly Weather Review*, Mr. E. H. Plumacher, United States Consul at Maracaibo, writes :—"On the morning of the great calamity that has fallen upon the island of Martinique, strong rumbling sounds were heard here, as well as in the other parts of this State. At many places during the day before the catastrophe, noises of heavy cannonading were heard at La Ceiba, Cabimas, Perija and Quisiro. At Sinamaica the people thought that a great battle with heavy artillery was in progress near Maracaibo. . . . Early in the morning of the catastrophe, I found that my servant had saddled my horse ; when I asked him if somebody was sick and needed a doctor, he answered that he thought I needed my horse to go to the city, as a big battle must be going on, judging from the sounds of the heavy firing of guns. Observing the same sounds, I knew at once that it could not be heavy artillery, for if all of the cannons of Venezuela were fired together, they could not produce such sounds. It was not like cannonading with heavy siege guns ; it was neither thunder nor the strange, unpleasant subterranean sounds of convulsions of the earth ; it was as if immense explosives were fired high up in the clouds. . . . Last night

(May 12) after eleven o'clock we had a slight horizontal trembling movement from a south-westerly direction."

AN aërial luggage transmitter has been erected recently by the L. and S.W. Railway Company at their junction at Woking, and is, we understand, in the nature of an experiment, being, it is believed, the first appliance of its kind used by any railway company in the kingdom. In briefly describing it, *Engineering* states that on the up and down platforms are erected iron towers, each 32 feet 6 inches in height, and set in blocks of concrete. Suspended from tower to tower are four spans of wire cable. The topmost cable, on which the transmitter runs to and fro, is exceptionally strong, and is capable of bearing a strain equal to at least 20 tons. The second cable keeps the transmitter in position, and the third and fourth cables, which are much thinner and are in one length, are for "paying out" and "returning." Each span is 110 feet long, and the height of the transmitter above the railway is 22 feet 6 inches. Attached to the transmitter is an iron cage capable of holding half a ton at one time. The whole is worked by hydraulic power, the engine being on the down side. Above it is a small box in which are the levers working the apparatus. The transmitter is very rapid in its working, taking only 30 seconds to deposit 10 cwt. of luggage from one platform to the other. All the experimental trials have been, it is said, most satisfactory, and the transmitter is now ready for use.

ATTENTION has recently been called to the possibilities of the balata fields on the Amazon. A gutta-percha merchant in the Guianas, examining this region about a year ago, found the balata tree growing in abundance near Para, and on the Amazon and its tributaries for thousands of miles. The Brazilians had no knowledge of its gum-producing qualities, and were found cutting down the trees for firewood and building material. A concession was bought, and the practical work of producing gutta-percha for the market begun. As in the case of rubber, there is practically no limit to the supply of gutta-percha on the Amazon, and, as it can be produced at a fraction of the cost of rubber, it offers a much higher percentage of profit. The method of bleeding the balata tree is entirely different from that used to extract the gum of the rubber tree, and only experienced and expert bleeders can be employed. But, on the other hand, these trees yield many times as much sap as the rubber trees, and one man can, it is said, easily produce as many kilograms of gutta-percha in a day as twenty men can extract of rubber. Each tree will average 3½ lb. of gutta-percha and a competent bleeder can prepare 40 to 50 lb. per day. The gum is first fermented and then dried in the sun, after which it is ready for shipment.

WE have received several communications on the variation of the small copper butterfly (*Chrysophanus Phlaeas*, Linn.) with reference to the letter of a correspondent in our issue of September 11. The insect is very variable, and the row of blue spots inside the dark border of the hind wing, which has been specially referred to, is not uncommon, and according to Rühl ("Palæarktischen Grossschmetterlinge," i. p. 217) is only met with in the female. The insect extends throughout the whole northern hemisphere, and exhibits local variation in many parts of its range. In the south of Europe and Asia, a larger and darker variety, with rudimentary tails (var. *Eleus*, Fabricius), is not uncommon. The species is also very prone to albinism, specimens with the usual copper colour of the wings replaced by white, leaving only the black markings dark, being occasionally met with (var. *Schmidtii*, Gerhard). We are not aware that it ever hybridises with "blues," as one of our correspondents has suggested. We may refer readers who require further information to the following works:—Barrett's "Lepidoptera of the British Islands," vol. i. pp. 62–65, plate 2, Figs. 2, 2*a* to 2*j* (Fig. 2*a* represents the white form); Tutt's "British Butterflies," pp. 152–155; Mosley's "Illustrations of Varieties of British Lepidoptera," part 10 ("Polyommatus Phlæas"), plates 1 and 2 (twelve varieties figured, some very remarkable, including not only coppery and black and white forms, but a dark greyish brown specimen, slightly suffused with copper and marked with a few large black spots); Rühl's "Palæarktischen Grossschmetterlinge," Band 1, pp. 217, 218, 746, 747 (this work gives full information respecting the foreign range and variation of the insect); Staudinger and Rebel, "Catalog der Lepidopteren des Palæarctischen Faunengebietes," p. 74. Mr. F. Merrifield has also called our attention to his paper on "The Coloration of *Chrysophanus Phlaeas* as affected by Temperature," in the *Entomologist* for November, 1893 (vol. xxvi. pp. 333–337).

THE report on "British Rainfall for the Year 1901," compiled by Mr. H. S. Wallis and Dr. H. R. Mill (60 + 252 pp. large 8vo), contains, as usual, most valuable and trustworthy data, showing the annual distribution of rain over the British Isles, as observed at about 3500 stations, together with the number of days on which 0·01 inch or more fell. This most useful organisation is so well known that it seems scarcely necessary to refer to the articles which regularly appear upon various branches of rainfall work. The notes on the meteorology of the year and on the principal phenomena, arranged according to months, are exceedingly interesting and valuable for reference, as are also the tables showing the heavy falls in short periods and the monthly rainfall at 232 stations. The comparison of the rainfall of the year with a thirty years' average is very instructive, and shows at a glance that, on the whole, there has been a great deficiency in the total amount. In the eastern counties the deficiency reached 30 or 35 per cent. of the normal value.

IN the *Transactions* of the South African Philosophical Society of June last, Mr. J. R. Sutton contributes an elaborate paper on the "Pressure and Temperature Results for the Great Plateau of South Africa," accompanied by useful daily and monthly means for the years 1888–97. The discussion exhibits a systematic comparison between the temperatures and pressures of the air over a plateau and corresponding coast station, as represented by observations at Kimberley and Durban, similarly to comparisons between the summit and base of a mountain.

THE United States Weather Bureau has published a valuable memoir on West Indian hurricanes (*Bulletin* No. 32), prepared by Mr. W. H. Alexander from all available sources. Part of the information has been published in a previous *Bulletin*, but the present paper includes additional observations on those of St. Kitts and Porto Rico in particular, with brief historical notes of the most remarkable storms that have occurred from the earliest times.

THE *Journal* of the College of Science of Tokio (vol. xvi. article 7) contains an interesting paper entitled "Studies in Atmospheric Electricity," by Prof. Y. Homma. The facts discussed have been obtained chiefly from observations and documents belonging to the Central Meteorological Observatory of Japan. The principal conclusions are:—(1) The negative potential observed during strong wind is entirely due to the negative electrification of the dust in the atmosphere by friction with terrestial objects; (2) similarly the high potential observed during fog or haze is due to the positive electrification of the water particles composing it; (3) when a mass of cold air comes in contact with a mass of warm air, the former becomes positively electrified with respect to the latter; (4) the high potentials about sunrise are probably owing to the air near the surface having a lower temperature than the air above it, and becoming, in consequence, positively electrified; (5) when two masses of air at different temperatures happen to be mixed suddenly, the

electric field is violently disturbed. Various types of potential are illustrated by reproductions of photographic curves of a self-recording electrometer.

IT is often necessary in experimental work to maintain a condenser continuously charged at a constant high potential for a considerable length of time, and various methods, none of them altogether satisfactory, have been proposed. An "electrostatic relay" suitable for this purpose is described by M. V. Crémieu in the *Journal de Physique* for September. The form hitherto found most satisfactory depends essentially on the action of an electrostatic balance, which automatically makes or breaks contact in an electric circuit when the potential passes a certain value, thereby connecting or disconnecting the condenser to be charged and an electrostatic machine. The objection to this arrangement arises from the fact that a certain force is necessary either to make or break the contact, and hence the potential of the condenser may fluctuate as much as 22 per cent. The arrangement which M. Crémieu now proposes obviates this difficulty. In one of the contacts there is no adhesion of the terminals and no sparking, because when the contact is made only a very small quantity of electricity flows through it, and when it is broken the terminals are both at the same potential. In the only contact in which adhesion may occur, the terminals are separated by a force which can by adjustment of the apparatus be made as large as desired. It results that the present arrangement is capable of regulating the potential of a condenser of 1 kilometre capacity, charged up to 5000 volts, to within $\frac{1}{2}$ per cent.

MR. J. L. WORTMAN contributes part i. of "Studies of Eocene Mammalia in the Marsh Collection, Peabody Museum" (*Amer. Journ. Science*, ser. 4, vols. xi.–xiv., 1901–1902). In this work the Carnivora are dealt with, the ancestral relations and progressive modifications of the several families are considered, some new genera and species are described, others are freshly defined, and some, like Triacodon, Ziphacodon and Harpalodon, are not regarded as valid genera. The author also discusses the general organisation of the Carnivora and the relationship of its more primitive members to the metatherian marsupials.

IN an exhaustive memoir relative to the Mexican meteorites which was published in the *Mineralogical Magazine* in 1890 (vol. ix. pp. 91–178), Mr. Fletcher called attention to the fact that a large mass of meteoric iron, found in 1867 in an ancient grave at Casas Grandes de Malintzin, Chihuahua, Mexico, and thus of much archæological interest, had not been heard of since 1873, in which year it was said to be about to be transported from Casas Grandes to the United States consulate at El Paso. Mr. Fletcher suggested that the missing mass was possibly identical with one which had been shown in the Mexican mineral exhibit at the United States International Exhibition of 1876 and had been afterwards transferred to the Smithsonian Institution. On investigation, the Washington authorities were convinced that the suggestion was well founded. Mr. Wirt Tassin has now published (*Proceedings* of the United States National Museum, 1902, vol. xxv. p. 69) a description of the mineralogical and chemical characters of the mass. Very sharply defined Widmanstätten figures are developed by the etching of a polished face. The percentage of nickel (and cobalt) varies in different parts from 4·5 to 5·3. The chemical composition of one of the alloys (tænite) corresponds to the formula Fe_6Ni. As is usual in meteoric irons, both troilite (ferrous sulphide) and schreibersite (phosphide of iron and nickel) are present; both minerals were isolated and analysed. Cliftonite, the cubic form of graphitic carbon, was carefully sought for, but only massive graphitic carbon was found.

IN the course of an interesting paper on the crustacean fauna of the Mammoth Cave, Kentucky, and its neighbourhood, forming No. 1285 of the *Proceedings* of the U.S. Museum, Mr. W. P. Hay describes a new form of blind shrimp discovered by himself in one of the streams passing through the cave. This shrimp, which belongs to a family previously unknown from the North American Continent, is referred to a new genus, although it appears to come very close to Xiphocaris, of which one representative is found in the West Indies, a second in New Zealand and a third in the Indo-Malay region. The author is of opinion that the group is a very ancient one and that the cave-forms have survived in districts whence their relatives have migrated south.

THE Report of the Director of the Botanical Survey for the year 1901–1902 has been received, and includes the independent reports of the directors of the three botanical departments. The chief items of interest are the failure of attempts to introduce the plant *Paspalum dilatatum*, which has a considerable reputation in America and Australia as a drought-resisting fodder grass, hybridisation experiments with wheat, and various sugar-cane pests and diseases.

WE have received a subject list of works on domestic economy, foods and beverages, including the culture of cacao, coffee, barley, hops, sugar, tea and the grape, in the library of the Patent Office. The list comprises 1270 works.

THE September issue of the *Agricultural Journal* of the Cape of Good Hope contains a powerful plea for the use of the metric system in South Africa from the pen of Mr. D. E. Hutchins, conservator of forests, western districts of Cape Colony. The number also contains the communications on the "Misuse of Coal" by Prof. John Perry, F.R.S., and Mr. Hutchins which appeared in our columns on March 20 and July 10 respectively.

THE same number of the journal has a note upon some French experiments which have been made respecting the use of salt in the dietary of sheep. Three lots of sheep were fed identically, excepting that one lot had no salt, another lot had half an ounce every day and the remainder three-quarters of an ounce daily. Those receiving half an ounce gained 4·5 pounds each more than those which had no salt and 1·25 pounds more than those which had more than half an ounce. The salted sheep had 1·75 pounds more wool and a better fleece than those which had no salt.

THE current issue of *Engineering* contains a description of the proposed scheme for the transmission of letters, newspapers and parcels by an aërial electric railway which is at present under the consideration of the Italian Minister of Posts and Telegraphs, to which we briefly referred in our columns of September 18.

THE *Times* of Thursday last contains an interesting account, by Mr. J. Y. Buchanan, F.R.S., of the recently completed fourth annual scientific cruise of the Prince of Monaco's steam yacht *Princesse Alice*.

A NEW edition, the sixth, of Lord Avebury's "The Origin of Civilisation and the Primitive Condition of Man" has just been issued by Messrs. Longmans and Co. The author, in his preface, states that he sees no reason to change in any essential respects the opinions originally expressed by him in the first edition of the book thirty years ago. The present issue of the work contains, however, numerous additions here and there.

THE Report of the proceedings and abstracts of the papers read at the International Engineering Congress held in Glasgow in 1901 has been issued in volume form by Mr. W. Asher, of Glasgow.

MESSRS. Philip Harris and Co., Ltd., Birmingham, have sent us a handy little pocket diary giving, besides space for notes, addresses, &c., particulars and dates of the various science examinations which are to take place during the session 1902–3.

THREE catalogues which should be of interest to our readers have reached us, viz., a "Subject List of Works on the Textile Industries and Wearing Apparel, including the Culture and Chemical Technology of Textile Fibres, in the Library of the Patent Office" (issued by the Patent Office); "Catalogue of Geological Books and Papers," on sale by Dulau and Co.; and a "Catalogue of Miscellaneous Books in Literature, Science and Art," offered by Sotheran and Co.

THE additions to the Zoological Society's Gardens during the past week include a White-throated Capuchin (*Cebus hypoleucus*) from Central America, presented by Dr. O. Inchley; an African Civet Cat (*Viverra civetta*) from Sierra Leone, presented by Mr. Reginald Espeut; a Ring-tailed Coati (*Nasua rufa*) from South America, presented by Mr. Alfred Stockman; a Sparrow Hawk (*Accipiter nisus*), British, presented by Mr. M. T. England; a Nilotic Crocodile (*Crocodilus niloticus*) from Africa, presented by Mr. L. C. Ditton; a Common Boa (*Boa constrictor*) from Trinidad, presented by Mr. W. J. Sanger Tucker; a Macaque Monkey (*Macacus cynomolgus*) from India, a Vervet Monkey (*Cercopithecus lalandii*) from South Africa, four Lesser Egyptian Gerbilles (*Gerbillus aegyptius*) from North Africa, a Great Anteater (*Myrmecophaga jubata*) from South America, a Spix's Macaw (*Cyanopsittacus spixi*), ten Cope's Terrapins (*Hydromedusa tectifera*) from Brazil, a Limbless Lizard (*Pygopus lepidopus*) from Australia, deposited.

OUR ASTRONOMICAL COLUMN.

EPHEMERIS FOR THE SEARCH OF THE COMET TEMPEL–SWIFT.—M. F. Bossert contributes to No. 3811 of the *Astronomische Nachrichten* an ephemeris for the search for this comet. An extract is given herewith:—

12*h*. *Paris M.T.*

1902.	α	δ	log *r*.	log Δ.
	h. m. s.	° ′		
Oct. 1 ...	19 3 28 ...	−19 12·2 ...	0·2518 ...	0·1335
,, 6 ...	8 1 ...	18 58·1 ...	0·2421 ...	0·1385
,, 11 ...	13 30 ...	18 42·3 ...	0·2321 ...	0·1432
,, 16 ...	19 51 ...	18 23·8 ...	0·2220 ...	0·1471
,, 21 ...	27 4 ...	18 3·0 ...	0·2117 ...	0·1507
,, 26 ...	35 8 ...	17 38·8 ...	0·2013 ...	0·1535
,, 31 ...	43 54 ...	17 12·0 ...	0·1909 ...	0·1563
Nov. 5 ...	19 53 28 ...	−16 41·3 ...	0·1803 ...	0·1582

GRIGG'S COMET.—The comet which was announced by Mr. John Grigg has been named 1902 *c*, and the following ephemeris has been calculated for it by Herr M. Ebell, taking T = June 20·0 Berlin M.T., from the elements previously published:—

1902.	α	δ	log *r*.	log Δ.	Brightness.
	h. m.	° ′			
May 20 ...	4 13·7	+16 15 ...	9·9407 ...	0·2706 ...	0·38
June 21 ...	7 28·1	+16 27 ...	9·7245 ...	0·0937 ...	2·29
July 23 ...	11 28·5	+ 7 1 ...	9·9567 ...	0·0416 ...	1·00
Aug. 24 ...	14 21·2	− 2 54 ...	0·1565 ...	0·1896 ...	0·20
Sept. 25 ...	15 57·5	− 8 22 ...	0·2855 ...	0·3536 ...	0·05
Oct. 27 ...	17 4·0	−10 39 ...	0·3785 ...	0·4773 ...	0·02

Unit of brightness on July 23. (*Astronomische Nachrichten*, 3816.)

REAPPEARANCE OF EROS.—This planet was visually rediscovered by Dr. Charles J. Ling, using the 20-inch refractor of the Chamberlain Observatory, at 3.15 a.m. on August 2. On August 7, Dr. Ling made an accurate determination of the planet's position and magnitude, and this showed the right ascension to be 15 seconds less than the computed R.A. obtained from Miss M. C. Traylor's ephemeris; the declination only shows a variation of less than 1 minute from the position given by the ephemeris. Dr. Ling estimated the magnitude to be 1m.·0 brighter than one would expect from the observations published in No. 61 of the Harvard College *Circular*, and he has confirmed his estimate on several later occasions. As these estimations were made when the planet was low down in the east and just before dawn, it is not likely that he has overestimated the brightness; photometric measures should therefore be made as soon as possible by those observatories which are equipped for this work.

Eros is now moving eastward nearly as fast as the sun, and will move southwards for several months, so that it will not be very favourably situated for observers in the northern hemisphere. Its position on August 11 at 15h. 25m. 19s. (University Park M.T.) was:—

R.A. 5h. 36m. 35s.·03
Dec. + 31° 56′ 17″·7
(*Popular Astronomy*, No. 97.)

A REMARKABLE METEOR.—A meteor of extraordinary brightness was observed at Earlsfield, Surrey, on the evening of September 29.

Two observers, Mr. Archibald McDougall, of Earlsfield, and Mr. W. E. Rolston, of the Solar Physics Observatory, were, at the moment of the meteor's appearance, looking at that part of the sky in which it was first visible, and both were very much surprised by the brightness and beauty of the appearance. They recorded the following data regarding the phenomenon:—

At 10.16 p.m. the meteor appeared as a faint greenish trailing light, having a phosphorescent appearance, in the S.S.W., and very deliberately travelled in a south-eastern direction. Its altitude at the commencement of its flight was about 25° to 30°, and its bursting point was 10° to 15° above the horizon. The head gradually swelled out into an elongated pear-shaped mass, and the light emitted by it on bursting was of a yellowish red tinge, which afterwards became rose-coloured. The whole phenomenon occupied about 4 to 5 seconds, but the faint greenish trail disappeared, closing up from its starting point, in about 1½ seconds; this trail was about 10° long. The meteor was appreciably brighter than Jupiter; it first appeared about halfway between α and γ Aquarii and then travelled in the direction of Cetus.

Several other bright meteors were seen by Mr. Rolston on the same evening.

METEOR RADIANTS.—In a list of radiants observed at the Observatory of Athens during 1900 and 1901, M. Eginitis records in the *Astronomische Nachrichten* (No. 3815) two new radiants, and three which he says are "probably new."

During 1900 and 1901, the maximum of the Perseid shower was recorded as occurring on August 11, the principal radiant being situated near to η Persei, whilst the principal point from which the Leonids seemed to radiate was recorded as being situated near to Regulus. M. Eginitis remarks on the number of different radiants from which each shower appears to proceed.

INSTRUCTIONS ON THE OBSERVATION OF THE SUN.—Under this heading, "La Commission Solaire" publish, in the September *Bulletin de la Société Astronomique de France*, an introduction to the "Instructions for Solar Observations," of which they propose to send a copy to all members of the Société Astronomique who intend taking part in the solar observations the preparation and collection of which form the *raison d'être* of the commission recently appointed.

The introduction first points out the vital importance of an earnest and continuous study of solar physics, and then proceeds to state under twenty-one subheadings the details of these studies, the necessity for each, and the necessity for the continuous gathering together and the reduction of the whole work. M. Deslandres, who is the writer of the introduction, especially insists upon the absolute necessity of the co-operation of many observers in this work.

CORRECTIONS TO THE RIGHT ASCENSIONS OF THE PRINCIPAL STARS OF THE BERLINER JAHRBUCH.—Nos. 3813 and 3814 of the *Astronomische Nachrichten* are devoted to an account, by Senor Campos Rodrigues, of the methods pursued, and the results obtained thereby, in determining the corrections obtained at Lisbon to the right ascensions of 384 of the principal stars given in the Berliner Jahrbuch.

Senor Rodrigues describes the meridian circle and the instrumental aids which he has used in this work, and then sets out in tabular form the results he has obtained since he commenced the work in 1887.

OBSERVATIONS OF PERRINE'S COMET, 1902 *b*.

THIS comet was discovered by Perrine, using the 12-inch refractor of the Lick Observatory, on the morning of September 1, and the discovery was published by the following telegram, of that date, from Prof. Pickering to the Kiel Centralstelle:—"A comet was discovered by Perrine August 31, 16h. 8m. 16s. Lick, α app. 3h. 17m. 49s.·4, δ app. + 34° 38′ 47″, slightly elongated, mean diameter 4′, magnitude 9, tolerably well-defined nucleus, tail." This object was also discovered, independently of Perrine, by M. Borelly, of the Marseilles Observatory, on September 2, 9h. 50m.·4, and the observation was forwarded to Kiel in a telegram from M. Lœwy, which stated that the comet's position, at the time of its discovery, was α = 49° 9′, N.P.D. = 54° 48′, its daily movement − 15′ and − 26′ respectively, and that it possessed a nucleus and a tail.

Further observations were made by Perrine, and the following parabolic elements, ephemeris and details have been obtained therefrom:—

Elements of Comet 1902 *b*.

T = 1902 November 23·472 G.M.T.

ω	=	153°	25′ 46″
Ω	=	49	56 10
i	=	156	54 22

log q = 9·60424.

Ephemeris for 12*h*. *G.M.T.* (*Perrine*).

1902.	True α.	True δ.	log. Δ.	Brightness.
	h. m. s.	° ′		
Oct. 5·5	... 20 55 49	... +50 28	... 9·566	... 27·1
22·5	... 17 43 15	... + 3 53	... 9·812	... 16·1
Nov. 8·5	... 16 57 23	... −11 0	... 0·040	... 13·9
23·5	... 16 13 8	... −18 13	... 0·139	... 17·2

The brightness given for each day is the value obtained on comparison with the brightness at the time of discovery, calling the latter unity. Perrine adds that, when discovered, the comet had a magnitude of 9, with a well-defined, but not stellar, nucleus of magnitude 10·5 or 11·0; the diameter of the coma was 4′ to 5′, whilst the short, brushy tail could be traced to the south-west for a distance of 8′ to 10′. As a correction to the telegram dispatched to the various observatories on September 2, he mentions that the calculated time of perihelion passage is November 23·47, and not November 24·47 as was stated in that telegram.

The above elements and ephemeris agree fairly closely with those calculated by Herr Elis Strömgren, of Kiel, from observations made at Lick (September 1·05), Urania (September 2·58) and Copenhagen (September 4·61), and he has calculated an ephemeris for every day from September 6 to October 16. Part of this ephemeris is given below, and from it has been prepared the accompanying chart, which shows the comet's approximate daily positions with regard to the neighbouring stars.

Ephemeris for 12*h*. *M.T.* (*Berlin*). (*Strömgren*.)

1902.	α app.	δ app	Brightness.[1]
	h. m. s.	° ′	
Oct. 2 ...	22 28 46 ...	+56 15·9	
3 ...	21 55 30 ...	54 56·5	
4 ...	21 23 23 ...	52 58·3	... 26·0
5 ...	20 53 36 ...	50 25·1	
6 ...	26 46 ...	47 22·8	
7 ...	20 3 5 ...	43 59·4	
8 ...	19 42 28 ...	40 23·5	... 29·4
9 ...	24 41 ...	36 42·9	
10 ...	19 9 20 ...	33 4·5	
11 ...	18 56 4 ...	29 32·9	
12 ...	44 33 ...	26 11·5	... 26·6
13 ...	34 31 ...	23 2·3	
14 ...	25 42 ...	20 6·2	
15 ...	17 54 ...	17 23·3	
16 ...	18 10 58 ...	14 53·3	... 21·8

[1] Brightness at time of discovery = 1.

MM. Borelly and Fabry, of the Marseilles Observatory, have observed the comet on several occasions since its discovery by the former, and they report that it is fairly brilliant, has an elongated nucleus and a tail 10′ to 12′ long. On September 2, at 14h. (Marseilles M.T.), the nucleus appeared to become double and thus form two small, globular nuclei; on September 3 it had much the same aspect, but on September 5 the nucleus was more diffuse and the light of the comet appeared to sensibly diminish.

It may be seen from the above ephemerides that the comet will attain its maximum brightness about October 8 and that it

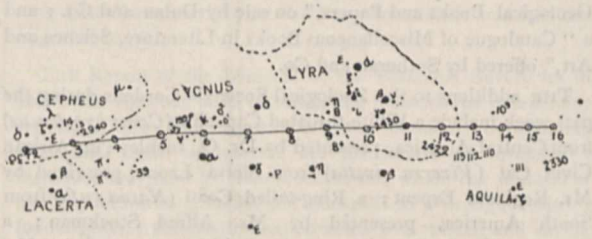

FIG. 1.

passed its maximum declination on September 30, so that by November 30 it will be comparatively faint, and so far south that it will be a difficult object for observers in the northern hemisphere, except on very fine nights and in clear atmospheres; at present (September 27) it is an easy object to find with an ordinary opera-glass, and, given good meteorological conditions, it should soon become obviously visible to the naked eye.

FORTHCOMING BOOKS OF SCIENCE.

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THE BRITISH ASSOCIATION AT BELFAST.

SECTION H.

ANTHROPOLOGY.

OPENING ADDRESS BY A. C. HADDON, M.A., Sc.D., F.R.S., M.R.I.A., PRESIDENT OF THE SECTION.

So much has been written of late on totemism that I feel some diffidence in burdening still further the literature of the subject. But I may plead a slight claim on your attention, as I happen to be an unworthy member of the Crocodile kin of the Western tribe of Torres Straits, and I have been recognised as such in another island than the one where I changed names with Maino, the chief of Tutu, and thereby became a member of his kin.

I do not intend to discuss the many theories about totemism, as this would occupy too much time; nor can I profess to be able to throw much light upon the problems connected with it; but I chiefly desire to place before you the main issues in as clear a manner as may be, and I venture to offer for your consideration one way in and some ways out of totemism.

A few years ago M. Marillier wrote ("Rev. de l'Hist. des Religions," xxxvi. 1897, pp. 368, 369), that "totemism is one of the rare forms of culture: it is incapable of evolution and transformation, and is intelligible only in its relations with certain types of social organisation. When these disappear it also disappears. Totemism in its complete development is antagonistic alike to transformation or progress." In due course I shall describe how one people at least is emerging from totemism. At the outset I wish it to be distinctly understood that I do not regard this as the only way out; doubtless there have been several transformations, but a record of what appears to be taking place appeals more to most students than a guess as to what may have happened.

What is most needed at the present time is fresh investigation in the field. Those who are familiar with the literature of the subject are only too well aware of the imperfection of the available records. There are several reasons which account for this. Some of the customs and beliefs associated with totemism have a sacred significance, and the average savage is too reverent to speak lightly of what touches him so deeply. Natives cannot explain their mysteries any more than the adherents of more civilised religions can fully explain theirs. Further, they particularly dislike the unsympathetic attitude of most inquirers, and nothing shuts up a native more effectually than the fear of ridicule.

Language is another difficulty. Even supposing the white man has acquired the language, the vocabulary of the native is not sufficiently full or precise to explain those distinctions which appeal to us, but which are immaterial to him.

Granting the willingness of the native to communicate his ideas, and that the hindrance of language has been overcome, there remains the difficulty of the native understanding what it is the white man wishes to learn. If there is a practically insuperable difficulty in the investigator putting himself into the mental attitude of the savage, there is also the reciprocal source of error.

> "Oh, East is East, and West is West,
> And never the twain shall meet."

If Kipling is right for the civilised Oriental, how about those of lower stages of culture and more primitive modes of thought?

We must not overlook the fact that the majority of white men who mix with primitive folk are either untrained observers or their training is such that it renders them yet more unsympathetic—one might say antagonistic—to the native point of view. The ignorance and prejudice of the white man are great hindrances to the understanding of native thought.

When students at home sift, tabulate and compare the available records they get a wider view of the problems concerned than the investigator in the field is apt to attain. Generalisations and suggestions crystallise out which may or may not be true, but which require further evidence to test them. So the student asks for fresh observations and sends the investigator back to his field.

The term "totemic" has been used to cover so many customs and beliefs that it is necessary to define the connotation which is here employed.

It appears from Major J. W. Powell's recent account of totemism (*Man*, 1902, No. 75) that the Algonkin use of the term "totem" is so wide as to include the representation of the animal that is honoured (but he does not state that the animal itself is called a totem), the clay with which the person was painted, the name of the clan,[1] and that of the gens,[2] the tribal name, the names of shamanistic societies, the new name assumed at puberty, as well as the name of the object from which the individual named. He distinctly states, "We use the term 'totemism' to signify the system and doctrine of naming." I must confess to feeling a little bewildered by this terminology, and I venture to think it will not prove of much service in advancing our knowledge. It looks as if there had been some misunderstanding, or that the Algonkins employed the word "totem" to cover several different ideas because they had not definite terms with which to express them. Major Powell's definitions practically exclude those cults which are practised in various parts of the world, and which by the common consent of other writers are described as totemic.

Prof. E. B. Tylor has given (*Man*, 1902, No. 1; *cf. Journ.* Anthrop. Inst., xxviii. 1898, p. 138) the following clear exposition of his interpretation of the American evidence: "It is a pity that the word 'totem' came over to Europe from the Ojibwas through an English interpreter who was so ignorant as to confuse it with the Indian hunter's patron genius, his *manitu*, or 'medicine.' The one is no more like the other than a coat of arms is like a saint's picture. Those who knew the Algonkin tribes better made it clear that totems were the animal signs, or, as it were, crests, distinguishing exogamous clans; that is, clans bound to marry out of, not into, their own clan. But the original sin of the mistake of Long the interpreter has held on ever since, bringing the intelligible institution of the totem clan into such confusion that it has become possible to write about 'sex totems' and 'individual totems,' each of which terms is a self-contradiction. . . . Totems are the signs of intermarrying clans."

A reviewer in "L'Année Sociologique," ii. 1899, says (p. 202): "One must avoid giving to a genus the name of a species. It will be said these are merely verbal quibbles; but does not the progress of a science consist in the improvement of its nomenclature and in the classification of its concepts?"

Totemism, as Dr. Frazer and as I understand it, in its fully developed condition implies the division of a people into several totem kins (or, as they are usually termed, totem clans), each of which has one, or sometimes more than one, totem. The totem is usually a species of animal, sometimes a species of plant, occasionally a natural object or phenomenon, very rarely a manufactured object. Totemism also involves the rule of exogamy, forbidding marriage within the kin, and necessitating intermarriage between the kins. It is essentially connected with the matriarchal stage of culture (mother-right), though it passes over into the patriarchal stage (father-right). The totems are regarded as kinsfolk and protectors or benefactors of the kinsmen, who respect them and abstain from killing and eating them. There is thus a recognition of mutual rights and obligations between the members of the kin and their totem. The totem is the crest, or symbol of the kin.

Sometimes all the kins are classified into two or more groups; for example, in Mabuiag, in Torres Straits, there is a dual grouping of the kins, the totems of which are respectively land and water animals; and in speaking of the latter group my informant volunteered the remark, "They all belong to the water; they are all friends." On the mainland of New Guinea also I found that one group of the totems "stop ashore," while the other "stop in water." When no member of a group of kins in a community can marry another member of that same

[1] A group that reckons descent only through the mother.
[2] A group that reckons descent only through the father.

group, that group is termed a phratry. An Australian tribe is generally divided into two exogamous phratries.

North America is the home of the term "totem," and though typical totemism does occur there, it is often modified by other customs. In Australia we find true totemism rampant, and it occurs in Africa, where also it is subject to much modification. Quite recently the Rev. J. Roscoe has published an important paper (*Journ.* Anthrop. Inst., xxxii. 1902, p. 25) on the Baganda, in which he describes a perfectly typical case of totemism. Among the Baganda there are a number of kins each of which has a totem, *muziro*. The kin, *kika*, is called after its totem; no member of a kin may kill or eat his totem, though one of another kin may do so with impunity. No one mentions his totem. Old people affirm their fathers found some things injurious to them either as food or to their personal safety, and made their children promise not to kill or eat that particular thing. No man may marry into his mother's kin, because all the members of it are looked upon as sisters of his mother; nor may he marry into his father's kin except in the case of two very large kins. In Uganda, royalty follows the totem of the mother, whilst the common people follow the paternal totem. Each kin has its own special part of the country where the dead are always buried. For sympathy or assistance the member of a kin always turns to his particular kin. From what Mr. Roscoe says about the married women of the Green Locust kin, it is evident that the magical aspect of totemism is present as it is in Australia and Torres Straits. The Baganda are thus a true totemic people who are in an interesting transitional condition between matriarchy and patriarchy. Totemic practices also occur in various parts of Asia.

To put the matter briefly, totemism consists of the following five elements:—

(1) Social organisation with totem kinsmen and totem symbols.

(2) Reciprocal responsibilities between the kin and the totem.

(3) Magical increase[1] or repression of the totem by the kinsmen.

(4) Social duties of the kinsmen.

(5) Myths of explanation.

Totemism is only one of several animal cults, and it is now necessary to consider certain cults that have been termed totemic before I proceed with the main object of this Address.

Manitu (*Guardian Spirit*).

Very widely spread in North America was the belief in guardian spirits which appeared to young men in visions after prayer and fasting. It then became the duty of the youth to seek until he should find the animal he had seen in his trance; when found he must slay and preserve some part of it. In cases when the vision had been of no concrete form, a symbol was taken to represent it: this memento was ever after to be the sign of his vision, the most sacred thing he could ever possess, for by it his natural powers were so to be reinforced as to give him success as a hunter, victory as a warrior, and even power to see into the future.

The guardian spirit was obtained in various ways by different American tribes, but the dream apparition was the most widely spread. Dr. Frazer ("Totemism," 1887, pp. 2, 53) calls it "individual totem"; Miss Fletcher speaks of the object dreamed of (the *wahube* of the Omaha) as the "personal totem" or simply as the "totem"; it is termed by the Algonkin *manitu*, by the Huron *okki*, by the Salish Indians *sulia*, and *nagual* in Mexico. Perhaps it would be best to adopt either *wahube* or *manitu* to express the guardian spirit.

Miss Alice C. Fletcher finds that among the Omaha ("The Import of the Totem," Amer. Assoc. Adv. Sci., Detroit Meeting, August, 1897) those who have received similar visions, that is, those who have the same *wahube*, formed brotherhoods which gradually developed a classified membership with initiatory rites and other rituals. These religious societies acquired great power; still later, according to this observer, an artificial social structure, the "gens," was organised on the lines of the earlier religious societies. Each "gens" had its particular name, which referred directly or symbolically to its totem, and its members practised exogamy and traced their descent only through the father. "As totems could be obtained in but one way—through the rite of vision—the totem of a 'gens' must have come into existence in that manner, and must have represented the manifestation of an ancestor's vision, that of a man whose ability and opportunity served to make him the founder of a family." Mr. C. Hill-Tout (*Trans.* Roy. Soc. Canada, 2nd ser., vii., sect. 2, 1901, p. 6), in discussing the origin of the totemism of the aborigines of British Columbia, states: "There is little room for doubt that our clan totems are a development of the personal or individual totem or tutelar spirit, as this is in turn a development of an earlier fetishism."

Dr. F. Boas points out ("Report U.S. Nat. Mus.," 1895 (1897), pp. 322, 323, 334) that the tribes of the northern portion of the North Pacific group of peoples, such as the Tlingit, Haida and Tsimshian, have a maternal organisation with animal totems; the clans bear the names of their respective totems and are exogamous. The central tribes, particularly the Kwakiutl, show a peculiar transitional stage. The southern tribes have a purely paternal organisation, and their groups are simple village communities which are often exogamic.

Dr. Boas distinctly asserts (*l.c.*, p. 323) that "the natives do not consider themselves descendants of the totems; all endeavours to obtain information regarding the supposed origin of the relation between man and animal invariably led to the telling of a myth in which it is stated how a certain ancestor of the clan in question obtained his totem. . . . It is evident that legends of this character correspond almost exactly to the tales of the acquisition of manitows among the eastern Indians, and they are evidence that the totem of this group of tribes is in the main the hereditary manitow of a family.[1] This analogy becomes still clearer when we consider that each man among these tribes acquires a guardian spirit, but that he can acquire only such as belong to his clan. Thus a person may have the general crest of his clan, and besides use as his personal crest such guardian spirits as he has acquired. This accounts partly for the great multiplicity of combinations of crests on the carvings of these people."

Throughout a considerable portion of North America there appears to be a mixture of variously developed cults of the totem and of the *manitu*. It is not perhaps possible at present to dogmatise as to the relative chronology of these two cults. Personally I am in favour of the superior antiquity of the totem cult, as the conception of an individual spirit-helper appears to me to be of a higher grade than the ideas generally expressed by purely totemic peoples, or what may be gathered by implication from a study of their ceremonies.

The social organisation appears to be very weak in some Californian tribes; our knowledge of the Seri in this respect is very meagre, but Dr. Dixon definitely denies (*Bull.* Amer. Mus. Nat. Hist., xvii., pt. 2, 1902, p. 35) the existence of totemic grouping among the Maidu.

Accepting then for the present the priority of the totem cult, we find a substratum of totemism underlying many of the social organisations in North America. Religious societies are a noticeable feature of the social life of North-west America; those societies have the guardian spirit (*manitu*) as their central idea, but it appears as if the organisation is rooted in a clan (matriarchal totemic kin) system which has been smothered and virtually destroyed by the parasitic growth. The problems to be solved in North-west America are very complicated, and we must await with patience further researches. It is perfectly evident from the researches of Boas, Nelson, Hill-Tout and others that comparatively recent great changes have taken place. Dr. Boas indeed states that "the present system of tribes and clans (of the Kwakiutl) is of recent growth and has undergone considerable changes" (*l.c.*, p. 333). An interesting illustration of this is found in the alteration in the organisation of the (Kwakiutl) tribe during the season of the winter ceremonial. "During this period the place of the clans is taken by a number of societies, namely, the groups of all those individuals upon whom the same or almost the same power or secret has been bestowed by one of the spirits" (*l.c.*, p. 418). The characteristic North

[1] The first intimation of this aspect of totemism is entirely due to the researches of Messrs. Spencer and Gillen ("The Native Tribes of Central Australia," 1899). Dr. J. G. Frazer, appreciating the value of these observations, extended the conception to totemism generally, *Journ.* Anthrop. Inst., xxviii. 1899, p. 285, read December 14, 1898; the *Fortnightly Review*, April, 1899, pp. 664, 665; *cf.* also "Israel and Totemism," by S. A. Cook, *Jewish Quart. Review*, April, 1902, pp. 25, 26 of reprint.

[1] But Mr. E. S. Hartland points out ("Folk-lore," xi 1900, p. 61) that we have clear evidence from the legends of the descent at all events of some of the clans from non-human ancestors; and Mr. Hill-Tout says: "Among the Salish tribes it is uniformly believed that in the early days, before the time of the tribal heroes or great transformers, the beings who then inhabited the world partook of the character of both men and animals, assuming the form of either apparently at will."

American idea of the acquisition of the *manitu* was evidently also fundamental among the Kwakiutl, as all their tales refer to it and the whole winter ceremonial is based on it.

I agree in the main with Mr. Hartland ("Folk-lore," xi. p. 68) in thinking that, "whether or no totemism was anciently a part of the tribal organisation, the *manitu* conception is of modern date. It is part of the individualism which is tending, not among these tribes only, to obscure the older communistic traditions."

Nyarong.

Allied to the *manitu* of North America is the *nyarong*, or spirit-helper, of the Iban (Sea Dayaks) of Sarawak. The Iban believe that the spirit of some ancestor or dead relative may come to them in a dream, and this *nyarong* becomes the special protector of the individual. An Iban youth will often retire to some lonely spot or mountain-top and live for days on a very restricted diet in his anxiety to obtain a vision. This custom is called *mampok*. On the following day the dreamer searches for the outward and visible form of the *nyarong*, which may be anything from a curious natural object to some one animal. In such cases the *nyarong* hardly differs from a fetish. In other cases, as the man is unable to distinguish the particular animal which he believes to be animated by his *nyarong*, he extends his regard and gratitude to the whole species. In some instances all the members of a man's family and all his immediate descendants, and if he be a chief all the members of the community over which he rules, may came to share the benefits conferred by the *nyarong* and pay respect to the species of animal in one individual of which it is supposed to reside. "In such cases," Drs. Hose and McDougall remark (*Journ.* Anthrop. Inst., xxxi. 1901, p. 210), "the species approaches very closely the clan totem in some of its varieties." Here we have a parallel to the North American custom, but the later stages are not carried as far.

Personally I concur in the opinion expressed by Drs. Hose and McDougall that there is no proof that the peculiar regard paid in Sarawak to animals, the sacrifice of animals to gods or spirits, the ceremonial use of the blood of these sacrificed animals are survivals of a fully developed system of totem worship now fallen into decay. It is very significant that the magical and social aspects of totemism are entirely lacking.

Those who have read Miss Alice Fletcher's sympathetic account of "The Import of the Totem" (Amer. Assoc. Adv. Sci., Section Anthropology, Detroit Meeting, August, 1897) can scarcely fail to recognise that the moral support due to a belief in the guidance and protection of a *wahube* ("personal totem") is of great importance to the individual, and would nerve him in difficulty and danger, and thus proving a very present help in time of need it would surely justify its existence in a most practical manner and consequently be of real utility in the struggle for existence—a struggle which in man has a psychical as well as a material aspect.

The advantages of totemism are many, but most of them are social and benefit the special groups or the community at large. The hold that the *manitu* has on the individual consists in its personal relation; the man feels that he himself is helped, and I suspect this is the main reason why it supplants totemism. I believe Mr. Lang some years ago suggested the term *manituism* for this cult. If this name be not accepted I venture to propose the revival of the word "daimon" (δαίμων) to include the *manitu*, *nyarong* and similar spirit-helpers, and "daimonism" as the name of the cult.

Theriomorphic Ancestor Worship.

Dr. Frazer calls attention (*Man*, 1901, No. 3) to a publication by Dr. G. McCall Theal ("Records of South-eastern Africa," vii. 1901) in which he describes the tribal veneration for certain animals, *siboko*. The Bantu believed that the spirits of the dead visited their friends and descendants in the form of animals. Each tribe regarded some particular animal as the one selected by the ghost of its kindred, and therefore looked upon it as sacred. Dr. Frazer says: "Thus the totemism of the Bantu tribes of South Africa resolves itself into a particular species of the worship of the dead; the totem animals are revered as incarnations of the souls of dead ancestors. This entirely agrees with the general theory of totemism suggested by the late S. G. A. Wilken and recently advocated by Prof. E. B. Tylor" (*Journ.* Anthrop. Inst., xxviii. p. 146). But is this totemism? The *siboko* are the residences of the ancestral spirits of the tribe, not of a clan; there is no mention of *siboko* exogamy. Is this anything more than theriomorphic ancestor worship? There can, however, be little doubt that true totemism did occur, and probably universally so, among the Bantu people; but some of the tribes appear to be in a transitional state, and others have doubtless passed beyond typical totemism. The decay of the Bantu totemism in South Africa appears to have been mainly due to a patriarchal organisation combined with a pastoral life.[1]

In describing Dr. Wilken's theory that the doctrine of the transmigration of souls affords the link which connects totemism with ancestor worship, Prof. Tylor concludes as follows: "By thus finding in the world-wide doctrine of soul-transference an actual cause producing the two collateral lines of man and beast which constitute the necessary framework of totemism, we seem to reach at least something analogous to its real cause." I have already expressed my belief that the animal cults of the Malay Archipelago, so far as they are known at present, cannot be logically described as totemism, and the majority of the peoples of this area have so long passed out of savagery that we are hardly likely to find here an unequivocal clue to the actual origin of totemism.

The reverence paid to particular animals or plants by certain groups of people in Fiji may, as Mr. Lorimer Fison says, ("Ann. Rep. Brit. New Guinea," 1897-98, p. 136) "look like reminiscences" of totemism, but he has "no direct evidence." It surely belongs to the same category as the Samoan custom of which Dr. George Brown writes (*ibid.*, p. 137), "In Samoa every principal family had some animal which they did not eat, and I have always regarded this as meaning, not that they thought the animal divine, or an object of worship, but that it was the 'shrine' in which their ancestral god had dwelt, or which was associated with some fact in their past history which had led them to adopt it as their totem." An opinion which Prof. Tylor has independently expressed (*Journ.* Anthrop. Inst., xxviii. p. 142), but he naturally dissents from the incarnate god being termed a "totem."

I agree with Dr. Codrington ("The Melanesians," 1891, p. 32) in doubting whether the evidence warrants a belief in totemism as an existing institution in the Southern Solomon Islands. I suspect that totemism has been destroyed over a considerable portion of Melanesia by the growth of secret societies as well as by theriomorphic ancestor worship. Herr R. Parkinson (*Abh. Ber. k. Zool. Anth. Eth. Mus. Dresden*, vii. 1899, Nr. 6), however, proves true totemism in the Northern Solomon Islands as the Rev. B. Danks had previously done (*Journ.* Anthrop. Inst., xviii. 1889, p. 281) for New Britain, Duke of York Island and New Ireland.

The more one looks into the evidence the more difficult is it to find cases of typical totemism; almost everywhere considerable modification has taken place, often so much so that the communities cannot logically be called totemistic. The magical increase of the totem by the clansmen does not appear to be common, but that may be due to its having been overlooked; on the other hand, magic may be performed against the totems to prevent them from injuring the crops, as in the case of the "Reptile people" of the Omaha (J. O. Dorsey, "Ann. Rep. Bureau Ethnol.," 1881-82 (1884), p. 248).

Animal Brethren.

Throughout South-eastern Australia and probably elsewhere in that continent, there is a peculiar association of a species of animal, unusually a bird, with each sex. To take two examples given by Mr. A. W. Howitt (*Journ.* Anthrop. Inst., xv. 1886, p. 416), "the bird totems of the Kurnai are the Emu, Wren and the Superb Warbler, which are respectively the 'man's brother' and 'woman's sister.' . . . When we turn to the Kulin, we find both the Kurnai totems in just the same position. In addition there are also a second male and female totem, namely, the Bat and the small Night Jar." Mr. Howitt is careful to point out, "They are not true totems in the sense that these represent subdivisions of the primary classes; yet they are true totems in so far that they are regarded as being the 'brothers' and 'sisters' of the human beings who bear their names." Mr. A. L. P. Cameron (*ibid.*, xiv. 1885, p. 350) also states that these are "something different from ordinary totems." Later Mr. Howitt (*ibid.*, xviii. 1888, pp. 57, 59) says: "Among the Wotjobaluk tribe which have a true totemic

[1] E. Durkheim, "L'Année Sociologique," v. 1902, p. 330; *cf.* also F. B. Jevons, "Introduction to the History of Religion," 1902, pp. 155, 158.

system these were real totems although of a peculiar kind. They were called *yaur*, or 'flesh,' or *ngirabül*, or *mir*, just as were the totems proper. The only difference was that the Bat was the brother of all the men, while any one totem was the brother only of the men who bore it as their totem. . . . It is evident that the institution of the 'man's brother' and the 'woman's sister' as totems is very widespread throughout Australia. I have traced it over an extent of about a thousand miles and in tribes having marked differences in language and in social organisation. It seems to be very persistent and enduring, for it remained among the Kurnai in full force after the ordinary social organisation in class divisions and totems had become extinct." Mr. Howitt speaks of these as "abnormal totems," and Dr. Frazer ("Totemism," p. 51; "The Golden Bough," iii. p. 416) calls them "sex totems." As it appears most desirable to distinguish between this cult, which is confined to Australia, and true totemism, I propose, in default of a distinctive native term, to call these reverenced animals "animal brethren." Although the natives do not appear to distinguish nominally between these animal brethren and ordinary totems, it does not follow they are to be considered as the same. I am calling attention to an analogous confusion of terms in the totemism of Torres Straits.

I must now pass on to a further consideration of true totemism as understood by Tylor, Frazer, Lang, Hartland, Jevons, Durkheim and others, as it is impossible within the limits of an Address to give an account of all the varieties of pseudo-totemism.

A Suggestion concerning the Origin of Totemism.

I take this opportunity to hazard a suggestion for a possible origin of one aspect of totemism. Primitive human groups, judging from analogy, could never have been large, and the individuals comprising each group must have been closely related. In favourable areas each group would have a tendency to occupy a restricted range owing to the disagreeable results which arose from encroaching on the territory over which another group wandered. Thus it would inevitably come about that a certain animal or plant, or group of animals or plants, would be more abundant in the territory of one group than in that of another. To take a clear example, the shore-folk and the river-folk would live mainly on different food from each other and both would have other specialities than fell to the lot of the jungle-folk. The groups that lived on the seashore would doubtless have some natural vegetable products to supplement their animal diet, but the supply would probably be limited alike in quantity and variety. Even they would scarcely have unlimited range of a shore line, and there would be one group of shore-folk that had a speciality in crabs, another would have shell-beds, while a third would own sandy shores which were frequented by turtle. A similar natural grouping would occur among the jungle-folk; sago flourishes in swampy land, certain animals frequent grassy plains, others inhabit the dense scrub, bamboos grow in one locality, various kinds of fruit trees thrive best in different soils; the coastal plains, the foot hills, the mountains, each has its characteristic flora and fauna. There is thus no difficulty in accounting for numerous small human groups each of which would be largely dependent upon a distinctive food supply the superfluity of which could be bartered [1] for the superfluities of other groups. These specialities were not confined to food alone; for example, the shore-folk would exchange the shells they collected for the feathers obtained from the jungle-folk.

It may be objected that in the great prairies and steppes of America, Eurasia and Australia the natural products are very uniform; but these areas are not thickly populated, and in most cases they probably were only inhabited when the pressure of population in the localities with more varied features forced migration into the open. Certainly these were never the primitive homes of man.

In a recent paper read before the Folklore Society, Mr. Andrew Lang put forward the hypothesis that while each primitive human group called itself "the men," they named the surrounding groups from the names of animals or plants, and hence arose totemism. The idea that there was an intimate connection between the group and the object from which they were nicknamed would soon be developed, and myths of origin would spring up to account for the name. Mr. Lang's theory, still unpublished, regards totem names as given from without for a variety of reasons, amongst which, I understand, he includes my own suggestion. His conjecture is based on the similar names, or sobriquets, of villages in the folklore, or *blason populaire*, of France and England, which, again, is almost identical with the extant names of Red Indian totem kindred now counting descent in the male line. Similar phenomena occur in Melanesia with female kin. Mr. Lang is rather indifferent to the causes of the name-giving so long as the name-giving comes from without and applies to groups, not to individuals.

To return to my suggestion. Among the shore-folk the group that lived mainly on crabs and occasionally traded in crabs might well be spoken of as the "crab-men" by all the groups with whom they came in direct or indirect contact. The same would hold good for the group that dealt in clams or in turtle, and reciprocally there might be sago-men, bamboo-men, and so forth. It is obvious that men who persistently collected or hunted a particular group of animals would understand the habits of those animals better than other people, and a personal regard for these animals would naturally arise. Thus from the very beginning there would be a distinct relationship between a group of individuals and a group of animals or plants, a relationship that primitively was based, not on even the most elementary of psychic concepts, but on the most deeply seated and urgent of human claims, hunger.

There is scarcely any need to point out that the association of human groups with fearsome animals would arise by analogy very early. Hence tiger-men and crocodile-men would restrain the ravages of those beasts (Dr. Frazer, *Fortnightly Review*, 1899, p. 835, describes this as the negative or remedial side of totemic magic); but I take it this was not as primitive as the nutritive alliances. The relation between groups of men and the elements has a purely economic basis; for example, rain is rarely required for itself, but as a means for the increase of vegetable food; similarly the fisherman wants a wind to enable him to get to and from his fishing grounds.

The next phase is reached when man arrived at elementary metaphysical conceptions and endeavoured by sympathetic or symbolic magic to increase his food supply. Naturally the food or product that each group would endeavour to multiply would be the speciality or specialities of that group, and for this practice we now have demonstrative evidence. Though this may be an early phase of totemism, I do not consider it the earliest; it can scarcely be the origin of totemism, but it doubtless helped to establish and organise the system.

The essential difference between the view advocated by Dr. Frazer (*loc. cit.*, 1899, p. 835) and that here suggested is that according to him totemism "is primarily an organised and cooperative system of magic designed to secure for the members of the community, on the one hand, a plentiful supply of all the commodities of which they stand in need, and, on the other hand, immunity from all the perils and dangers to which man is exposed in his struggle with nature. Each totem group, on this theory, was charged with the superintendence and control of some department of nature from which it took its name, and with which it sought, as far as possible, to identify itself." Whereas I suggest that the association between a group of men and a species of animals or plants was the natural result of local causes, and that departments of nature were not "assigned to a particular group" of men. I think it is scarcely probable "that in very ancient times communities of men should have organised themselves more or less deliberately for the purpose of attaining objects so natural by means that seemed to them so simple and easy." I suspect that if there was any deliberate organisation it was in order to regulate already existing practices.

To us it might appear that these magical practices could be undertaken by anyone, but this does not seem to have been an early conception. As far as we can penetrate the mind of existing backward man, there is a definite acknowledgment of the limit of his own powers. The members of one group can perform a certain number of actions; there are others that they cannot undertake. One group of men, for example, may ensure the abundance of a certain kind of animal, but another will have power over the rain. An interesting example of this limitation is afforded at Port Moresby, in British New Guinea, where the Motu immigrants have to buy fine weather for their trading voyages from the sorcerers of the indigenous agricultural Koitapu (J. Chalmers, "Pioneering in New Guinea," 1887, p. 14).

[1] It may be objected that the idea of barter is by no means primitive; but as I believe that sociability was a fundamental characteristic of primitive man I can see no reason why it should not have occurred quite early in a rudimentary sort of way.

The remarkable researches of Messrs. Spencer and Gillen in Central Australia prove that it is the function of the kinsmen of a particular totem to perform what are known as *intichiuma* ceremonies, the object of which is to cause the abundance of the species of animal or plant which is the totem of that kin. The descriptions of these ceremonies are well known to students.[1] I have adduced further evidence of a like nature,[2] and from what Mr. Roscoe has found in Uganda we may expect other examples from Africa.

It may be that in some, possibly in all, of the instances of sympathetic and symbolic magic there is a belief that wind or sun, animal or plant, or whatever the objects may be, are animated by spirits akin to those of humankind; but even so, as Dr. Frazer[3] points out, the action of the magician is a direct one; it does not imply the assistance of other powers who can control the body or spirit of those objects. The data from Australia and Torres Straits point to the conclusion that there is a magical aspect of totemism, which is of great economic importance, and there is no evidence that the officiators at these ceremonies acknowledge the assistance of spiritual powers resident either within the objects themselves or in the form of independent, more or less supreme beings. The existing data do not deny their existence, they simply ignore them in the ceremonies, and so far they are practically non-existent.

According to the suggestion I have ventured to make, the primitive totemic groups ate their associated animals or plants; indeed, these were their chief articles of diet. Messrs. Spencer and Gillen point out[4] that while amongst most Australian tribes a man may not eat his totem, amongst the Arunta and other tribes in the centre of the continent there is no restriction according to which a man is altogether forbidden to eat his totem. On the other hand, though he may, only under ordinary circumstances, eat very sparingly of it, there are certain special occasions on which he is obliged by custom to eat a small portion of it, or otherwise the supply would fail. The Arunta are a peculiar people, while they may be primitive in some respects; in others they are not so, as also has been pointed out by Durkheim ("L'Année Sociologique," v. 1902). According to the strict definition of the term, they are not even a totemic people. Judging from the evidence of the legends of the Alcheringa time and the traces of group marriage and mother right, Mr. Hartland ("Folk-lore," xi. 1900, pp. 73–75) is of opinion that the present disregard by the Arunta of the totem in marriage is a stage in the sloughing of totemism altogether, whereas the *engwura*, or final initiation ceremonies, indicate that "the organisation is undergoing a slow transformation into something more like the so-called secret societies of the British Columbian tribes."

The eating of what are evidently the totem animals by the Arunta may possibly be a persistence from an earlier phase, but, without doubt, the totem taboo is characteristic of totemism in full sway.[5] We have evidence to show that under certain conditions the totem taboo may break down, but this is a later transformation, and indicates a breaking up of the rigid observance of totemism.

Mr. Lang ("Magic and Religion," 1901, pp. 264, 265) has made a simple suggestion to account for the origin of the totem taboo. He says: "These men therefore would work the magic for propagating their kindred in the animal and vegetable world. But the existence of this connection would also suggest that, in common decency, a man should not kill and eat his animal or vegetable relations. In most parts of the world he abstains from this uncousinly behaviour; among the Arunta he may eat sparingly of his totem, and must do so at the end of the close-time or beginning of the season. He thus, as a near relation of the actual kangaroo or grubs, declares the season is open, now his neighbours may begin to eat grubs or kangaroos; the taboo is off." Dr. Frazer puts forth two suggestions (*Fortnightly Review*, 1899, pp. 838–40): the one is that as animals do not eat their own kind, so man thought it inconsistent to eat his totem kin; the other is a hypothetical idea of conciliation.

[1] Baldwin Spencer and F. J. Gillen, "The Native Tribes of Central Australia," 1899; *cf.* also J. G. Frazer, *Fortnightly Review*, 1899, pp. 648, 835.

[2] "Folk-lore," xii. 1901, p. 230, and "Report Camb. Anthrop. Expedition to Torres Straits," vol. v. (in the press).

[3] *Loc. cit.*, 1899, p. 657.

[4] *Loc. cit.*, pp. 73, 167.

[5] I am fully aware that this appears to cut the ground from under my suggestion; but the latter deals with incipient totemism, and I do not see why the totem taboo should not have arisen from several causes.

I have barely touched upon the relation of social organisation, with its marriage taboo, to totemism. It is by no means certain that the social regulations and customs, which are so much in evidence in a fully developed totemic society, were primitively connected with totemism. So far as the Arunta are concerned, Messrs. Spencer and Gillen believe (*Journ.* Anthrop. Inst., xxviii. 1899, pp. 277, 278) the "totemism appears to be a primary, and exogamy a secondary, feature . . . and that exogamic groups were deliberately introduced so as to regulate marital relations." But is this primitive?

If one admits that mankind was originally distributed in small groups, which must have consisted of near kin, it does not seem difficult to imagine that marriage would more likely take place between members of contiguous groups rather than within the groups themselves. The attraction for novelty must always have operated, and in the struggle for existence there was always one advantage to be gained by alliances between neighbouring groups, not only from a commissariat point of view, but for offensive and defensive purposes. There is, of course, the converse of this, as wife-stealing would lead to feuds; perhaps daughter-abduction was more frequent, and this probably was not regarded as an offence so serious that a mild scrimmage would not set matters right. It would not take long for wont to crystallise into rigid custom, and custom is always supported by public opinion.

Social regulations must be later than social conditions, and I suspect that the privileges and taboos which run through the social aspect of totemism first arose when totemic groups were in process of aggregation into more complex communities, and afterwards gradually became fixed into a system.

Hero-cults.

The facts to which I have hitherto directed your attention fall well within the sphere of totemism, but I wish now to indicate two interesting departures from typical totemism, both of which occur among the Western tribe of Torres Straits.

I have alluded to the dual grouping of the totem kins at Mabuiag, and an analogous arrangement occurred in the other islands; I propose to speak of each group of kins as a phratry. Strictly speaking, a phratry is a group of exogamous kins within a community; that is, no member of a group of kins (or phratry) could marry another person belonging to the same phratry. The evidence that this is or was the case in the Western tribe of Torres Straits is strong, but it is not absolutely proven.

In Yam, as in the other islands, there is at least one *kwod*, or taboo ground, where sacred ceremonies were held. In the principal *kwod* in Yam there was formerly a low fence surrounding a space about thirty-five feet square in which were the shrines of the two great totems of the island. All that now remains is several heaps of great Fusus shells.

Two of the heaps are about twenty-five feet in length. Formerly at the southerly end of each long row of shells was a large turtle-shell (tortoise-shell) mask representing respectively a crocodile and a hammer-headed shark. These were decorated in various ways, and under each was a stone in which the life of the totem resided; stretching from the front end of each mask was a cord to which numerous human lower jaw-bones were fastened, and its other end was attached to a human skull, which rested on a stone. Beside the shrine of the hammer-headed shark was a small heap of shells which was the shrine of a sea-snake, which was supposed to have originated from the shark. These shrines were formerly covered over by long low huts, which like the fence were decorated with large Fusus shells.

Outside the fence were two heaps of shells which had a mystical connection with the shrine; they were called the "navels of the totems."

I have referred to the *intichiuma* ceremonies of the Arunta tribe of Central Australia as being magical rites undertaken by certain kinsmen for the multiplication of the totems. In some cases, apparently, the ceremonies may take place wherever the men happen to be camping; in other cases there are definite localities where they must be performed, as there are in these places certain stones, rocks or trees which are intimately connected with the magical rites. These spots may be spoken of as shrines. In the island of Mabuiag the magical ceremony for the alluring of the dugong was performed by the men of that kin in their own *kwod*, which was a fixed spot; and doubtless this was the case in the other islands of Torres Straits, for even

in the small islands there was a tendency to a territorial grouping of the kins. This localisation of a totem cult has proceeded one step further in Yam Island. Here we have a dual synthesis. The chief totem of each group of kins is practically alone recognised; in other words, the various lesser totems are being absorbed by two more important totems. Each totem has a distinct shrine, and the totem itself, instead of being a whole species, is visualised in the form of a representation of an individual animal, and this image was spoken of as the totem (*augud*). Indeed, the tendency to concretism had gone so far that the life of the *augud* was supposed to reside in the stone that lay beneath the image,[1] and certain heaps of shells were the navels of the totems, a further linkage of the totem to that spot of ground.

A suggestion as to the significance of this transformation is not lacking. There are various folk-tales concerning a family of brothers who wandered from west to east across Torres Straits. Some of them were, in a mysterious way, sharks as well as men. The two brothers who went to Yam were called Sigai and Maiau, and each became associated, in his animal form, with one of the two phratries. The shrines in the *kwod* were so sacred that no women might visit them, nor did the women know what the totems were like. They were aware of Sigai and Maiau, but they did not know that the former was the hammer-headed shark and the latter was the crocodile; this mystery was too sacred to be imparted to the uninitiated. When the totems were addressed it was always by their hero names, and not by their animal or totem names.

Malu, another of these brothers, introduced the cult that bears his name to the Murray Islanders, who form part of the Eastern tribe. He also was identified with a hammer-headed shark. Totemism, as such, had practically disappeared from Murray Island before the advent of the white man, and the great ceremonies at the initiation of the lads into the Malu fraternity were a main feature of the religion of these people.

In Yam totemism was merging into a hero cult; in Murray Island the transformation was accomplished; the one had replaced the other.

In Mabuiag, one of the Western Islands, there was a local hero named Kwoiam whose deeds are narrated in a prose epic. Kwoiam made two crescentic ornaments of turtle-shell, which blazed with light when he wore them at night-time, and which he nourished with the savour of cooked fish. These ornaments were called totems (*augud*)—presumably because the natives did not know by what other sacred name to call them—and they became the insignia of the two groups of kins of Mabuiag. The crescent which was worn above Kwoiam's mouth was regarded as the more important, and those kins which had land animals for their totems were called from it "the children of the great totem," but the water group was called "the children of the little totem." There is reason to believe that the dual grouping of the kins is ancient. The erecting Kwoiam's emblems as the head totems of the two groups of kins must be comparatively recent. Here, again, the primitive association of a group of men with a group of natural objects obtains in the small groups or totem-kins, but in the larger synthesis a manufactured object replaces a group of animals, and this object possesses definite magical powers. There were two navel-shrines connected with the cult of Kwoiam, which were constructed to show that the two *augud* were born there. When it was deemed necessary to fortify the *augud*—that is, the emblems—they were placed on their respective navel-shrines. Further, in Muralug and the adjacent islands Kwoiam himself was a totem (*augud*). Thus in the westernmost islands of the Western tribe the transition from totemism to hero-worship was in process of evolution till it was arrested by the coming of the white man.

To what was this transformation due? It is not very easy to answer this question. We have evidence that in comparatively recent times a change took place in the social organisation of the people, and that the former matriarchal conditions had been replaced by patriarchal. Although superficially the marriage system of the Western tribe appears to be regulated by totemism, Dr. Rivers has found[2] that it is really a relationship system, and that descent, rather than totemism, is the regulating factor. The Eastern tribe, as represented by the Murray Islanders, had progressed further along this road than had the Western tribe. Such a change as this could not fail to have a disturbing effect upon other old customs.

The folk-tales that I collected clearly indicate a migration of culture from New Guinea to the Western tribe, and from the Western tribe to the Eastern tribe. I believe I can demonstrate the migration from New Guinea of a somewhat broad-headed people that spread over the Western Islands but barely reached Murray Island. It is conceivable that the culture myths have reference to this migration, and that the gradual substitution of a hero cult for totemism may be part of the same movement; but, on the other hand, this social and religious change is most thorough in Murray Island, where, I imagine, the racial movement has been least felt. The isolation of Murray Island from outside disturbing factors is very complete, and, being but a small island, a change once started might take place both rapidly and effectively.

It is interesting to note that the totem heroes of the Western tribe were invoked when their votaries were preparing to go to war. I obtained the following prayer in Yam Island:—"O *Augud* Sigai and O *Augud* Maiau, both of you close the eyes of those men so that they cannot see us," which had for its intent the slaughtering of the enemy without their being able to make a defence. I was informed that when the Yam warriors were fighting they would also call on the name of Kwoiam, who belonged to another group of islands, and on Yadzebub, a local warrior. Yadzebub was always described as a "man," whereas Kwoiam and Sigai were relegated to a "long time" back. From the folk-tales it is evident that Sigai and Maiau are more mythical or mysterious than Kwoiam. We thus have an instructive series: Yadzebub, the local famous man; Kwoiam, the hero, who was also a totem to other people; and Sigai and Maiau, the local totem heroes whose cult was visualised in turtle-shell images, and the life of each of whom resided in a particular stone. Perhaps it would be more correct to speak of this as the grafting of a new cult on totemism rather than to describe it as an evolution of totemism. A transformation has certainly occurred, but it does not appear to me to be a gradual growth—a metamorphosis in the natural history sense of the term—so much as the pouring of new wine into old bottles.

I hope on another occasion to deal with the question of religious and secret societies, as the growth of these has invariably disintegrated whatever antecedent totemism there may have been.

It is highly probable that something like what was taking place in Torres Straits has occurred elsewhere, but I cannot now enter into a comparative study of the rise of hero cults.

Local or Village Exogamy.

I have more than once ("Folk-lore," xii. 1901, p. 233; "Head-hunters, Black, White, and Brown," 1901, p. 258) called attention to the fact that among some Papuans marriage restrictions are territorial and not totemic. Dr. Rivers (*Journ.* Anthrop. Inst., xxx. 1900, p. 78) has shown that in Murray Island, Eastern tribe of Torres Straits, marriages are regulated by the places to which natives belong. A man cannot marry a woman of his own village or of certain other villages. The totemic system which probably at one time existed in this island appears to have been replaced by what may be called a territorial system. A similar custom occurs in the Mekeo-district of British New Guinea, and it is probably still more widely distributed.

I was informed by a member of the Yaraikanna tribe of Cape York, North Queensland, that children must take the "land" or "country" of their mother; all who belong to the same place are brothers and sisters, a wife must be taken from another "country" ("Brit. Assoc. Report," Dover, 1899, p. 585); thus it appears their marriage restrictions are territorial and not totemic. The same is found amongst the Kurnai and the Coast Murring tribe in New South Wales (Frazer, "Totemism," p. 90).

At Kiwai, in the delta of the Fly River, B.N.G., all the members of a totemic group live together in a long house which is confined to that group. I have also collected evidence which proves there was a territorial grouping of totemic clans among the Western tribe of Torres Straits ("Reports Camb. Anthrop. Expedition to Torres Straits," v. in the press).

Within a comparatively small area we have the following conditions:—

[1] For the keeping of a soul in an external receptacle, and for Dr. Frazer's views on its bearing on totemism, *cf. Fortnightly Review*, May, 1899, p. 844; "The Golden Bough," iii. 1900, pp. 418-422; and S. A. Cook, *Jewish Quart. Review*, 1902, p. 34 of reprint.

[2] "Reports Camb. Anthrop. Expedition to Torres Straits," v. "Kinship" (in the press).

(1) A typical totemic community with totem-kin houses (Kiwai).

(2) A typical totemic community with territorial grouping of the kins. Although there is totem exogamy, the marriage restrictions are regulated by relationship. The former mother-right has comparatively recently been replaced by father-right, but there are many survivals from matriarchy (Western tribe, Torres Straits).

(3) A community in which totemism has practically lapsed, with village exogamy and marriage restrictions regulated by relationship, patriarchy with survivals from matriarchy (Eastern tribe, Torres Straits).

(4) Total absence of totemism (?), village exogamy (Mekeo).

I do not assert this is a natural sequence, but it looks like one, and it appears to indicate another of the ways out of totemism. It is suggestive that this order also indicates the application of the several peoples to agriculture: the people of Kiwai are semi-nomadic, those of the Mekeo district are firmly attached to the land. This constraint of the soil must have operated in a similar manner elsewhere (*cf.* "L'Année Sociologique," v. 1902, pp. 330, 333). The territorial exogamy occasionally found in Australia cannot be explained as being due to agriculture; a rigid limitation of hunting grounds may here have had a similar effect.

In offering these remarks to-day I desire, above all, to impress on you the need there is for more work in the field. When one surveys the fairly extensive literature of totemism one is struck with the very general insufficiency of the evidence; as a matter of fact, full and precise information is lamentably lacking. The foundations upon which students at home have to build their superstructures of generalisation and theory are usually of too slight a character to support these erections with much chance of their permanence. There is only one remedy for this, and that is more extensive and more thorough field work. The problems connected with totemism bear upon many of the most important phases in the social and religious evolution of man, the solution of which can only be obtained within the space of a few years. The delay of each year in the investigation of primitive peoples means that so much less information is possible to be obtained. There is no exaggeration in this. Those who have a practical experience of backward man and who have travelled in out-of-the-way places can testify as to the surprising rapidity with which the old order changeth. In sober earnestness I appeal to all those who are interested in the history and character of man, whether they be theologians, historians, sociologists, psychologists or anthropologists, to face the plain fact that the only available data for the solution of many problems of the highest interest are daily slipping away beyond recovery.

SECTION I.

PHYSIOLOGY.

OPENING ADDRESS BY W. D. HALLIBURTON, M.D., F.R.S., PROFESSOR OF PHYSIOLOGY IN KING'S COLLEGE, LONDON, PRESIDENT OF THE SECTION.

The Present Position of Chemical Physiology.

AN engineer who desires to thoroughly understand how a machine works must necessarily know its construction. If the machine becomes erratic in its action, and he wishes to put it into proper working order, a preliminary acquaintance with its normal structure and function is an obvious necessity.

If we apply this to the more delicate machinery of the animal body, we at once see how a knowledge of function (physiology and pathology) is impossible without a preliminary acquaintance with structure or anatomy.

It is therefore not surprising, it is indeed in the nature of things, that physiology originated with the great anatomists of the past. It was not until Vesalius and Harvey by tedious dissections laid bare the broad facts of structure that any theorising concerning the uses of the constituent organs of the body had any firm foundation.

Important and essential as the knowledge is that can be revealed by the scalpel, the introduction and use of the microscope furnished physiologists with a still more valuable instrument. By it much that was before unseen came into view, and microscopic anatomy and physiology grew in stature and knowledge simultaneously.

The weapons in the armoury of the modern physiologist are multitudinous in number and complex in construction, and enable him in the experimental investigation of his subject to accurately measure and record the workings of the different parts of the machinery he has to study. But preeminent among these instruments stands the test-tube and the chemical operations typified by that simple piece of glass.

Herein one sees at once a striking distinction between the mechanism of a living animal and that of a machine like a steam engine or a watch. It is quite possible to be an excellent watchmaker or to drive a steam engine intelligently without any chemical knowledge of the various metals that enter into its composition. In order to set the mechanism right if it goes wrong, all the preliminary knowledge which is necessary is of an anatomical nature. The parts of which an engine is composed are stable; the oil that lubricates it and the fuel that feeds it never become integral parts of the machinery. But with the living engine all this is different. The parts of which it is made take up the nutriment or fuel and assimilate it, thus building up new living substance to replace that which is destroyed in the wear and tear associated with activity. This condition of unstable chemical equilibrium is usually designated metabolism, and metabolism is the great and essential attribute of a living as compared with a non-living thing.

It seems childish at the present day, and before such an audience as this, to point out how essential it is to know the chemical structure as well as the anatomical structure of the component parts of the body. But the early anatomists to whom I have alluded had no conception of the connection of the two sciences. Speaking of Vesalius, Sir Michael Foster says: "The great anatomist would no doubt have made use of his bitterest sarcasms had someone assured him that the fantastic school which was busy with occult secrets and had hopes of turning dross into gold would one day join hands in the investigation of the problems of life with the exact and clear anatomy so dear to him." Nor did Harvey, any more than Vesalius, pay heed to chemical learning. The scientific men of his time ignored and despised the beginning of that chemical knowledge which in later years was to become one of the foundations of physiology and the mainstay of the art of medicine.

The earliest to recognise this important connection was one whose name is usually associated more with charlatanry than with truth, namely, Paracelsus, and fifty years after the death of that remarkable and curious personality his doctrines were extended and developed by van Helmont. In spite, however, of van Helmont's remarkable insight into the processes of digestion and fermentation, his work was marred by the mysticism of the day, which called in the aid of supernatural agencies to explain what could not otherwise be fully comprehended.

In the two hundred and fifty years that have intervened between the death of van Helmont and the present day, alchemy became a more and more exact science and changed its name to chemistry, and a few striking names stand out of men who were able to take the new facts of chemistry and apply them to physiological uses. Of these one may mention Mayow, Lower, Boerhaave, Réaumur, Borelli, Spallanzani and Lavoisier. Mulder in Holland and Liebig in Germany bring us almost to the present time, and I think they may be said to share the honour of being regarded as the fathers of modern chemical physiology. This branch of science was first placed on a firm basis by Wöhler when he showed that organic compounds can be built out of their elements in the laboratory, and his first successful experiments in connection with the comparatively simple substance urea have been followed by numberless others, which have made organic chemistry the vast subject it is to-day.

Sir Michael Foster's book on the History of Physiology, from which I have already quoted, treats of the older workers who laid the foundations of our science, and whose names I have not done much more than barely mention. Those interested in the giants of the past should consult it. But what I propose to take up this morning is the work of those who have during more recent days been engaged in the later stages of the building. The edifice is far from completion even now. It is one of the charms of physiological endeavour that, as the older areas yield their secrets to the explorers, new ones are opened out which require equally careful investigation.

If even a superficial survey of modern physiological literature is taken, one is at once struck with the great preponderance of papers and books which have a chemical bearing. In this the

physiological journals of to-day contrast very markedly with those of thirty, twenty, or even ten years ago. The sister science of chemical pathology is making similar rapid strides. In some universities the importance of biological chemistry is recognised by the foundation of chairs which deal with that subject alone; and though in the United Kingdom, owing mainly to lack of funds, this aspect of the advance of science is not very evident, there are signs that the date cannot be far distant when every well-equipped university or university college will follow the example set us at many seats of learning on the Continent and at Liverpool.

With these introductory remarks let me now proceed to describe what appear to me to be the main features of chemical physiology at the present time.

The first point to which I shall direct your attention is the rapid way in which chemical physiology is becoming an exact science. Though it is less than twenty years since I began to teach physiology, I can remember perfectly well a time when those who devoted their work to the chemical side of the science might almost be counted on the fingers of one hand, and when chemists looked with scarcely veiled contempt on what was at that time called physiological chemistry; they stated that physiologists dealt with messes or impure materials, and therefore anything in the nature of correct knowledge was not possible. There was a good deal of truth in these statements, and if physiologists to-day cannot quite say that they have changed all that, they can at any rate assert with truth that they are changing it. This is due to a growing *rapprochement* between chemists and physiologists. Many of our younger physiologists now go through a thorough preliminary chemical training; and on the other hand there is a growing number of chemists—of whom Emil Fischer may be taken as a type—who are beginning to recognise the importance of a systematic study of substances of physiological interest. A very striking instance of this is seen in the progress of our knowledge of the carbohydrates, which has culminated in the actual synthesis of several members of the sugar group. Another instance is seen in the accurate information we now possess of the constitution of uric acid. When Miescher began his work on the chemical composition of the nuclei of cells, and separated from them the material he called nuclein, he little foresaw the wide practical application of his work. We now know that it is in the metabolism of cell-nuclei that we have to look for the oxidative formation of uric acid and other substances of the purine family. Already the chemical relationships of uric acid and nuclein have taught practical physicians some of the secrets that underlie the occurrence of gout and allied disorders.

With the time at my disposal, it would be impossible to discuss all the chemico-vital problems which the physiologists of the present day are attempting to solve, but there is one subject at which many of them are labouring which seems to me to be of supreme importance—I mean the chemical constitution of proteid or albuminous substances. Proteids are produced only in the living laboratory of plants and animals; proteid metabolism is the main chemical attribute of a living thing; proteid matter is the all-important material present in protoplasm. But in spite of the overwhelming importance of the subject, chemists and physiologists alike have far too long fought shy of attempting to unravel the constitution of the proteid molecule. This molecule is the most complex that is known; it always contains five, and often six, or even seven elements. The task of thoroughly understanding its composition is necessarily vast, and advance slow. But little by little the puzzle is being solved, and this final conquest of organic chemistry, when it does arrive, will furnish physiologists with new light on many of the dark places of physiological science.

The revival of the vitalistic conception in physiological work appears to me a retrograde step. To explain anything we are not fully able to understand in the light of physics and chemistry by labelling it as vital or something we can never hope to understand is a confession of ignorance, and, what is still more harmful, a bar to progress. It may be that there is a special force in living things that distinguishes them from the inorganic world. If this is so, the laws that regulate this force must be discovered and measured, and I have no doubt that those laws when discovered will be found to be as immutable and regular as the force of gravitation. I am, however, hopeful that the scientific workers of the future will discover that this so-called vital force is due to certain physical or chemical properties of living matter which have not yet been brought into line with the known chemical and physical laws that operate in the inorganic world, but which as our knowledge of chemistry and physics increases will ultimately be found to be subservient to such laws.

Let me take as an example the subject of osmosis. The laws which regulate this phenomenon through dead membranes are fairly well known and can be experimentally verified; but in the living body there is some other manifestation of force which operates in such a way as to neutralise the known force of osmosis. Is it necessary to suppose that this force is a new one? May it not rather be that our much vaunted knowledge of osmosis is not yet complete? It is quite easy to understand why a dead and a living membrane should behave differently in relation to substances that are passing through them. The molecules of the dead membrane are, comparatively speaking, passive and stable; the molecules in a membrane made of living cells are in a constant state of chemical integration and disintegration; they are the most unstable molecules we know. Is it to be expected that such molecules would allow water, or substances dissolved in water, to pass between them and remain entirely inactive? The probability appears to me to be all the other way; the substances passing, or attempting to pass, between the molecules will be called upon to participate in the chemical activities of the molecules themselves, and in the building up and breaking down of the compounds so formed there will be a transformation of chemical energy and a liberation of what looks like a new force. Before a physicist decides that his knowledge of osmosis is final, let him attempt to make a membrane of some material which is in a state of unstable chemical equilibrium, a state in some way comparable to what is called metabolism in living protoplasm. I cannot conceive that such a task is insuperable, and when accomplished, and the behaviour of such a membrane in an osmometer or dialyser is studied, I am convinced that we shall find that the laws of osmosis as formulated for such dead substances as we have hitherto used will be found to require revision.

Such an attitude in reference to vital problems appears to be infinitely preferable to that which too many adopt of passive content, saying the phenomenon is vital and there is an end of it.

When a scientific man says this or that vital phenomenon cannot be explained by the laws of chemistry and physics, and therefore must be regulated by laws of some other nature, he most unjustifiably assumes that the laws of chemistry and physics have all been discovered. He forgets, for instance, that such an important detail as the constitution of the proteid molecule has still to be made out.

The recent history of science gives an emphatic denial to such a supposition. All my listeners have within the last few years seen the discovery of the Röntgen rays and the modern development of wireless telegraphy. On the chemical side we have witnessed the discovery of new elements in the atmosphere and the introduction of an entirely new branch of chemistry called physical chemistry. With such examples ready to our hands, who can say what further discoveries will not shortly be made, even in such well-worked fields as chemistry and physics?

The mention of physical chemistry brings me to what I may term the second head of my discourse, the second striking characteristic of modern chemical physiology; this is the increasing importance which physiologists recognise in a study of inorganic chemistry. The materials of which our bodies are composed are mainly organic compounds, among which the proteids stand out as preeminently important; but everyone knows there are many substances of the mineral or inorganic kingdom present in addition. I need hardly mention the importance of water, of the oxygen of the air, and of salts like sodium chloride and calcium phosphate.

The new branch of inorganic chemistry called physical chemistry has given us entirely new ideas of the nature of solutions, and the fact that electrolytes in solution are broken up into their constituent ions is one of fundamental importance. One of the many physiological aspects of this subject is seen in a study of the action of mineral salts in solution on living organisms and parts of organisms. Many years ago Dr. Ringer showed that contractile tissues (heart, cilia, &c.) continue to manifest their activity in certain saline solutions. Howell goes so far as to say, and probably correctly say, that the cause of the rhythmical action of the heart is the presence of these inorganic substances in the blood or lymph which usually bathes it. The subject has more recently been taken up by Loeb and his colleagues at Chicago; they confirm Ringer's original statements, but interpret them now as ionic action. Contractile

tissues will not contract in pure solutions of non-electrolytes like sugar or albumin. But different contractile tissues differ in the nature of the ions which are their most favourable stimuli. An optimum salt solution is one in which stimulating ions, like those of sodium, are mixed with a certain small amount of those which like calcium restrain activity. Loeb considers that the ions act because they affect either the physical condition of the colloidal substances (proteid, &c.) in protoplasm or the rapidity of chemical processes.

Amœboid movement, ciliary movement, the contraction of muscle, cell division and karyokinesis all fall into the same category as being mainly dependent on the stimulating action of ions.

Loeb has even gone so far as to consider that the process of fertilisation is mainly ionic action; he denies that the nuclein of the male cell is essential, but asserts that all it does is to act as the stimulus in the due adjustment of the proportions of the surrounding ions, and supports this view by numerous experiments on ova in which without the presence of spermatozoa he has produced larvæ by merely altering the saline constituents and so the osmotic pressure of the fluid that surrounds them. Whether such a sweeping and almost revolutionary notion will stand the test of further verification must be left to the future; so also must the equally important idea that nervous impulses are to be mainly explained on an electrolytic basis. But whether or not all the details of such work will stand the test of time, the experiments I have briefly alluded to are sufficient to show the importance of physical chemistry to the physiologist, and they also form a useful commentary on what I was saying just now about vitalism. Such eminently vital phenomena as movement and fertilisation are to be explained in whole or in part as due to the physical action of inorganic substances. Are not such suggestions indications of the undesirability of postulating the existence of any special mystic vital force?

I have spoken up to this point of physical chemistry as a branch of inorganic chemistry; there are already indications of its importance also in relation to organic chemistry. Many eminent chemists consider that the future advance of organic chemistry will be on the new physical lines. It is impossible to forecast where this will lead us; suffice it to say that not only physiology, but also pathology, pharmacology and even therapeutics will receive new accessions to knowledge the importance of which will be enormous.

I have now briefly sketched what appear to me to be the two main features of the chemical physiology of to-day, and the two lines, organic and inorganic, along which I believe it will progress in the future.

Let me now press upon you the importance in physiology, as in all experimental sciences, of the necessity first of bold experimentation, and secondly of bold theorising from experimental data. Without experiment all theorising is futile; the discovery of gravitation would never have seen the light if laborious years of work had not convinced Newton that it could be deduced from his observations. The Darwinian theory was similarly based upon data and experiments which occupied the greater part of its author's lifetime to collect and perform. Pasteur in France and Virchow in Germany supply other instances of the same devotion to work which was followed by the promulgation of wide-sweeping generalisations.

And after all it is the general law which is the main object of research; isolated facts may be interesting and are often of value, but it is not until facts are correlated and the discoverers ascertain their inter-relationships that anything of epoch-making importance is given to the world.

It is, however, frequently the case that a thinker with keen insight can see the general law even before the facts upon which it rests are fully worked out. Often such bold theorisers are right, but even if they ultimately turn out to be wrong, or only partly right, they have given to their fellows some general idea on which to work; if the general idea is incorrect, it is important to prove it to be so in order to discover what is right later on. No one has ever seen an atom or a molecule, yet who can doubt that the atomic theory is the sheet anchor of chemistry? Mendeléeff formulated his periodic law before many of the elements were discovered; yet the accuracy of this great generalisation has been such that it has actually led to the discovery of some of the missing elements.

I purpose to illustrate these general remarks by a brief allusion to two typical sets of researches carried out during recent years in the region of chemical physiology. I do not pretend that either of them has the same overwhelming importance as the great discoveries I have alluded to, but I am inclined to think that one of them comes very near to that standard. The investigations in question are those of Ehrlich and of Pawlow. The work of Ehrlich mainly illustrates the useful part played by bold theorising, the work of Pawlow that played by the introduction of new and bold methods of experiment.

I will take Pawlow first. This energetic and original Russian physiologist has by his new methods succeeded in throwing an entirely new light on the processes of digestion. Ingeniously devised surgical operations have enabled him to obtain the various digestive juices in a state of absolute purity and in large quantity. Their composition and their actions on the various foodstuffs have thus been ascertained in a manner never before accomplished; an apparently unfailing resourcefulness in devising and adapting experimental methods has enabled him and his fellow workers to discover the paths of the various nerve impulses by which secretion in the alimentary canal is regulated and controlled. The importance of the psychical element in the process of digestion has been experimentally verified. If I were asked to point out what I considered to be the most important outcome of all this painstaking work, I should begin my answer by a number of negatives, and would say, not the discovery of the secretory nerves of the stomach or pancreas; not the correct analysis of the gastric juice, nor the fact that the intestinal juice has most useful digestive functions; all of these are discoveries of which anyone might have been rightly proud; but after all they are more or less isolated facts. The main thing that Pawlow has shown is that digestion is not a succession of isolated acts, but each one is related to its predecessor and to that which follows it; the process of digestion is thus a continuous whole; for example, the acidity of the gastric juice provides for a delivery of pancreatic juice in proper quantity into the intestine; the intestinal juice acts upon the pancreatic, and so enables the latter to perform its powerful actions. I am afraid this example, as I have tersely stated it, presents the subject rather inadequately, but it will serve to show what I mean. Further, the composition of the various juices is admirably adjusted to the needs of the organism; when there is much proteid to be digested, the proteolytic activity of the juices secreted is correspondingly high, and the same is true for the other constituents of the food. It is such general conclusions as these, the correlation of isolated facts leading to the formulation of the law that the digestive process is continuous in the sense I have indicated, and adapted to the needs of the work to be done, that constitute the great value of the work from the Russian laboratory. Work of this sort is sure to stimulate others to fill in the gaps and complete the picture, and already has borne fruit in this direction. It has, for instance, in Starling's hands led to the discovery of a chemical stimulus to pancreatic secretion. This is formed in the intestine as the result of the action of the gastric acid, and taken by the blood-stream to the pancreas. Whether this *secretin* as it is called may be one of a group of similar chemical stimuli which operate in other parts of the body has still to be found out.

The other series of researches to which I referred are those of Ehrlich and his colleagues and followers on the subject of immunity. This subject is one of such importance to every one of us that I am inclined to place the discovery on a level with those great discoveries of natural laws to which I alluded at the outset of this portion of my Address. I hesitate to do so yet because many of the details of the theory still await verification. But up to the present all is working in that direction, and Ehrlich's ideas illustrate the value of bold theorising in the hands of clear-sighted and far-seeing individuals.

But when I say that the doctrine is bold, I do not mean to infer that the experimental facts are scanty; they are just the reverse. But in the same way that a chemist has never seen an atom, and yet he believes atoms exist, so no one has yet ever seen a toxin or antitoxin in a state of purity, and yet we know they exist, and this knowledge promises to be of incalculable benefit to suffering humanity.

It may not be uninteresting to state briefly, for the benefit of those to whom the subject is new, the main facts and an outline of the theory which is based upon them.

We are all aware that one attack of many infective maladies protects us against another attack of the same disease. The person is said to be *immune* either partially or completely against that disease. Vaccination produces in a patient an

attack of cow-pox or vaccinia. This disease is related to small-pox, and some still hold that it is small-pox modified and rendered less malignant by passing through the body of a calf. At any rate, an attack of vaccinia renders a person immune to small-pox, or variola, for a certain number of years. Vaccination is an instance of what is called *protective inoculation*, which is now practised with more or less success in reference to other diseases like plague and typhoid fever. The study of immunity has also rendered possible what may be called *curative inoculation*, or the injection of antitoxic material as a cure for diphtheria, tetanus, snake poisoning, &c.

The power the blood possesses of slaying bacteria was first discovered when the effort was made to grow various kinds of bacteria in it; it was looked upon as probable that blood would prove a suitable soil or medium for this purpose. It was found in some instances to have exactly the opposite effect. The chemical characters of the substances which kill the bacteria are not fully known; indeed, the same is true for most of the substances we have to speak of in this connection. Absence of knowledge on this particular point has not, however, prevented important discoveries from being made.

So far as is known at present, the substances in question are proteid in nature. The bactericidal powers of blood are destroyed by heating it for an hour to 56° C. Whether the substances are enzymes is a disputed point. So also is the question whether they are derived from the leucocytes; the balance of evidence appears to me to be in favour of this view in many cases at any rate, and phagocytosis becomes more intelligible if this view is accepted. The substances, whatever be their source or their chemical nature, are sometimes called alexins, but the more usual name now applied to them is that of *bacteriolysins*.

Closely allied to the bactericidal power of blood, or blood-serum, is its globulicidal power. By this one means that the blood-serum of one animal has the power of dissolving the red blood-corpuscles of another species. If the serum of one animal is injected into the blood-stream of an animal of another species, the result is a destruction of its red corpuscles, which may be so excessive as to lead to the passing of the liberated hæmoglobin into the urine (hæmoglobinuria). The substance or substances in the serum that possess this property are called *haemolysins*, and though there is some doubt whether bacteriolysins and hæmolysins are absolutely identical, there is no doubt that they are closely related substances.

Another interesting chemical point in this connection is the fact that the bactericidal power of the blood is closely related to its alkalinity. Increase of alkalinity means increase of bactericidal power. Venous blood contains more diffusible alkali than arterial blood and is more bactericidal; dropsical effusions are more alkaline than normal lymph and kill bacteria more easily. In a condition like diabetes, when the blood is less alkaline than it should be, the susceptibility to infectious diseases is increased. Alkalinity is probably beneficial because it favours those oxidative processes in the cells of the body which are so essential for the maintenance of healthy life.

Normal blood possesses a certain amount of substances which are inimical to the life of our bacterial foes. But suppose a person gets run down; everyone knows he is then liable to "catch anything." This coincides with a diminution in the bactericidal power of his blood. But even a perfectly healthy person has not an unlimited supply of bacteriolysin, and if the bacteria are sufficiently numerous he will fall a victim to the disease they produce. Here, however, comes in the remarkable part of the defence. In the struggle he will produce more and more bacteriolysin, and if he gets well it means that the bacteria are finally vanquished, and his blood remains rich in the particular bacteriolysin he has produced, and so will render him immune to further attacks from that particular species of bacterium. Every bacterium seems to cause the development of a specific bacteriolysin.

Immunity can more conveniently be produced gradually in animals, and this applies, not only to the bacteria, but also to the toxins they form. If, for instance, the bacilli which produce diphtheria are grown in a suitable medium, they produce the diphtheria poison, or toxin, much in the same way that yeast-cells will produce alcohol when grown in a solution of sugar. Diphtheria toxin is associated with a proteose, as is also the case with the poison of snake venon. If a certain small dose called a "lethal dose" is injected into a guinea-pig, the result is death. But if the guinea-pig receives a smaller dose it will recover; a few days after it will stand a rather larger dose; and this may be continued until after many successive gradually increasing doses it will finally stand an amount equal to many lethal doses without any ill effects. The gradual introduction of the toxin has called forth the production of an antitoxin. If this is done in the horse instead of the guinea-pig the production of antitoxin is still more marked, and the serum obtained from the blood of an immunised horse may be used for injecting into human beings suffering from diphtheria, and rapidly cures the disease. The two actions of the blood, antitoxic and antibacterial, are frequently associated, but may be entirely distinct.

The antitoxin is also a proteid probably of the nature of a globulin; at any rate, it is a proteid of larger molecular weight than a proteose. This suggests a practical point. In the case of snake-bite the poison gets into the blood rapidly owing to the comparative ease with which it diffuses, and so it is quickly carried all over the body. In treatment with the antitoxin or antivenin, speed is everything if life is to be saved; injection of this material under the skin is not much good, for the diffusion into the blood is too slow. It should be injected straight away into a blood-vessel.

There is no doubt that in these cases the antitoxin neutralises the toxin much in the same way that an acid neutralises an alkali. If the toxin and antitoxin are mixed in a test-tube and time allowed for the interaction to occur, the result is an innocuous mixture. The toxin, however, is merely neutralised, not destroyed; for if the mixture in the test-tube is heated to 68° C. the antitoxin is coagulated and destroyed and the toxin remains as poisonous as ever.

Immunity is distinguished into *active* and *passive*. Active immunity is produced by the development of protective substances in the body; passive immunity by the injection of a protective serum. Of the two the former is the more permanent.

Ricin, the poisonous proteid of castor-oil seeds, and *abrin*, that of the Jequirity bean, also produce when gradually given to animals an immunity, due to the production of antiricin and antiabrin respectively.

Ehrlich's hypothesis to explain such facts is usually spoken of as the *side-chain theory* of immunity. He considers that the toxins are capable of uniting with the protoplasm of living cells by possessing groups of atoms like those by which nutritive proteids are united to cells during normal assimilation. He terms these *haptophor* groups, and the groups to which these are attached in the cells he terms *receptor* groups. The introduction of a toxin stimulates an excessive production of receptors, which are finally thrown out into the circulation, and the free circulating receptors constitute the antitoxin. The comparison of the process to assimilation is justified by the fact that non-toxic substances like milk introduced gradually by successive doses into the blood-stream cause the formation of anti-substances capable of coagulating them.

Up to this point I have spoken only of the blood, but month by month workers are bringing forward evidence to show that other cells of the body may by similar measures be rendered capable of producing a corresponding protective mechanism.

One further development of the theory I must mention. At least two different substances are necessary to render a serum bactericidal or globulicidal. The bacteriolysin or hæmolysin consists of these two substances. One of these is called the *immune body*, the other the *complement*. We may illustrate the use of these terms by an example. The repeated injection of the blood of one animal (*e.g.* the goat) into the blood of another animal (*e.g.* a sheep) after a time renders the latter animal immune to further injections, and at the same time causes the production of a serum which dissolves readily the red blood-corpuscles of the first animal. The sheep's serum is thus hæmolytic towards goat's blood-corpuscles. This power is destroyed by heating to 56° C. for half an hour, but returns when fresh goat's serum is added. The specific immunising substance formed in the sheep is called the immune body; the ferment-like substance destroyed by heat is the complement. The latter is not specific, since it is furnished by the blood of non-immunised animals, but it is nevertheless essential for hæmolysis. Ehrlich believes that the immune body has two side groups—one which connects with the receptor of the red corpuscles and one which unites with the haptophor group of the complement, and thus renders possible the ferment-like action of the complement on the red corpuscles. Various antibacterial serums which have not been

the success in treating disease they were expected to be are probably too poor in complement, though they may contain plenty of the immune body.

Quite distinct from the bactericidal, globulicidal and antitoxic properties of blood is its agglutinating action. This is another result of infection with many kinds of bacteria or their toxins. The blood acquires the property of rendering immobile and clumping together the specific bacteria used in the infection. The test applied to the blood in cases of typhoid fever, and generally called Widal's reaction, depends on this fact.

The substances that produce this effect are called *agglutinins*. They also are probably proteid-like in nature, but are more resistant to heat than the lysins. Prolonged heating to over 60° C. is necessary to destroy their activity.

Lastly, we come to a question which more directly appeals to the physiologist than the preceding, because experiments in relation to immunity have furnished us with what has hitherto been lacking, a means of distinguishing human blood from the blood of other animals.

The discovery was made by Tchistovitch (1899), and his original experiment was as follows :—Rabbits, dogs, goats and guinea-pigs were inoculated with eel-serum, which is toxic ; he thereby obtained from these animals an antitoxic serum. But the serum was not only antitoxic, but produced a precipitate when added to eel-serum, but not when added to the serum of any other animal. In other words, not only has a specific antitoxin been produced, but also a specific *precipitin*. Numerous observers have since found that this is a general rule throughout the animal kingdom, including man. If, for instance, a rabbit is treated with human blood, the serum ultimately obtained from the rabbit contains a specific precipitin for human blood ; that is to say, a precipitate is formed on adding such a rabbit's serum to human blood, but not when added to the blood of any other animal.[1] The great value of the test is its delicacy ; it will detect the specific blood when it is greatly diluted, after it has been dried for weeks, or even when it is mixed with the blood of other animals.

I have entered into this subject at some length, because it so admirably illustrates the kind of research which is now in progress ; it is also of interest to others than mere physiologists. I have not by any means exhausted the subject, but for fear I may exhaust my audience let me hasten to a conclusion. I began by eulogising the progress of the branch of science on which I have elected to speak to you. Let me conclude with a word of warning on the danger of over-specialisation. The ultra-specialist is apt to become narrow, to confine himself so closely to his own groove that he forgets to notice what is occurring in the parallel and intercrossing grooves of others. But those who devote themselves to the chemical side of physiology run but little danger of this evil. The subject cannot be studied apart from other branches of physiology, so closely are both branches and roots intertwined. As an illustration of this, may I be permitted to speak of some of my own work? During the past few years the energies of my laboratory have been devoted to investigations on the chemical side of nervous activity, and I have had the advantage of cooperating to this end with a number of investigators, of whom I may particularly mention Dr. Mott and Dr. T. G. Brodie. But we soon found that any narrow investigation of the chemical properties of nervous matter and the changes this undergoes during life and after death was impossible. Our work extended in a pathological direction so as to investigate the matter in the brains of those suffering from nervous disease ; it extended in a histological direction so as to determine the chemical meaning of various staining reactions presented by normal and abnormal structures in the brain and spinal cord ; it extended in an experimental direction in the elucidation of the phenomena of fatigue, and to ascertain whether there was any difference in medullated and non-medullated nerve fibres in this respect ; it extended into what one may call a pharmacological direction in the investigation of the action of the poisonous products of the breakdown of nervous tissues. I think I have said enough to show you how intimate are the connections of the chemical with the other aspects of physiology, and although I have given you but one instance, that which is freshest to my mind, the same could be said for almost any other well-planned piece of research work of a bio-chemical nature.

[1] There may be a slight reaction with the blood of allied animals ; for instance, with monkey's blood in the case of man.

We have now before us the real work of the Section, the reading, hearing and seeing the researches which will be brought forward by members of the Association, and I must, in thanking you for your attention, apologise for the length of time I have kept you from these more important matters.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

IT is recommended by Mr. Herbert Welsh, of Philadelphia, who was largely instrumental in raising the Wilson endowment fund, value 100,000 dollars, of the Washington and Lee University, that a fund of 500,000 dollars be raised to endow a scientific and technical school for the University.

THE papers read at the conference of science teachers held at the Hartley University College, Southampton, to which attention was directed in our issue of June 19, 1902, have now been published in book form. The title of the little volume is "Science Teaching and Nature Study." Copies may be obtained from Mr. H. M. Gilbert, Above Bar, Southampton, price 6*d*. each.

THE following courses of lectures on advanced physiology are announced for delivery in the physiological laboratory at the buildings of the University of London during the coming term :—(*a*) "On the Sources of Animal Energy," by Prof. E. H. Starling, on Tuesdays, October 14, 21, 28, November 4, 11, 18, 25, December 2, at 5 p.m. ; (*b*) "On Animal Heat and Respiration," by Dr. M. S. Pembrey, on Wednesdays, October 15, 22, 29, November 5, 12, 19, 26, December 3, at 5 p.m. The lectures, admission to which is free, are addressed to advanced students, and are arranged to meet the requirements of candidates for honours in physiology at the University. Cards of admission may be obtained on application to the Academic Registrar, at the University Buildings, South Kensington, S.W.

SCIENTIFIC SERIALS.

Journal of Botany, September.—Under the title of "Alabastra diversa," Mr. Spencer le M. Moore continues his account of new plants. *Amphoranthus spinosus*, from Damaraland, furnishes a new genus of the suborder Cæsalpinieæ, approximating to the existing genus Cordyla. Five new species are added to the Acanthaceæ. A note by the same writer refers to the plant which, under the name of *Haemacanthus coccineus*, was described in a previous number of the *Journal* as a new genus ; there is some possibility of this proving to be identical with the plant named *Satanocrater coccineus* by Dr. Lindau.—Dr. Rendle describes two new varieties of orchids from China, and a new species of Burmannia from the same country. The latter is figured along with Amphoranthus.—Two papers deal with the genus Hieracium ; in the first, Mr. H. J. Riddelsdell gives a list of Welsh Hieracia ; in the second, Mr. F. N. Williams, in the course of his remarks on the "Salient Features in Hieracium," alludes to the difference between the characters emphasised by Scandinavian and Continental botanists, and points out the importance of the hairs, the structure of the receptacle and the stem branching as distinguishing morphological features.—Messrs. R. E. and F. Cundall contribute a list of Glamorganshire plants which furnishes a supplement to that published recently by Messrs. Marshall and Shoolbred.—The article entitled "Botany in England a Century Ago" gives the impressions of Dr. H. A. Noehden formed during his visit to this country in the year 1799.

The American Journal of Science, September.—The relationships of some American and Old World birches, by M. L. Fernald.—On the fertile fronds of Crossotheca and Myriotheca, and on the spores of other Carboniferous ferns from Mazon Creek, Illinois, by E. H. Sellards.—On the validity of *Idiophyllum rotundiflorum*, Lesquereux, a fossil plant from the Coal-measures of Mazon Creek, Illinois, by E. H. Sellards. It

is shown that the species *Idiophyllum rotundiflorum* is a synonym of *Neuropteris rarinervis*, and that the genus Idiophyllum has no status in fossil botany.—The precipitation of ammonium vanadate by ammonium choride, by F. A. Gooch and R. D. Gilbert. Previous work on the separation of vanadium as ammonium metavanadate by means of ammonium chloride having led to contradictory results, the method has been exhaustively re-examined, with the result that under suitable conditions, easily realised experimentally, the determination by Gibbs's method is accurate.—Some additions to the alunite-jarosite group of minerals, by W. F. Hillebrand and S. L. Penfield.—The Niagara limestones of Hamilton County, Indiana, by Edward M. Kindle.—On the velocity and the structure of the nucleus, by C. Barus.—Note on corundum and a graphitic essonite from Barkhampstead, Connecticut, by B. K. Emerson.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 22.—M. Bouquet de la Grye in the chair.—The president announced to the Academy the loss it had sustained by the death of M. Damour.—The extension of Fermat's principle on the economy of time to the relative movement of light in a transparent homogeneous body subject to a rapid translation, by M. J. Boussinesq. It is shown that the principle of least time as enunciated by Fermat applies to the case of a body subjected to a rapid translatory motion. Polarisation is also unaffected.—The enclosures in the andesites from Mont Pelée, by M. A. Lacroix. The enclosures contain a greenish or yellowish-grey rock of a microlitic character; the mineralogical composition is always the same qualitatively, but the proportion of the elements varies considerably. The most complete type contains plagioclases, hypersthene, augite, titanomagnetite, hornblende and olivine. These enclosures are not fragments of solid rock torn off from the depths of the volcano, there being abundant evidence that they have been formed in place. They greatly resemble certain nodules of hypersthene-andesite from the last eruption of Santorin.—Spectral researches on the rotation of the planet Uranus, by M. H. Deslandres. The first researches on the rotation of the planets have been made by simply measuring the movement of certain well-defined points; if the image is uniform and without detail, this method fails. On account of the small apparent diameter and feeble lustre of Neptune and Uranus, their time of rotation has hitherto remained undetermined. A new mode of attacking this problem is by applying the Döppler-Fizeau principle. This was first applied successfully to the Sun in 1889, to Jupiter and Saturn in 1895, and to Venus in 1900. The same method in a modified form has now been applied to Uranus, with the result that it is very probable that this planet turns in a retrograde sense, like its satellites. To obtain more definite measurements, further researches must be carried out in observatories nearer the equator, with more powerful instruments and in a very calm atmosphere, and for a period of twenty-one years. Encouraging results have also been obtained by the application of the same method to the planet Neptune.—On the combinations of silicon with cobalt, and on a new silicide of this metal, by M. P. Lebeau. When cobalt is heated in the presence of an excess of fused silicon, or when a mixture of silicide of copper, cobalt and silicon is submitted to the temperature of the electric furnace, a well-crystallised cobalt silicide of the composition Si_2Co is formed, the physical properties and chemical reactions of which are given in detail. Cobalt thus forms three definite crystalline compounds with silicon, having the formulæ $SiCo_2$, SiCo and Si_2Co, these compounds forming a series in all respects comparable with the silicides of iron.—On the calorific power of coal, by M. Goutal. By an examination of 600 specimens of coal of different kinds, the calorific value (P) is found to be given, with an approximation of 1 per cent., by the formula $P = 82\,C + a\,V$, in which C is the percentage of ash-free coke, V the volatile matter, and a a coefficient, a curve for the determination of which is given in the paper. The error may amount to 2 per cent. of the calorific value in the case of anthracite and some lignites.—On the existence of stable yeast forms in some moulds, by M. G. Odin.—On a modification produced in *Scopolia carnolica* following its grafting on the tomato, by M. Lucien Daniel.

NEW SOUTH WALES.

Royal Society, August 6.—Prof. Warren, president, in the chair.—On the mitigation of floods in the Hunter River, by Mr. J. H. Maiden. The paper discusses the subject from the point of view of the forester.

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