THURSDAY, MAY 10, 1906.

THE CELL IN MODERN BIOLOGY.

Algemeine Biologie. Die Zelle und die Gewebe. Second edition. By Oscar Hertwig. Pp. xvi+648; 371 illustrations. (Jena: Gustav Fischer, 1906.) Price 15 marks.

THE volume before us appears as the second edition of the author's well known treatise on the cell, the first part of which was published so long ago as 1892.

Cytology has advanced a good deal since that time, and one finds a significant recognition of its wider scope in the new title—"General Biology"—given by Prof. Hertwig to his book. Experience is showing that the larger problems connected with living things, such as organisation, heredity, function, as well as those abnormal reactions constituting what we call pathology, are all reducible to cell problems.

For the most complex living creature is resolvable into groups of more or less modified cells, and the latter are not merely bound together like faggots in a bundle, but each group, each cell it may be, in so far as it is the seat of chemical or physical change, is able in greater or less degree to exert an influence on other individuals of the cell community. In this way there arise those adjusted relationships that exist between different organs, tissues, and cells which we designate as correlations, and it is just because of the existence of these inter-dependent cellular reactivities that complex organisation has come to be a possibility.

One of the chief aims of Prof. Hertwig's book is to trace the cell in its manifold variety of form and its diverse conditions of activity, especially with reference to the part it plays as a corporate unit of the organism. It is perhaps inevitable that such a task should prove too great for any single writer to accomplish satisfactorily throughout, and, indeed, the present work is by no means free from the faults of its ambition. Some aspects of the subject are exceedingly well treated, others are left comparatively untouched, while in the case of yet others the standpoint taken up perhaps hardly represents that of contemporary thought. The last criticism especially applies to the discussion of some of the physiological attributes of cell life. Again, the more recently studied phenomena of apospory, apogamy, and parthenogenesis, with their general bearings on the processes of maiosis and fertilisation, are very scantily dealt with. The work is decidedly strongest on the morphological side, although even here the treatment seems to suffer from want of the physiological relationships involved.

A considerable portion of the book is occupied with discussions as to the connection that may subsist between the facts of cell structure and the phenomena of ontogeny and heredity. Brief accounts are given of the standpoints adopted and the theories advocated by other writers, and Hertwig adds another of his own, which he terms biogenesis.

It is not very easy to extract the author's exact position with regard to biogenesis, and nowhere in the volume does the theory appear to be summarised and presented in a succinct and complete form. But the doctrine it seems to embody is that development and specialisation of function, with the corresponding segregation of structure, are due to the correlative action of the parts on one another coupled with the influence of agencies operating from without—*i.e.* of the environmental conditions. It is this speculative part of the treatise, suggestive and interesting as it is, that will probably provoke the greatest antagonism. Hertwig is a thorough believer in the inheritance of acquired characters, though it seems not improbable that many will dissent from the interpretations he puts on cases that he apparently regards as critical ones.

The example of the supposed inheritance of immunity against the poisonous action of ricin, shown by Ehrlich to occur in the case of the offspring of mice under certain conditions, can hardly be accepted as satisfactory evidence of the "inheritance of acquired characters" as the phrase is critically understood. Indeed, it seems to break down altogether when the conditions under which it may be observed are examined and analysed. Mice are excessively sensitive to the effects of ricin, very minute doses being sufficient to bring about the death of the animal. But by repeated inoculation of sublethal doses of the poison a mouse may reach a state of immunity against the action of a quantity far greater than that which normally proves fatal. The offspring of *female* immunised mice are themselves also immune, at least during early life, whereas the young resulting from a cross between an immune male and an ordinary female do not exhibit the transmission of the "acquired character." In other words, the transmission is confined to the female side. It is evident, however, that such a case is really of no value whatever as evidence of transmission of acquired characters in the proper acceptation of the term. For it is manifest that the young animal during the whole of its existence *in utero* has been directly exposed to influences that ought to confer immunity upon it, apart altogether from any question of "transmission." Furthermore, it might well be that the bulky protoplasm of the egg, irrespective of the maternal influence after conception, may have been affected without any disturbance of the hereditary mechanism, and, indeed, Hertwig himself admits as much.

The case of certain Lepidoptera is more difficult of satisfactory explanation, although the evidence would probably be insufficient to convince an opponent. Some of these insects respond to different climatal conditions by the production of different colour-patterns on their wings. Now if the pupæ of some species (*e.g. Arctia caja*) be subjected to cold, the "cold" form of imago will appear, and if the fertile eggs of such "cold" forms be raised under warmer conditions, a small percentage of the perfect insects thus produced will retain the characters of the "cold" form. Hertwig dissents from the explanation, suggested by Weismann, that the eggs themselves may have been affected whilst still in the body of the

parent insect in the pupal condition, but his argument does not amount to much; and it may well be borne in mind that an example of somewhat analogous character is afforded by the alternative characters exhibited by the leaves and other structures of many amphibious plants. Many of these can assume one of two different forms, the production of either depending on the stimulus given by the environment to the embryonic tissues at the growing points. Thus the form of, say, a leaf of such a plant is determined at a very early stage in its development, and long before it is sufficiently advanced for any functionally direct adaptation to a terrestrial or to an aquatic environment. But when once the stimulus has operated, subsequent removal to opposite conditions does not result in a corresponding alteration in the future development of such a leaf—it belongs definitely to the aquatic or to the terrestrial type, whichever line of ontogeny it embarked on from the first. It would seem, at any rate for the present, and in the absence of sufficient experimental evidence to the contrary, more natural to regard these di- or polymorphic species as "balanced" forms; the actual course of their ontogeny, whilst restricted to certain directions, and confined within definite limits, depending on the alternative character of some metabolic activity. This is, however, very different from an admission of the "inheritance of acquired characters." For if anything at all is meant by the expression, it can only imply that the hereditary mechanism has itself undergone a definite and corresponding change; and at present a direct influence of the environment in this sense is negatived by the results of the most critically conducted experiments on breeding.

Hertwig takes up a definite position as to the relation of the "somatic" to the "germ" cells. He regards all the cells of the body as fundamentally equivalent, though differentiation may mask and finally render impossible the return of a particular cell to the embryonic state. The definite tissue cell has become specialised rather as the result of an impulse from without than by a segregative process of analysis; and herein he is diametrically opposed to Weismann and his followers, in regarding cellular differentiation as a secondary rather than as a primary matter. In this he will find many who are at one with him, for the "erbungleich" division postulated by Weismann, which would result in development consisting of a sorting out or analysis of the characters of the germ, conflicts with many facts of experience, and it is only by numerous "Hilfshypothese" that it can be sustained for the plant and vegetable kingdoms.

In a notice of a book like this one of Hertwig's, it is natural that the points on which diversity of opinion prevails should occupy a relatively prominent place. But such treatment is in no way intended to detract from or to minimise the great value of the work, coming as it does from one who has himself done so much to advance the subject of which he writes, and whose lucid and suggestive treatment of his theme will always command attention. It is a book that should be read by all who are interested in the questions of modern biology. J. B. FARMER.

APPRECIATIONS OF HAECKEL.

(1) *Ernst Haeckel: Der Mann und sein Werk.* By Carl W. Neumann. Pp. 80. (Berlin: Gose and Tetzlaff, n.d.) Price 1.50 marks.

(2) *Haeckel: His Life and Work.* By Wilhelm Bölsche, with introduction and supplementary chapter by the translator, Joseph McCabe. Pp. 336; illustrated. (London: T. Fisher Unwin, 1906.) Price 15*s.* net.

(3) *Last Words on Evolution: a Popular Retrospect and Summary.* By Ernst Haeckel. Translated from the second edition by Joseph McCabe. Pp. 127; with portrait and three plates. (London: A. Owen and Co., 1906.) Price 6*s.*

(1) MANY who know Prof. Haeckel only as the author of zoological memoirs, evolutionist essays, and monistic propaganda, will be glad of the opportunity which this brightly written booklet affords of becoming more closely acquainted with the man himself and with the story of his life. We read with interest of the eager boy-naturalist wandering on the Siebengebirge, of the apprenticeship under Johannes Müller, of the year of medical practice (if a man can practise on three patients!), of the eventful year in Italy during which Haeckel nearly became a landscape painter, of the growing fascination which the plankton exerted, satisfying at once his artistic and scientific interests, of the influence that the "Origin of Species" had on him, and of his early settlement in Jena—that "feste Burg freien Denkens"—which nothing could ever induce him to leave. At the Stettin Versammlung in 1863 Haeckel entered the lists as a champion of the evolutionist "Weltanschauung," contending almost single-handed against contempt and prejudice. His cause, which eventually prevailed, as the truth must, had to be fought for, and those who are offended by the impetuous expressions of Haeckel's "Stürmernatur" are profitably reminded by this little book of the courage and indefatigability of perhaps the most virile protagonist of a thesis which has been one of the greatest contributions made by science to human progress. The author has told the story of Haeckel's life and work with vividness and enthusiasm. He concludes his effective sketch by indicating, somewhat too tersely and vaguely, how it has been possible for him to use the truth that is in Haeckel in developing a monistic philosophy more satisfying to the human spirit.

(2) Prof. W. Bölsche's study of Ernst Haeckel is, like the frontispiece to the book, a picture in warm colours. The author is nothing if not enthusiastic, and indeed no one can think over the achievements of Haeckel's life without sharing the author's admiration for his hero. If it be true, as the translator says, that "a hundred Haeckels, grotesque in their unlikeness to each other, circulate in our midst to-day," this "plain study of his personality and the growth of his ideas" should go far to replace them by giving us an appreciation approximately true. We should not ourselves have called Bölsche's book, as Mr. McCabe does, a "plain study," for its characteristic features are exuberant enthusiasm and a brilliantly

picturesque style which sometimes startles the reader with its daring.

We cannot do more than refer to a few of the interesting facts regarding Haeckel to which the author gives prominence. "Haeckel's genealogical tree spreads into the legal profession in a curiously complex way." This inheritance was expressed in Haeckel's imperious craving for clear lines and systematic arrangement, and in his fondness for formulating "laws." Apart from the influence of his teachers, such as Johannes Müller and Virchow, and of his friends, such as Gegenbaur, it was the sea—at Helgoland, at Nice, at Messina—that really won Haeckel for zoology. Regarding his pupillary period, the curious fact is mentioned that one of the theses he defended when taking his doctorate at Berlin was the impossibility of spontaneous generation. In 1860 Haeckel was "profoundly moved" by a first reading of "The Origin of Species," and conversations with Gegenbaur finally confirmed his conviction of the truth of Darwinism—a conviction which found its first, though not prominent, expression in his monograph on Radiolaria (1862). In 1863, at the Stettin congress, when Haeckel made his first open confession of the faith that was now in him, he won a laurel crown at the Leipzig athletic festival for the long jump (20 feet), and the translator justly remarks that we have here "the note of much in his character." What many zoologists, who neither misunderstand Haeckel nor fail to do him homage, feel, is that the impetuous, daring, pioneering evolutionist of Jena has taken many long jumps which scientific caution makes them refuse.

A fine chapter of the book is devoted to what is perhaps Haeckel's best and most lasting work, the "Generelle Morphologie" (1866). It was written, partly as a relief from sorrow, in less than a year, during which the author lived the life of a hermit, sleeping barely three or four hours a day, with habits so ascetic that he wondered at his survival. But the great work was too difficult for the general reader, too philosophical for the biologists, too biological for the philosophers, and thus with a clearly defined mission Haeckel set himself to the task, which he has so successfully accomplished, of making monistic evolutionism "understanded of the people."

One of the many interesting incidents related in Bölsche's appreciation may be quoted.

"A stern theologian presented himself in person at the chateau of Karl Alexander, Grand Duke of Weimar, and begged him to put an end to this scandal of the professorship of Haeckel, the arch-heretic. The Grand Duke, educated in the Weimar tradition of Goethe, asked, 'Do you think he really believes these things that he publishes?' 'Most certainly he does,' was the prompt reply. 'Very good,' said the Grand Duke, 'then the man simply does the same as you do.'"

As Prof. Bölsche closed his charming biographical sketch in 1900, the translator, who has done his work admirably, has added a chapter on the crowning years, dealing with the controversies over the "Riddle of the Universe," and other events. The whole work, helped by the excellent portraits, leaves one with a grateful impression of a remarkable personality who has all his life been a good fighter yet most lovable withal, who has done much for pure science and yet has never ceased to say "Das Leben ist schön."

(3) In these three lectures, delivered last year in Berlin, Prof. Haeckel reiterated with wonted frankness and fearlessness his evolutionist and monistic convictions. He trounced the theologians and metaphysicians for ignoring or combating or misrepresenting the secure results of science, and he did not refrain from reproving some of his own craft—even his revered master, Virchow—for trying to sit on both sides of the fence. He is himself so well satisfied with the naturalistic formulation of what goes on, and has gone on, in the wide world, that he has no patience with those who seek for explanations that science *ex hypothesi* can never give.

The law of evolution and the law of substance (the conservation of matter and energy) "are irreconcilable with the three central dogmas of metaphysics, which so many educated people still regard as the most precious treasures of their spiritual life—the belief in a personal God, the personal immortality of the soul and the liberty of the human will." Not that these are to be driven out of the world. "They merely cease to pose as truths in the realm of pure science. As imaginative creations, they retain a certain value in the world of poetry."

To many this will seem a false antithesis, an opposition of incommensurables. It can hardly be pathologically that the human spirit has so persistently attempted to get beyond common sense and empirical science to a formulation of the efficient causes, the significance, the purpose of all becoming. As a matter of fact, Haeckel himself is a worshipper of "a Monistic god, the all-embracing essence of the world, the Nature-god of Spinoza and Goethe, identical with the eternal, all-inspiring energy, one, in eternal and infinite substance, with space-filling matter," whose "will is at work in every falling drop of rain and every growing crystal, in the scent of the rose and in the spirit of man."

The lectures have been very successfully translated by Mr. McCabe. We may note that the date given for Weismann's theory of germ-plasm is 1844, which seems rather early, while that of Lamarck's "Philosophie Zoologique" (1899) is rather late.

PRACTICAL GEOGRAPHY.

An Introduction to Practical Geography. By A. T. Simmons and Hugh Richardson. Pp. xi+380. (London: Macmillan and Co., Ltd., 1905.) Price 3*s.* 6*d.*

THIS book is based on an excellent idea, which has in many ways been excellently carried out. Its design is to show how to cultivate in the teaching of geography the methods of scientific training, the methods by which boys and girls are guided to reach sound conclusions from their own observations and experiments.

Unfortunately, the execution of this design is marred by the apparent absence from the minds of the authors of a clear idea of what geography is. Geography, it must be admitted, is a subject which

is sadly in want of a generally accepted definition fitted to give a clear idea of its scope. But though this definition is lacking, the handling of the subject is coming to be more and more in accordance with the idea that the governing function of geography is to indicate the nature and relative importance of the influences exercised on the life of the globe, especially human life, by local conditions and place relations. It is evident that this idea has been implicitly in the minds of the authors in the preparation of some parts of the book, but it is equally evident that the idea has never been expressly recognised by them, and accordingly it has not been consistently acted on. One result is that a good deal is admitted into the book which has no place in geography, but a still more serious result is that again and again the practical guidance stops short of the goal to which the learners should have been led.

Some examples may be given. Inevitably the work lays stress on map-making and the observations on which maps are based. Maps being necessary in the study of geography, boys and girls must be got to understand as clearly as possible how far those records of the facts which have to be studied serve in place of the actual facts, and in what points they are apt to mislead. Now, while there is much that is admirable in what is said, shown, and hinted on pp. 51–72 on hachures and contours, there is no hint of what hachures and contours respectively fail to represent. The subject of projections is rightly dealt with, for within due limits it is not beyond the reach of school children. But here the failure is more striking. The only reason for taking up this subject is to get the learners to understand how inevitably any projection must fail to represent the truth in some points, to perceive in each case the chief failures, and to discern the reasons for using certain projections in spite of their defects. But on these points no hint is given. The principle of the construction of what is called Mercator's projection is described, but, strangely enough, no question is put with the view of getting those who use the book to recognise its obvious faults, and no indication is furnished of its compensating utilities. This, indeed, would have been impossible, at least in the case of its utility for marine charts, inasmuch as the projection described is not Mercator's, but the useless central cylindrical. So, too, the projection described as the conical is not the conical, and is, in fact, no used projection whatever.

To take another subject, under the heading of isotherms and parallels of latitude we have on pp. 227 and 228 a large number of average mean temperatures for the months of January and July, but for different places, thus failing to afford an opportunity for comparing ranges of temperature. Then again, under the heading of aspect and temperature, pp. 241–3, the important subject of the difference of temperature between the east and west of the northern oceans and land-masses is dealt with, but is illustrated only by certain figures from Hann presenting this difference in the least instructive light, in the manner which fails to bring out the difference which is of most practical importance to the inhabitants of the earth. The figures show only the difference in the mean annual range of temperature, and do not indicate that this difference is brought about in every case in a greatly preponderant degree by the varying range of the winter temperatures.

Such defects are worth pointing out, chiefly because the book is on the whole so good that one cannot help earnestly wishing that it were better, and because it may be hoped that they will be removed in a future edition. Even as it is, it must be recognised that the immense pains taken by the authors have resulted in the preparation of a work which is full of suggestiveness, and ought to supply a countless number of useful hints to capable teachers of geography.

GEO. G. CHISHOLM.

FOLKLORE AND MEDICINE OF THE ZULU-KAFIR.

Bantu Folklore (Medical and General). By Dr. Matthew L. Hewat. Pp. 112. (Cape Town: T. M. Miller; London: J. and A. Churchill, n.d.)

THIS is an interesting little work. It will be of value to students of primitive races. It deals chiefly with the ideas of the South African Kafir tribes on the subject of magic, medicine, diseases, and initiation ceremonies. Incidentally it gives a great insight into the extraordinary mixture of superstition, quackery, and practical research in native medicine. The Kafirs are nearly always at fault in their guesses as to the origin of diseases. Some maladies are thought to be caused by the supernatural influence of snakes or of water monsters, half man and half animal, or by the strange bird called impundulu, which by some is thought to be the origin of lightning. Other diseases are attributed to direct poisoning—the word for poison, *ubuti*, being a very old Bantu root that means the "essence of the tree." This is a word that in many Bantu languages means medicine quite as much as poison, all the medicines of primitive man having been derived from the bark, sap, fruit, or leaves of trees. Some of the "snakes" alluded to by the author as the cause of intestinal diseases (in the native mind) are evidently distorted accounts of guinea-worm or tape-worm.

The king or chief of the tribe is theoretically regarded as the first amongst the local medicine men. Professional doctors, however, may be of either sex. They are often divided into the following classes: (1) Witch doctors—diviners, mesmerists, prophets, or secret service agents, "faith-healers," and masseurs. The last-named type of witch doctor is the only one that performs any good service. Like most negro races, the Kafirs believe greatly in the efficacy of massage. (2) The surgeon or bone-setter, who also practises cupping. (3) The physician or herb doctor. In addition there are two special classes of medicine men, who attend to the bringing of rain or the prediction and direction of warlike operations. Very great misery and loss of life were caused until quite recently by the witch-hunting practices of the medicine men. These priests often became petty tyrants, in-

troducing a tyranny as hateful as that of the Holy Inquisition by their witch-smelling practices.

As regards the use of herbs, it is pointed out that the natives are in the possession of many valuable drugs. Amongst these they have been for generations in the habit of using a decoction of the leaves of the Cape willow for the cure of rheumatic pains, thus preceding Europe in an appreciation of the curative properties of salicin. A list of all the diseases to which Kafir man, woman, and child are liable is given, together with their native names, and the remedies which the natives so successfully apply. There is a chapter on midwifery and the rearing of infants, which leaves one surprised that the Kafir race has not long since come to an end by indirect infanticide. The extraordinary treatment of newly-born children may act as a kind of spur to the survival of the fittest; it most certainly kills out weakly children. The newly-born baby is "bled at the point of the fingers for luck; then held in the smoke of a slow fire till it sneezes or coughs, to show that it is not bewitched. It is then thoroughly rubbed all over with a solution of cow-dung," and so forth. Instead of being allowed to suck at the breast, it is fed at first on sour cow's milk, which is "forced down the throat of the poor little mortal by blowing into its mouth and compelling it to swallow."

Notes are given as to the operations performed on girls in the initiation schools (the elongation of the *labia minora*), and also in regard to the circumcision of the males.

The introduction to the book contains a useful summary of Kafir history, but is marked, like nearly all the writing that comes from South Africa, by a curious ignorance of Bantu history north of the Zambezi. H. H. JOHNSTON.

OUR BOOK SHELF.

Sociological Papers. Vol. ii., 1905. Pp. xiii+312. Published for the Sociological Society. (London: Macmillan and Co., Ltd., 1906.) Price 10*s.* 6*d.*

THOUGH hardly equal in interest to its precursor, the present volume contains some valuable contributions to sociology. First, and foremost in interest and importance, comes a paper on eugenics by Mr. Francis Galton. He argues that man, whether civilised or barbarian, has submitted to restrictions in marriage, and, therefore, that a new restriction in accordance with eugenics may be imposed. Mankind has borne the yoke of monogamy, endogamy, exogamy. He has recognised prohibited degrees of kinship. Why cannot a new taboo be started? Dr. Haddon adduces an argument that is much to the point: the world is becoming self-conscious and modern civilisation has at command great resources for bringing about a revolution in men's views and practice. Dr. Max Nordau thinks the proposals unpractical. Modern restrictions would have no religious sanction, and would therefore fail. He would trust more to an improvement of the environment than to eugenics. There are many medical men who, like Dr Max Nordau, think that environment is everything. Prof. Tönnies fears that *mariages de convenance* and *mariages de passion* will continue in spite of eugenics. Lady Welby sees the difficulty of considering the interests of the race and at the same time making the most of the individual. Mr. Galton, whose enthusiasm compels admiration, answers the main objections forcibly.

Among the other papers are the following:—Civics, by Prof. Geddes (he argues for evolutionary sociology and for a civics exhibition); The school in some of its relations to social organisation and to national life, by Prof. M. E. Sadler (he urges that scope be left for "group effort and private enterprise in education"); The influence of magic on social relationships, by Dr. E. Westermarck; On the relation between sociology and ethics, by Prof. Höffding; Some guiding principles in the philosophy of history, by Dr. J. H. Bridges; Sociological studies, by Mr. J. S. Stuart-Glennie. F. W. H.

The Heart of a Garden. By Rosamund Marriott Watson. Pp. 162. (London: Alexander Moring, Ltd., The De La More Press, 1906.) Price 7*s.* 6*d.* net.

THE title of this book is significant. The reader is not led to expect cultural details or botanical technicalities. To use a vulgarism, "science is not in it." What we have is a record of musings, such as would suggest themselves at each successive season, to one more concerned with the poetry and beauty of nature than with its philosophy. Notwithstanding this, the author shows herself a careful observer and a skilful delineator. Take, for instance, this account of the winter aconite (Eranthis). The writer is descanting on the promise of early spring, and goes on to say:—

"And even flowers are not wanting; multitudes of small, gold heads have shyly thrust themselves up through the dark earth, wrapped closely about in their green hoods which, as the sun grows warmer, they will fling back to do service as jaunty fringed capes."

This is not a botanical description; nevertheless, there is no mistaking what flower the writer had in view. The lady, with most other people, has her likes and her dislikes, and her ideals are not those of her gardener. Still, that functionary is paid to do certain work, and it is difficult to see how he can fulfil his duties properly if "milk-white pigeons with the roseate feet" are allowed to gratify their proclivities among the sweet peas and the gooseberries, and other culprits are permitted to make havoc with the strawberries.

Be this as it may, the author contrives to get a continuous feast of pleasure from the garden of which she writes, and by her cheery optimism and the elegance of her narrative affords the reader a share of the gratification she herself experiences. Dainty lyrics enliven the text. Even the pug-dog "Momotaro" is immortalised, though the invocation to him, "Hued like the full moon of the apricot," strikes us as peculiar. What sort of apricots can they be that possess full moons? In a work of this kind, however, allowance must be made for poetic imaginings. The illustrations are numerous and well executed. The book throughout is pleasantly written, and attractive to the eye.

Methods in Microscopical Research—Vegetable Histology. By Abraham Flatters. Pp. x+116. (Manchester and London: Sherratt and Hughes.) Price 2*1s.* net.

THIS work is designed to give a course of instruction in the practical working out of the internal structure of a number of higher types belonging to the vegetable kingdom, and should admirably fulfil this purpose. The earlier portion deals with the general preparation of specimens, collection, fixation, and preservation; instruments and section cutting; staining and mount-

ing, and is fully illustrated. Formulæ for reagents, stains, &c., then follow, after which certain types are selected and full directions given for demonstrating root, stem, floral, cell, and other structures. This section is illustrated with twenty-three coloured plates of the specimens, beautifully executed and with ample descriptions. The author is to be congratulated on the success which he has attained in the production of this work. R. T. HEWLETT.

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 San Francisco Earthquake of April 18.

THIS disastrous earthquake was remarkable for its long duration and the rotatory character of the movement. As observed at Mare Island the first sign was a very faint, gentle rustling, the waves being the merest tremors; but after about a minute's duration they had grown to such proportions as to be felt by everyone. The violent phase lasted about forty seconds, and then the shocks died out, the last feeble tremors vanishing about three and a half minutes from the time of the first perception. The writer was favourably situated for noting the slightest disturbance, and had been awake some time before the first tremors were felt, and he could see the clock face at the beginning and end of the disturbance, which read about 5h. 11m. and 5h. 14m. 30s. Two of the four astronomical clocks at the Mare Island Observatory were stopped by having their pendulums thrown upon the ledge which carries the scale for measuring the amplitude of the swing. The time of the violent oscillation thus automatically recorded was 5h. 12m. 37s., Pacific Standard Time, eight hours slow of Greenwich. The waves were mainly from the south and south-south-west, and they seemed to turn to the west, giving the movement an elliptical, clockwise rotation. The pendulums of the two clocks which kept moving had their points rubbed against the swing index of the ledge so violently that the metal of the index was brightened by the friction of the pendulum points, and the time thereby deranged more than twenty seconds. Except for the disturbance of objects on the ground, the earthquake seemed to be essentially noiseless. Other slight shocks have continued at irregular intervals for the past five days. T. J. J. SEE.

U.S. Naval Observatory, Mare Island, California, April 23.

Interpretation of Meteorological Records.

I REGRET that, owing to absence from home, I have only now seen Mr. Lander's letter in NATURE of April 19; I have to apologise for my inexcusable carelessness in writing of the storm as being accompanied by rain in place of snow and hail. However, accepting Mr. Lander's correction, it does not appear that the change will produce any alteration in the interpretation of the records, as it does not matter whether the water fell in the liquid or the solid state; its presence in either form would check any rise of temperature due to compression in the downward moving air. Any difference in the effect of snow compared with rain in producing a downward movement of the air would be to make the current stronger, because the air offers greater resistance to the fall of snow than to rain.

It is very interesting to know that at the place where Mr. Lander made his observations the barometer began to rise before the first hail arrived. But if the interpretation offered of the records be correct, this would only seem to indicate that his place of observation was not directly under the area where the storm began, and that the compression produced by the falling hail and snow travelled outwards and caused a rise in his barometer before the storm cloud brought the hail to him.

Baveno, Italy, May 7. JOHN AITKEN.

RECENT PUBLICATIONS OF THE BUREAU OF AMERICAN ETHNOLOGY.[1]

WE welcome the long-looked-for monograph on the Hako ceremony of the Pawnee by Miss Alice C. Fletcher, the Thaw Fellow of Harvard University, as upon her, so to speak, has fallen the mantle of Cushing. Not only has she a long and intimate acquaintance with certain tribes of the Plains Indians, but her affection for and sympathy with the Indians is so marked that the old and prominent natives have confided to her their sacred lore; and she was even able to induce Tahirussawichi to come to Washington, he being the keeper of the old and sacred objects, whose life has been devoted to the acquisition and maintenance of certain sacred rites. In 1898 he was taken to the Capitol and the Library of Congress. While the vastness and beauty of these structures gave him pleasure, they did not appeal to him, for such buildings, he said, were unfitted to contain sacred symbols of the religion of his ancestors, in the service of which he had spent his long life. He admired at a distance the Washington Monument, and when he visited it he measured the base by pacing, but he would not go up, saying, "I will not go up. The white man likes to pile up stones, and he may go to the top of them; I will not. I have ascended the mountains made by Tira'wa."

The purpose of the ceremony was twofold: (1) to benefit particular individuals by bringing to them the promise of children, long life, and plenty; (2) to establish a bond of friendship and peace between two distinct groups of people. It is intertribal, and not only serves as a means for the interchange of ideas through contact and through gifts, but represents one of the many powerful agencies which, by spreading tolerance and friendly feeling, tend to weld scattered warlike bands of men into great, peaceful nations. A desire for offspring was probably the original idea. The ceremony is very old, and has been modified in the process of time to adapt it to changed conditions of environment. For example, the substitution of the buffalo for the deer, and the transference of songs; thus one formerly sung while on a journey to the mesa is now sung within the lodge.

"Each ritual contains one general thought, which is elaborated by songs and attendant acts. These songs and acts are so closely related to the central thought that one helps to keep the other in mind, and they all form a sequence that, in the mind of the Pawnee, can not logically be broken. The compact structure of the Hako ceremony bears testimony to the mental grasp of the people who formulated it. As we note the balancing of the various parts, and the steady progression from the opening song of the first ritual to the closing prayer in the twentieth, and recall the fact that the ceremony was constructed without the steadying force of the written record, we

1 "Hopi Katcinas." Drawn by Native Artists. By Jesse Walter Fewkes.

"Iroquoian Cosmology." First Part. By J. N. B. Hewitt. Twenty-first Annual Report of the Bureau of American Ethnology. 1899–1900. (Washington, 1902.)

"Two Summers' Work in Pueblo Ruins." By Jesse Walter Fewkes.

"Mayan Calendar Systems, II." By Cyrus Thomas. Twenty-second Annual Report. Part i., 1900–1901 (1904).

"The Hako: a Pawnee Ceremony." By Alice C. Fletcher, assisted by James R. Murie. Music transcribed by E. S. Tracy. *Ibid.* Part ii. (1904).

"The Zuñi Indians; their Mythology, Esoteric Fraternities, and Ceremonies." By Matilda Coxe Stevenson. Twenty-third Annual Report, 1901–1902 (1904).

"Mexican and Central American Antiquities, Calendar Systems, and History." Twenty-four Papers. By E. Seler, E. Förstmann, P. Schellhas, C. Sapper, and E. P. Dieseldorff. Translated from the German under the supervision of C. P. Bowditch. Smithsonian Institution, Bureau of American Ethnology. Bulletin 28 (pp. 682). (Washington: Government Printing Office, 1904.)

"Haida Texts and Myths; Skidegate Dialect." Recorded by John R. Swanton. *Ibid.* Bulletin 29, 1905.

are impressed, on the one hand, by the intellectual power displayed in the construction, and, on the other, by the sharply defined belief fundamental to the ceremony."

Miss Fletcher gives the music and exact translation of the songs, with a native explanation of their meaning. The ritual objects are illustrated by several coloured plates. This sympathetic interpretation of an ancient ritual deserves the careful study of those interested in comparative religion or in the beginnings of literary expression.

Mr. J. N. B. Hewitt gives the first part of a careful study of Iroquoian cosmology; three texts, with literal and free translations, are given of Onondaga, Mohawk, and Seneca variants. A fact of great importance in these texts is that man-beings were in Iroquoian thought the primal beings; they belonged to a rather vague class of which man was the characteristic type. Beast gods appear later. In the development of

FIG. 1.—The Kurahus in ceremonial dress. A Kurahus is the director of the Hako Ceremony; the name means an old man who is venerated for his knowledge and experience.

Iroquoian thought animals, plants, rocks, and streams, having human or other effective attributes or properties in a paramount measure, were regarded as the controllers of those attributes or properties, which could be made available by *orenda* or magic power. Thus began the reign of beast gods, tree gods, and their kind, but the native term usually translated into English as "god" really signifies "disposer" or "controller," and each received worship and prayers.

In a profusely and beautifully illustrated memoir of over six hundred pages Mrs. Matilda Coxe Stevenson has given us an elaborate account of the mythology, esoteric fraternities, and the ceremonies of the Zuñis, as well as brief sketches describing the everyday life, arts, and customs of the people. It is obvious that it would be very difficult to give anything like an adequate account of this storehouse of data. The ceremonies are described with that commendable wealth of detail which characterises the work done by the best American students, and the book is a worthy extension of earlier studies of the Zuñi by the lamented Cushing and by Dr. J. W. Fewkes. The Pueblo Indians are the most interesting of North American aborigines, owing to the effects the wonderful desert-land has upon the social condition of the people, and to the intricate and symbolic ritual they have evolved, which also may in a real sense be said to be a direct result of their environment. It is therefore with great satisfaction that we welcome additions to the already voluminous literature concerning these charming people. Mrs. Stevenson says:—

"The philosophy of the Indian, as of man wher-

FIG. 2.—Hopi Katcinas drawn by native artists. Pañwû is represented by the two top figures. The figure Tiwenu carries a tablet on the head and a pine branch in each hand. The Kwewû picture has a well-drawn wolf's head with projecting mouth. The kilt is made of horse-hair stained red.

ever found, is the result of his desire and his efforts to understand the mysteries of nature. These children of the human family are highly imaginative. The soul of the Zuñi expands with adoration toward the supreme mysterious power that controls all things, and toward the gods, whose forms are visible in the heavens above, in the earth beneath, and in the waters under the earth, who are only less mighty than the supreme power, and who bless the good and punish the wicked."

She admits it is yet to be determined what part clanship played in the dawn of the ritualistic life of the Zuñi.

"It is certain that for a long time past membership at large in the fundamental religious bodies of the Zuñi has not been dependent on the ties of clanship, though in certain cases succession to office in fraternities does depend on clanship. Before any exposition of the origin of the fundamental religious organisations and of the ritual can be offered, a comparative study of the Pueblos must be made. In this work the passing hours are golden, for not only are the villages losing their old-time landmarks, but the people themselves are changing, are adapting themselves to a suddenly and profoundly altered environment, and the Zuñi at least, whose religion teaches them to speak with one tongue, to be gentle to all, and to subdue the passions, thereby winning the favour of their gods, are, under the influence of modern conditions, losing the restraining power of this religion, and, as a result, are changing for the worse."

It is to be hoped that competent students will make a thorough study of the sociology of these people without delay, and at the same time make a serious effort to trace the transition of the old clan system into the later religious fraternities.

FIG. 3.—Sword Swallowers of Ma'ke Hlan nakwe (Great Fire Fraternity of the Zuñis).

The memoir by Dr. J. W. Fewkes on Hopi Katcinas drawn by native artists cannot fail to be of considerable interest to students of various departments of ethnology. The practice of illustrating ethnological researches by native drawings is much to be recommended, as the drawings throw considerable sidelight upon the ideas and skill of the artists, and help us in the study of their psychology; in the present instance they have additional value in the suggestive similarities they present to pictographs in the codices of more southerly regions. The term katcina was originally limited to the spirits of the ancients of the Hopi or personified medicine power, and personifications of a similar power in other objects have likewise come to be called katcinas. Thus the magic power or medicine of the sun or earth may be called katcina. The term is also applied to personations of these spirits or medicine potencies by men, or their representation by pictures or images. In the Hopi ritual there are dramatic celebrations of the arrival and departure of the katcinas, and during the whole year there are ceremonies in which katcinas take part. The annual ceremonies vary considerably each year, so the katcinas are correspondingly numerous, and not only have clans introduced new katcinas from time to time, but individuals have done the same even by men still alive. Some of these ceremonies have developed into a regular dramatic performance; the motive of one of these dramas is the growth of corn, with representations of the maleficent and beneficent agencies that affect the crop. The performance is designed primarily to invoke the favour of the mysteries by appropriate symbols combined with the edification of the community at large. Thus a portion of the chamber is set apart as a stage, while the greater portion is reserved as an auditorium. A screen on the stage is painted with appropriate symbols, and is perforated to permit the passage of the masked effigies representing the mystical potencies, which are operated by shamans hidden behind the screen, something after the fashion of marionettes. The front of the stage is occupied by a symbolic field of corn, and the figures which represent the storm and drought emerge from their respective apertures in the screen and destroy the cornfield; but they are opposed partly by musical and other incantations of a group of shamans occupying one side of the stage, and partly by human actors who wrestle with and finally overcome the evil marionettes. The entire dramatisation stands on a higher plane than any prevalent among other tribes of the territory of the United States, though lower than that reached among the Nahuatlan and Mayan peoples of Mexico.

Under the title of "Two Summers' Work in Pueblo Ruins," Dr. Fewkes describes his survey of certain ruins mainly in the Province of Tusayan. Dr. Fewkes's excavations confirmed some statements made by the Hopis concerning their former history, and his intimate knowledge of the ritual and ceremonies of the existing Pueblo Indians has enabled him to explain the use or significance of objects dug up by him. The report is illustrated by photographs of ruins, plans of buildings, and a large number of beautifully executed coloured plates of decorated pottery, besides numerous figures in the text. The author inclines to the belief that the Zuñis never advanced to the same perfection in the ceramic art as did the Hopis. The author says, "In the evolution of Pueblo decoration the development of ornamentation advances from geometrical patterns to rude picture writing, and, as a rule, the pottery on which the former predominate is inferior to that on which the latter is most prominent"; but this hardly seems consistent with the subsequent remark that "the more ancient the ruin is, the better is the pottery."

Dr. Cyrus Thomas gives the second portion of his study of Mayan calendar systems, in which he deals with Maudslay's investigation of the ruins at Quirigua and discusses Goodman's results. The paper includes an account of the Maya method of calculation.

Serious English-speaking students of Central American archæology must know the writings of the distinguished German scholars whose names appear in Bulletin 28 under review; but even they will be glad to have these scattered papers translated for more convenient reference and collected in one volume. Other students who like to know what is being discovered in this region will be very thankful to Mr. Bowditch for his enterprise and labour in translating these papers, and to the Smithsonian Institution for placing all this material at their disposal in so convenient a form. On the whole, these papers will be of most value to those who concern themselves with the chronology and history of the Central American peoples; but there is a great deal to interest the general ethnologist, though he will have to search for his material, as most of it is scattered all over the volume in diverse papers. Particularly interesting in this respect are the papers on "Zapotec Priesthood and Ceremonials," "Deities and Religious Conceptions of the Zapotecs," and "Comparative Studies in the Field of Maya Antiquities"; the last paper deals with the clothing, personal decoration, and utensils of the Mayas as illustrated in the manuscripts, or on the monuments or other remains. According to a widespread tradition, the Toltecs were the originators of all arts and sciences; and the invention of the calendar is ascribed to them, and we are informed they carried their book with them on their migrations. The calendar is the fount of the Central American sacerdotal wisdom, and the great mass of Mexican and Maya manuscripts is nothing more than an elaboration of this calendric system in respect to its numerical theory, its chronology, and its system of divination. The book is copiously illustrated, and altogether it will form a most welcome addition to the working library of various kinds of students of archæology and ethnology.

Mr. Swanton gives literal translations of a number of Haida folk-tales obtained on the Queen Charlotte Islands, British Columbia; this careful piece of work will be much appreciated by folklorists.

When one looks at the bulk of ethnological matter published by the United States Government, and realises the enormous value to students of these full, accurate, and well-illustrated memoirs, one cannot but feel ashamed of our Government, which, possessing every opportunity and inducement to study and report upon our own native races, does absolutely nothing.

A. C. HADDON.

THE EDUCATION AND TRAINING OF THE ENGINEER.

ENGINEERING in its various branches takes so large and important a part in the industrial activities of modern nations that no pains are too great which will secure for our engineers a suitable and adequate school and college training, supplemented by a judiciously organised scheme of practical work in the shops and drawing office. More especially is this the case in this country, where, owing to the satisfaction which has followed previous success, manufacturers have been insufficiently alive to the fact that for many years other nations have been steadily building up efficient schemes of technical and professional education at the cost of much enterprise and greater self-sacrifice, with the natural result that our supremacy, long undisputed in these spheres of industry, has been undermined, and in some degree wrested from us.

It is for reasons such as these that the investigations inaugurated and carried out under the auspices of the Institution of Civil Engineers, the results of which are embodied in a recent report on the education and training of engineers, are to be welcomed. In November, 1903, the council of the Institution appointed a committee to consider and report as to the best methods of training for all classes of engineers, including both scholastic and subsequent technical education, it being an instruction of the council that the principle was to be maintained that the education of an engineer must include both practical experience and scientific training. The constitution of the committee was completed in February, 1904, and owing to the wisdom and breadth of outlook of the council of the Institution of Civil Engineers, accredited representatives of the various institutions of mechanical, electrical, gas, and mining engineers, naval architects, shipbuilders, and others were added to the committee, which under the able chairmanship of Sir William White, K.C.B., F.R.S., was soon actively at work.

The inquiry, which has extended over more than two years, proceeded under the following sections: (1) Preparatory education in secondary schools; (2) training in offices, workshops, factories, or on works; (3) training in universities and higher technical institutions; (4) post-graduate work. The investigations under the first heading were entrusted to a subcommitee, while the committee as a whole undertook the consideration of the questions arising under the remaining three sections. The inquiries of the committee have been prosecuted by obtaining, sometimes orally though generally by correspondence, the opinions of teachers and professors with experience in engineering education, and of eminent engineers practising in various branches of the profession. The ultimate result is that, though diversities of opinion have been disclosed in regard to some details, yet, in all the main features of its recommendations, the committee has support from the great majority of professional engineers as well as of the professors of engineering subjects in our universities and higher technical institutions.

PREPARATORY EDUCATION.

The subcommittee, entrusted with the work of ascertaining the views of authorities competent to speak concerning the most suitable form of secondary education for boys destined to become engineers, issued a schedule of questions to 120 representative teachers in engineering colleges, headmasters of secondary schools devoting special attention to scientific training, and engineers not engaged in teaching. The queries raised in the schedule dealt with such points as the proper age for leaving school, the desirability of a leaving examination for secondary schools, the extent and methods of the teaching—suitable for future engineers—in English subjects, languages, mathematics, science, drawing, and surveying. The schedule of questions raised, in addition, the important subject as to how far schoolboys should have, as a school exercise, practice in ordinary handicraft work, such as carpentry or turning; and to what extent it has been found better to make all "practical" work into laboratory exercises in science. Replies were received from 80 per cent. of the gentlemen whose opinions were invited, and from these definite conclusions were deduced as to the prevailing opinion on the points raised in the schedule of questions. These conclusions were embodied in a report of the subcommittee, which was eventually approved and adopted by the main committee. The following recommendations are the outcome of the exhaustive inquiry.

A boy intended for the engineering profession should, before leaving school and commencing to specialise, have attained a standard of education equivalent to that recognised by universities for matriculation

purposes. His special training should not commence until he is about seventeen years of age. To ensure such a standard of efficiency a leaving examination for secondary schools is desirable throughout the United Kingdom, so that there may be no room for doubt as to whether a boy has received a satisfactory preliminary education.

Advanced teaching of history and geography, with instruction and practice in essay-writing and in précis-writing, should be included in the ordinary school curriculum; and the instruction in English subjects should include at least an introduction to English literature.

Greek should not be required, but an elementary knowledge of Latin is desirable. The study of Latin should, however, be discontinued during the last two years of attendance at school, or after the standard required for the leaving certificate has been attained. Modern languages, especially French and German, should be studied, and should be taught colloquially or in such a way as to give the pupils a practical knowledge of each language, sufficient to enable them to study its literature and to converse in it with some degree of facility.

Instruction in mathematics should be given by methods differing considerably from those usually adopted in the teaching of this subject merely as an intellectual exercise. The geometrical side of mathematics should be fostered, and before they leave school boys should be conversant with the use of logarithms, and with at least the elements of trigonometry. Instruction in practical arithmetic should be carried further than has been generally the case hitherto, with the object especially of encouraging the use of contracted methods and of encouraging also the expression of results with only such a degree of accuracy as is consistent with the known degree of certainty of the data on which the calculations are based.

It is preferable that boys should attain at school a general knowledge of physics and chemistry rather than that they should pursue in detail some particular branch of science. Special attention should be given to drawing. Work in the nature of handicraft, such as carpentry or turning, may be encouraged as a recreation, but should not be required as a school exercise.

The committee very properly recommends that the scheme of education outlined in its report should be communicated officially to the Board of Education and be circulated widely amongst those responsible for the work in secondary schools and engineering colleges. The importance of the committee's recommendations, indeed, cannot be overestimated. Educational experts have long foreseen the impossibility of securing a rational system of secondary education in the absence of a carefully planned investigation to determine precisely what secondary education has to accomplish and how the desired end may best be reached. The Institution of Civil Engineers has by its public-spirited action shown schoolmasters the way so far as the education of future engineers is concerned. Here is the opportunity for which earnest educators have been looking. The ground to be covered has been carefully mapped out by experts, and we at last know precisely what is required of the secondary school so far as training engineers is concerned. It is earnestly to be hoped that the opportunity will not be lost. If for the next ten years these judicious recommendations could be made the basis of the secondary education provided for all boys intended for engineering, and if the results of following the scheme could be accurately recorded during this period, we should in 1916 be in possession of data which would bring us within easy distance of formulating with confidence a course of school study which would provide engineers with boys trained in such a way as to make their future rational development easy and straightforward.

Engineering Training.

It was eventually decided by the committee to deal together with the sections of its inquiry concerned with training in offices, workshops, factories, or on works; training in universities and higher technical institutions; and post-graduate work. As in the case of the investigation dealing with the school career of the future engineer, so in this case a schedule of questions was framed and circulated widely. But a modification was introduced; the committee embodied in the schedule certain conclusions on important subjects on which it was unanimous. At the same time a free expression of divergent opinions was invited.

In the schedule of opinions and questions the committee expressed its opinion that the age for leaving school of the future engineer should be seventeen years, and seventy per cent. of the 267 engineers and others who sent replies expressed agreement with this proposal. The opinion of the committee that it is desirable that the course of training for all branches of engineering should include at least one year's training in mechanical engineering workshops, where, ordinarily, information would be gained of the practical applications of electricity, was endorsed by 72 per cent. of those who responded to the invitation of the committee to express their views, and 21 per cent. considered this period too short. There was, however, far less unanimity as to when this introductory workshop course should be taken. The committee laid it down that the course should be taken at an early period—either previously to the commencement of college training, or after that portion of the college training which is common to all branches of engineering has been completed. Thirty-three per cent. of the responding referees merely expressed agreement with the committee, while 47 per cent. were definite that it should be before the college training began.

Four-fifths of the replies received agreed with the committee that during the introductory workshop course, and indeed in subsequent similar courses, boys should keep the regular working hours, be treated like ordinary apprentices, and be paid wages. Rather more than half the referees replying thought boys should be expected to attend evening classes during this workshop course, and 35 per cent. thought educational work should be suspended during this time. A large majority of the replies showed that it is generally considered desirable that this workshop course should be followed by a period of study in a technical college or university before specialisation in particular branches of engineering is undertaken, and that the period of college study should be arranged so as to alternate with the practical training.

There was great diversity of opinion as to what constitutes a reasonable total period of practical training on works, in factories, workshops, mines, and so on—apart from the introductory workshop course. Thirty per cent. of the replies mention three years, twenty per cent. give two years, and the remaining opinions vary from one to five years. The committee recommends a total period of four years inclusive of the introductory workshop course. On the other hand, it seemed to be generally agreed that the scale on which appliances and equipment for instructing engineering students should be provided in technical colleges should be limited only by the funds at the disposal of the college authorities.

The three concluding opinions formulated by the committee on the schedule distributed met with general approval. It is considered desirable, in con-

nection with the grant of degrees, diplomas, and certificates to engineering students, that great importance should be attached to laboratory and experimental work performed by individual students, as well as to their progress in mathematical and scientific studies, rather than that degrees and so on should be granted on the results of terminal or final examinations. It is urged that facilities for post-graduate work by engineering students in higher technical institutions should be much increased; and it is admitted by almost all authorities that the improvements of engineering education depend greatly on the attitude of employers towards the recommendations made by the committee, and employers are urged to extend the facilities to engineering students for post-graduate study and research.

The recommendations of the committee in respect of engineering training embody the conclusions arrived at by an examination of the replies just summarised, and it is unnecessary to do more than point out the respects in which the recommendations amplify the opinions set forth in the schedule prepared for distribution. The recommendation respecting the introductory workshop course explained above recognises that at present there are practical difficulties in arranging for this workshop year being interposed between the school and college work, and that employers may consider the arrangement detrimental to their interests. The committee suggests, however, that these difficulties should not be insurmountable, and the general agreement as to its advantageous effect on training leads it to hope that practical trial may be given to the plan.

Concerning attendance at evening classes during the introductory workshop course, the committee thinks it is most important that all boys should at least maintain their scholastic acquirements, and it is considered that this result might be secured, by private tuition or otherwise, without undue physical strain. So, too, the general recommendation that the introductory workshop course should be followed immediately by attendance at college is modified. It is stated that in some cases—as, for example, when boys are intended to become mechanical engineers—it may be advantageous to complete the practical training before entering college; but, if this is done, private tuition or evening classes must be the rule during the years of practical work.

The longest of the recommendations urges the need for a sound and extensive knowledge of mathematics in all branches of engineering. The committee endorses the practically universal opinion that a sufficient time should be allotted to the study of pure mathematics during the common college course, and that the extent to which individual students can be carried in mathematics must be decided by the teachers.

Such are, in brief, the more important of the committee's recommendations, and it is interesting to compare these with some aspects of American practice. The rule in the engineering courses of the colleges of the United States, which it must be remembered always follow a prolonged secondary education, is that in the first two years of the course—which generally lasts four years—a fair amount of time is given to mathematics, English, modern languages, and experimental science, and it is chiefly in the workshop and drawing office that the specialisation towards engineering is apparent during these years. Specialisation begins to show itself prominently during the third year, and mechanical technology and electrotechnics are more or less taken up in the mechanical and electrical engineering courses. In the fourth year a crowd of engineering subjects is frequently introduced. But as Prof. Ripper remarks in his Mosely Commission report, "From the English standpoint too much importance may be attached to prolonged literary training, and not enough importance to the practical training of students during the earlier years of their career, nor to the cultural value of a scientific and professional education." But in no respect are American conditions more different from those at home than in the attitude of the employers of labour toward higher education. As Dr. Walmsley has testified in a recent report (see NATURE, vol. lxx., p. 231), "Without exception the officials interviewed asserted that, far from having any difficulty in placing the graduates turned out year by year from the engineering courses, for the last few years the graduate class has had every one of its individual members engaged for remunerative work before the completion of the course at college."

Such are the importance of the report of the Institution of Civil Engineers and the care which has been expended upon its preparation, that it is to be hoped it will be read alike by all responsible for the education of our future engineers, and by those who are in a position to employ the young men when their training is complete. In face of the severe competition between nations for industrial supremacy, it becomes a national duty for each and all, who can assist and forward the means of preparing the men in whose care our manufactures and general mercantile welfare will rest, to do their best; and a debt of gratitude is due to the Institution of Civil Engineers for the work it has accomplished. A. T. S.

BALLOONS AND KITES IN THE SERVICE OF METEOROLOGY.

DURING recent years a considerable amount of information has been accumulated about the conditions which prevail in the higher strata of the atmosphere. Although observations of temperature and humidity were made by Glaisher from a free balloon more than fifty years ago, and later Mr. Archibald used kites to determine the change of wind velocity with elevation, it is only in the last ten years that a systematic attempt has been inaugurated to obtain information. There is now a fair amount of observational material awaiting someone with the necessary skill and leisure to work it up, and it is much to be hoped that the task may be taken in hand shortly, so that the results obtained in various countries and by various organisations or individuals may be arranged and coordinated, in order that further inquiry may be pushed along the most promising lines.

The means of observation available are practically kites and small unmanned balloons carrying self-recording instruments, aided to some extent by direct observations made from manned balloons; and the only obstacle to continuous daily or even hourly readings at moderate heights is that of expense.

The free balloons possess the advantages of reaching heights unattainable by any other means, and of being independent of weather conditions. Either paper or rubber balloons are used of about six to ten feet diameter. These balloons are filled with hydrogen, and carry up with them a self-recording meteorograph made as light as possible; they frequently reach heights exceeding ten miles, and it is seldom, at least on the more thickly inhabited parts of the Continent, such as France and Germany, that they are lost. Each balloon carries an attached label offering a small reward to the finder, and the address to which information is to be sent, and in general the meteorograph is recovered with its record in a decipherable condition within a few weeks or a month. It is desirable that the balloon should fall as near as possible to its starting point, and with a rubber balloon this

is effected in the following manner. The balloon is only partially filled with gas, and is then securely tied up. As it rises the external pressure is lessened and the gas inside expands, until finally the rubber is no longer able to stand the strain and the balloon bursts. A small parachute is used to prevent a too rapid fall of the meteorograph, and sometimes a second smaller balloon, filled to a less extent, so that it does not burst, is also attached; the second balloon takes the place of the parachute, but is employed that it may float over the position of the fallen meteorograph, and direct attention to it. With paper balloons an automatic arrangement is used by which the balloon is freed when it reaches a certain height. The general result is that the meteorograph returns to the earth within a time of about an hour, and within a distance of a hundred miles from the starting point.

Observations obtained by the help of kites have the advantage of being less costly, but they are dependent on the weather conditions, and it is not often that heights exceeding two miles are reached. At Lindenberg in Germany, the best equipped station for the purpose in existence, last year a height of just on four miles was reached by a train of kites. Given sufficient wind it is a perfectly simple process to send a kite up to the height of a few thousand feet, although if the wind be very strong it is not so simple to draw it back again. The chief obstacle to attaining great altitudes is the wind resistance upon the cord or wire which holds the kite, and it is on this account that the strongest and thinnest obtainable steel wire is used. The wire introduces many technical difficulties; it is difficult and to some extent dangerous to handle, and although capable of withstanding a great strain if fairly used, if a kink is once formed the piece of wire in which it is, is utterly useless. Usually steel music wire, the kind of wire used in a piano in fact, of about 1-32in. in diameter is used; this will bear a weight of 250lbs., and weighs 16lbs. to the mile. With a good kite presenting 77 square feet of surface to the wind and 8000 feet of this wire, a vertical height of one mile is easily reached under favourable conditions of wind, and one kite of this size has carried a meteorograph to 8000 feet of height. The conditions are not always favourable; instead of a steady wind of twenty-five to thirty miles per hour, increasing somewhat with altitude, which affords the best conditions, it not infrequently happens that quite different velocities are found in different strata. It is impossible to get through a stratum in which the velocity is under fifteen miles per hour, and if a velocity of much over forty miles per hour is encountered in the lower strata, the kite is very likely to be damaged or the wire broken. At greater heights a higher velocity is not so likely to cause damage, since the air is less dense, and (a point of perhaps far greater importance) the wind is far steadier.

Hence it is easily seen that to reach very great heights with a train of kites, in addition to having apparatus of the best design and quality, exceptional weather conditions must hold, and the observer must succeed in straining his wire just short, but only just short, of its breaking point. The attempt very often ends in the breaking of the wire near the winch, and the departure of five or six miles of wire and six or eight kites.

Very interesting results have been given by the unmanned balloons. It has been found that when they have reached a great height they fall in some locality lying to the east of their starting point, not necessarily due east, but on a more easterly meridian. Since they pass far beyond the upper limit of the cirrus cloud, this fact confirms the statement that in the temperate latitudes the upper currents are always from some westerly point. M. Teisserenc de Bort also finds that balloons sent up in a cyclone tend to move away from the centre at great heights, thus showing that the cyclonic circulation is not a mere surface phenomenon. He also states that at ten miles height the air is warmer over the cyclone, and colder over the anticyclone.

When observations by means of kites were first started by Mr. Rotch, at Blue Hill, Boston, U.S., it was hoped that the long disputed point as to the origin of cyclones would be elucidated; so far this has not been the case.

Ferrel, the well-known American meteorologist, held that cyclones were convectional effects, and that they were maintained chiefly by the latent heat of condensation of the vapour in the central and rainy part. Dr. Hann on the other hand considers that cyclones are what may be described as driven eddies in the general circulation of the atmosphere. Opinion on the Continent, based on the results of observations obtained by balloons and kites, seems to be in favour of Dr. Hann's hypothesis, but Mr. Clayton, of Blue Hill, U.S., considers that the ascents there made favour the convectional theory. The results of some two hundred kite ascents which I have obtained in England and Scotland, with an average height of about one mile, seem to me to give no evidence one way or the other. I think, however, that a fundamental error has generally been assumed in the discussion. We know that in a gas in equilibrium under a conservative system of forces the isothermal and isobaric surfaces must be identical; this point at least is not open to question. It is not, therefore, the proper test to consider whether the temperature in a cyclone is greater or less than in an anticyclone at the same height, but the test is whether it be greater or less at points on the same isobaric surfaces; and the isobaric surfaces in temperate latitudes may well differ from surfaces of equal height above mean sea level by a thousand feet or more.

W. H. DINES.

THE BICENTENARY CELEBRATION OF THE BIRTH OF BENJAMIN FRANKLIN.

THE oldest scientific society in the new world is, I believe, the American Philosophical Society of Philadelphia. The Society was founded by Benjamin Franklin, son of an English father and born at Boston, Massachusetts, in January, 1706. It was natural that the bicentenary of the birth of a man of such extraordinary and diverse genius as Franklin should be commemorated in his native land, and accordingly during the past winter the Society issued invitations to leading universities and societies throughout the world to be present, through their delegates, at a festival to be held at Philadelphia from April 17 to 20. The date of the meeting was no doubt chosen because Philadelphia is liable to be intolerably hot in the summer, and would certainly be deserted at that season by many of the leading members of the Society, yet the chosen time was not a good one for European delegates, since academic duties would certainly preclude any large attendance from across the seas. Although, then, there were actually present only some half-dozen delegates from Europe, yet many European societies were represented by honorary members of American nationality, and sent addresses of congratulation to the Philosophical Society. The United States and Canada were naturally in great force, and the hundred and fifty or two hundred delegates who attended formed an imposing body of men of scientific repute.

The proceedings began on the evening of April 17,

when the President of the Society, Prof. Edgar Smith, presided over a meeting of delegates for the reception of addresses. The President began by a speech in which he set forth the share taken by Franklin in the foundation of the Philosophical Society, and the bearers of addresses then handed to him successively, in the chronological order of the several foundations, the documents with which they had been entrusted. I myself had the honour of presenting addresses from Cambridge, the Royal Society, the Royal Institution, the British Association, and the Royal Meteorological Society. I do not know the whole number of addresses, but 126 bodies were represented in one way or another. The evening ended with an interesting ceremony, when Mr. Carnegie, in his robes as Lord Rector of the University of St. Andrews, conferred the degree of doctor on Miss Irwin, a great-granddaughter of Franklin; she is principal of Radcliffe Hall, which bears nearly the same relation to Harvard University that Newnham and Girton do to Cambridge.

Wednesday, April 18, was devoted to the reading of scientific papers, as in a sectional meeting of the British Association. The session was continued on the afternoon of Friday, and twenty-three papers in all were read. Amongst the papers which appeared to excite the greatest interest were those by Chamberlin, de Vries, Pickering, Hall, and Lorentz. I myself gave an account of a paper recently presented to the Royal Society, but as yet unpublished; but before doing so I had the pleasure of presenting to the Philosophical Society two Wedgwood medallions of Benjamin Franklin and of Erasmus Darwin. The archives of the Society show (what I was not aware of) that both Erasmus Darwin and my father had been honorary fellows—an honour which I share myself.

On Thursday morning, April 19, the University of Pennsylvania (of which Franklin was the initiator) conferred, at the hands of its Provost, Mr. Harrison, a number of honorary degrees in the fine theatre called the Academy of Music. The whole pit was occupied by students, and a national flavour was conferred on the ceremonies by their staccato college yell, and by their singing college songs.

An altogether exceptional feature of the ceremony was that a degree was conferred on the King, who was represented by Sir Mortimer Durand, H.M. Ambassador at Washington. In announcing this degree the Provost read with great effect the celebrated speech on England from Henry V. It is pleasant to record the enthusiastic cheers which the whole audience gave, standing, as the Ambassador was hooded. Some fifteen or twenty degrees were afterwards conferred, and the recipients—amongst whom I may name de Vries, Lorentz, Marconi, and Rutherford—were greeted with hearty cheers by the students. Afterwards the Attorney-General of Pennsylvania, Mr. Carson, gave an address on the shares borne by Franklin and by subsequent benefactors in the foundation of the University. In the afternoon there was a public procession to the grave of Franklin, but as I was not present I am unable to give any account of the proceedings.

On Friday morning, April 19, we heard some interesting speeches in the theatre by Mr. Furness, President Elliot, and Mr. Choate, formerly ambassador in London, on the various sides of Franklin's character and activity. On the stage in full view of the audience was the portrait of Franklin which had been removed from America by General Grey at the time of the revolutionary war. It has just been presented to the President of the United States by Lord Grey, Governor-General of Canada, and its ultimate destination will, I believe, be the White House at Washington. This graceful act of international courtesy is highly appreciated in America, and the fact that it coincides with the bicentenary of Franklin's birth can hardly be merely accidental.

After the addresses of which I have spoken came the presentation to the Republic of France, through the French Ambassador, M. Jusserand, of a gold medal commemorative of Franklin. All who have studied the history of the revolutionary war know the importance of Franklin's residence in Paris as a determining factor in the outcome of the war. It may easily be imagined how great was the enthusiasm created by this ceremony.

The festival closed with a banquet in the evening at which there were many striking speeches. An American dinner is managed somewhat differently from our own, for the toast-master is not, as with us, a servant with a stentorian voice, but is the most highly honoured of the hosts of the occasion. Dr. Weir Mitchell, the illustrious physician, performed this arduous task, and gave us a number of appropriate little speeches to the admiration of all.

To describe the other speeches would be simply tedious, but I may mention the excellent speech of M. Jusserand, who referred with the most exquisite tact to the appalling disaster of San Francisco, then at its full height. M. Jusserand is the most accomplished living student of England of the Plantagenet times, and his speech, although clothed in English, retained all the grace of its French origin.

It was natural that the ruin and misery at San Francisco should exercise a certain depressing influence on all, but those responsible for the proceedings determined, rightly, as I think, to carry them through as planned.

Those who have taken part in such festivals in America need not be told that the organisation was admirable and the hospitality unbounded.

G. H. DARWIN.

NOTES.

THE seventy-eighth annual meeting of the German Association of Naturalists and Physicians will be held at Stuttgart on September 16–22.

A REUTER message from Rome on May 5 reports that the volcano of Stromboli is in active eruption. Advices received from Tacna, Chile, state that a violent earthquake shock was felt in that city on May 6, the vibrations lasting thirty-five seconds. The shock was also felt at Arica.

THE death is announced of Prof. Eugène Renevier, professor of geology and palæontology at the University of Lausanne. Prof. Renevier was president of the Swiss Geological Society and president of the Simplon Geological Society.

ON Saturday week, May 19, Sir James Dewar will deliver the first of a course of two lectures at the Royal Institution on "The Old and the New Chemistry." The Friday evening discourse on May 18 will be delivered by Prof. Arthur Schuster, on "International Science."

THE second annual dinner of the London section of the Society of Dyers and Colourists will be held on Wednesday, May 23. Persons interested in dyeing and the allied industries who are not members of the society are specially invited. Particulars may be obtained from the hon. secretary, Mr. Wallace Burton, 219 Shooters Hill Road, Blackheath, S.E.

AT the final meeting of the sixth International Congress of Applied Chemistry on Saturday, it was resolved that the seventh congress shall be held in London, with Sir

William Ramsay, K.C.B., as the president, and Sir Henry Roscoe as honorary president. We hope to give in an early issue an account of matters of interest and importance brought before the recent congress at Rome.

THE astronomical observatory of La Plata has been affiliated with the new National University of La Plata, recently inaugurated by the Minister of Public Instruction of the Argentine Republic. The director of the observatory, Mr. Francisco Porro, invites observers in similar institutions to exchange publications with him, at the Observatorio Astronómico, Universidad Nacional, La Plata.

WE learn from *Science* of April 27 that the University of California and the Lick Observatory were not damaged by the disastrous earthquake of April 18. The buildings of Leland Stanford Junior University suffered severely, the loss being estimated at 800,000*l*. The building of the California Academy of Sciences and its valuable collections were destroyed.

THE engineering journals publish lengthy obituary memoirs of one of the most prominent figures in the industrial life of the north of England—Sir David Dale, Bart., of Darlington, who died suddenly on April 28. He was an eminent authority on economic questions, and probably did more than anyone to promote industrial peace. He was one of the founders of the Iron and Steel Institute, and served as treasurer until his election as president in 1898.

THE Harben lectures of the Royal Institute of Public Health will be delivered by Prof. Elie Metchnikoff, of the Pasteur Institute, Paris, on May 25, 28, and 30. A course of three lectures on "The Bacteriology of Water, Milk, and Tuberculosis," by Dr. Carl Prausnitz, commenced at the institute on Wednesday, May 9, and a course of three lectures on "The Manufacture and Sophistication of Potable Spirits," by Dr. C. E. Harris, will begin on June 12.

WE regret to see the announcement that Mrs. Brightwen, the popular writer on natural history, died on May 5 at seventy-five years of age. In 1890, at the age of sixty, Mrs. Brightwen published her first book, "Wild Nature won by Kindness." This book was very successful. In 1895 "Inmates of My House and Garden" appeared; then followed, in 1897, "Glimpses of Plant Life"; in 1899, "Rambles with Nature Students"; and in 1904, "Quiet Hours with Nature." Mrs. Brightwen was vice-president of the Selborne Society, a Fellow of the Zoological and Entomological Societies, and an active member of various local associations connected with the encouragement of natural history.

THE eighty-ninth annual meeting of the Société helvétique des Sciences naturelles will be held at St. Gall on July 21 to August 1. This will be the fifth time since the foundation of the society that the town of St. Gall has been the place of meeting. On Tuesday, July 31, there will be a discussion on variations among plants and animals and their phylogenetic and physiological importance, with reports upon the subject by Profs. Goebel and Ernst. During the meeting there will also be papers on the following subjects:—modern views on the tectonic synthesis and genesis of the Alps, Prof. Schardt; measurements of base lines in general, with particular reference to the geodetic work connected with the Simplon Tunnel, Prof. Rosenmund; results of the latest explorations made in the Wildkirchli grotto, and their importance to zoology and prehistoric science, Mr. E. Bächler; fossil remains at Kesslerloch and from palæolithic grottos in general, Prof. C. Hescheler; studies of the plankton of the Lake of Constance. The president of the society is Dr. G. Ambühl, and the two secretaries are Dr. H. Rehsteiner and Dr. A. Dreyer.

AFTER being closed for a very considerable time, the fish gallery of the British Museum (Natural History)—or, to be accurate, the southern half of it—has just been re-opened to the public in what may be termed a metamorphosed condition. In place of a dismal crowd of ill-mounted specimens, faded, for the most part, to one dull uniformity, the public has now a small but well-assorted selection of specimens, coloured artificially to imitate, so far as practicable, their appearance in life, and arranged in such a manner that they can be seen to the very best advantage. Descriptive labels—of which only a portion are yet printed—will render the exhibit about as perfect as is at present possible, and the gallery as a whole will enable the public to gain the greatest possible amount of information about fishes with the least possible trouble. As regards the advisability of colouring exhibited specimens of this nature there can scarcely be two opinions, for, although with our present methods and our present lack of knowledge of the appearance of many fishes in life it is impossible to imitate nature closely, yet such an approximation to natural colouring as it is practicable to make is infinitely better than no colour at all.

THE annual dinner of the Institution of Mining and Metallurgy was held on May 4, when a distinguished company of engineers and others assembled. Sir Julius Wernher, in proposing the toast of the institution, insisted that the mining industry has been conducted in the past as seriously and honourably as any other industry in the world. In replying to the toast, the chairman, Mr. William Frecheville, read a letter from Mr. Birrell, the President of the Board of Education, stating that the Government is keenly interested in the proposal to establish an institution at South Kensington for the advancement of the highest technical education, and that a scheme is in course of preparation designed to give effect to the recommendations of the recent departmental committee. The letter went on to express satisfaction that various bodies and persons associated with mining and metallurgy are showing sympathy with the proposed college by contributing to the Bessemer fund, which has for its object the furtherance of mining and metallurgical science by means of advanced education. Mr. Birrell's letter concluded by expressing the hope that this excellent example may be followed by other great industries, all of which must depend for success in no small degree upon the promotion of the study of the higher branches of science. The chairman announced that the subscriptions to the Bessemer memorial amounted to 11,000*l*.

DR. W. N. SHAW, F.R.S., delivered the second of his instructive lectures on "Atmospheric Circulation and its relation to Weather" at the University of London on May 8. The subjects specially dealt with related to persistent and periodical winds, tropical revolving storms and cyclonic depressions of middle latitudes. The lecturer referred more particularly to the rainfall in the various wind-systems, especially in the monsoons, and also quoted some remarkable instances of increase of rain with height above sea-level, for example, at Ascension and St. Helena. Among the many interesting diagrams thrown on the screen we may mention one showing a remarkable fall of the barometer from 755 mm. to 728 mm. during a typhoon at Manila in October, 1882, with an equally sudden rise

in the course of a few hours. A wind velocity of 120 miles in the hour (old factor 3) was recorded in this storm. Diagrams of depressions moving across the British Isles were also shown, and an ingenious explanation was given of the usually heavy rainfall in the central portion of the storms.

THE contents of the April number of the *American Naturalist*, which include three articles, are chiefly interesting to specialists. The first, by Mr. A. S. Pearse, is devoted to the fresh-water copepod crustaceans of Massachusetts, of which several new species are described. In the second Dr. J. B. Pollock discusses variations in the pollen-grain of *Picea excelsa*, while in the third Mr. A. M. Reese describes in considerable detail the anatomy of the American salamander, *Cryptobranchus allegheniensis*, comparing and contrasting it with that of its larger relative of Japan and China.

THE *Journal of Anatomy and Physiology* for April is mainly devoted to anatomical subjects. Dr. Bertram Windle contributes a valuable report (the sixteenth) on recent teratological literature.

THE new catalogue (thirty-third edition) of microscopes and appliances issued by Messrs. Carl Zeiss, of Jena, gives a complete list of apparatus manufactured by this eminent firm. Some new and improved microscope stands are included, and the majority of achromatic objectives are reduced in price.

IN the *Révue Scientifique* (March 31) Dr. Remlinger discusses the *rôle* of the rat and mouse in the propagation of rabies. These animals are very susceptible to rabies, and Dr. Remlinger adduces evidence which suggests that certain cases of hydrophobia in man, apparently spontaneous, may be due to this source of infection.

ACCORDING to the *Pioneer Mail* (Allahabad, March 23), the Plague Research Commission has established beyond question the validity of the theory of plague transmission by rat-fleas. A room was selected in which had been found the dead body of a rat suffering from plague. Animals were placed in this room, some protected by fine metallic wire screens against the attacks of rat-fleas, others unprotected. It was soon found that the unprotected animals were attacked by plague, while the protected animals enjoyed a complete immunity.

WE learn from the *Pioneer Mail* that snakes and other wild animals accounted for the death of 2195 persons in the Madras Presidency last year, or twenty-six more than in 1904; and they caused the death of 14,899 cattle in 1905 as compared with 14,146 in the previous year. Of the fatalities among human beings, no fewer than 1896, or more than 80 per cent., were caused by snakes; while of those caused by other wild animals 155 were due to tigers, eighty to panthers, ten to wild pigs, nine to bears, eight to wolves, and five to wild dogs. The elephant only accounted for four deaths and the bison for only one, while the hyæna caused the death of two—presumably children. The total number of wild beasts destroyed, for which rewards were paid during the year, was 809, or four more than in the previous year. Included in this total are ninety-two tigers, 666 leopards and panthers, and fifty bears. The only method of reducing danger to life by snakes is apparently, according to our contemporary, the removal of prickly pear and noxious undergrowth.

BRYOLOGISTS who have had experience of Jameson's "Guide to Mosses" will be glad to know of a similar work, wherein Mr. Symes M. Macvicar provides a revised key to the liverworts of the British Isles. It differs considerably from the key that was originally published in the *Journal of Botany* five years ago, although drawn up on the same lines. It contains merely the tables for determining the genera and keys to the species, without any further details. It is not apparent why the specific names are not given for the monotypic genera, as was done in the earlier issue.

IN a contribution to the *Annales Mycologici*, vol. iii., No. 6, 1905, Mr. E. S. Salmon describes three well-marked varieties of the fungus *Phyllactinia corylea*, two of them distinguished by the characters of the conidiophore and the third by the special shape of the conidia. To a certain extent the characteristic features of the varieties appear to be associated with certain hosts, and Mr. Salmon hopes to discover further new varieties in the examination of the conidial stages of the fungus on other host plants; for this purpose he requests the cooperation of mycologists to supply him with material. Should such new varieties be found, it is probable that Phyllactinia, like other genera of the Erysiphaceæ, will prove to have developed special biologic forms on different hosts.

AT the meeting of the scientific society of the Kaiserliche Akademie der Wissenschaften, in Vienna (February 1), Prof. F. Krasser and Mr. Kubart contributed a paper on the fossil flora of Moletein, in Moravia; the list of fossils includes *Gleichenia Kurriana, Sequoia Reichenbachi, Aralia formosa*, and *Eucalyptus Geinitzi*. Prof. O. Richter has confirmed the observation recorded by Molisch and others that seedlings, notably vetches and peas, respond more readily to the stimuli of light and gravity in the impure air of the laboratory than in the purer air of a greenhouse. An account of the nature of the mucilage in the fruit of the mistletoe and *Loranthus Europaeus* was presented by Prof. J. Wiesner at the subsequent meeting on February 8.

THE occurrence in the United States of three fungi belonging to the Hypocreales or Perisporiales forms the subject of two papers by Prof. G. F. Atkinson. In the *Botanical Gazette*, December, 1905, he discusses the species *velutacea*, formerly referred to the genus Hypocrea, but now assigned to Podocrea or Podostroma. Tulasne and Winter stated that it was parasitic on Clavaria, but Prof. Atkinson agrees with Schröter that it is an autonomous plant, and adduces the evidence that he has obtained specimens in pure cultures from ascospores. In the *Journal of Mycology*, November, 1905, Prof. Atkinson describes a species of Balansia, a genus differing from Claviceps in the formation of a stroma without a sclerotium, found growing parasitically on *Danthonia spicata*, and another fungus, parasitic on Andropogon, for which he proposes a new genus, Dothichloë, allied to Hypocrea and Hypocrella.

WITHIN the last five years much has been written on the subject of the disposal of towns' refuse by fire. The more technical points have, however, received slight attention, and in this direction a paper contributed to the Transactions of the Institution of Engineers and Shipbuilders in Scotland (vol. xlix., part vi.) by Mr. H. Norman Leask throws much light. The forms of furnace in use and their accessories are described, and the results obtained in various parts of the world are considered. The results of careful tests show that, with a destructor of modern type, a high efficiency, both as regards evaporation and burning, is not more costly to work than a destructor burning at a lower rate and giving lower evaporative efficiencies.

THE general report of the Geological Survey of India for the year 1905, published by Mr. T. H. Holland, F.R.S., in the Records of the Geological Survey of India (vol. xxxiii., part ii.), is a document of permanent value. An enormous amount of valuable information on palæontology, petrology, physical geology, seismology, and economic geology has been got together, and the programme of work arranged for the current season indicates that results of more than ordinary interest are likely to be obtained. The investigation of the manganese ore deposits has now been completed, the deposits of chief importance consisting of braunite, psilomelane, and pyrolusite associated with and derived from manganese-bearing silicates occurring as bands and lenticles in the Archæan schists and gneisses. In the same issue of the Records, Mr. T. D. La Touche and Mr. R. R. Simpson describe the Lashio coalfield in the northern Shan States, and Mr. R. R. Simpson describes the Namma, Man-sang, and Man-se-le coalfields, also in the northern Shan States. In the case of Lashio the results are not encouraging. The coal is lignitic with a large proportion of moisture and more than 9 per cent. of ash. The Namma coal, or rather lignite, is distinctly superior to that of any other field in the northern Shan States; but in its raw state it would be a distinctly poor fuel, unfit for locomotive use, and would be mined under the usual difficulties due to soft including rocks.

THE Meteorological Service of the Netherlands, the central office of which is at De Bilt, a suburb of Utrecht, was recently re-organised, and has commenced the issue of a neat octavo publication entitled *Mededeelingen en Verhandelingen*, containing memoirs on meteorological and allied subjects. The articles will be written in Dutch and French, or in French, English, or German according to the nature of the contributions or the wish of the authors. There are separate branches at Amsterdam and Rotterdam; these act as agencies for maritime purposes, and issue local weather forecasts, while the branch at Amsterdam deals exclusively with storm warnings. Among the various useful publications of the Netherlands Institute we may specially mention (1) the daily weather report; (2) the monthly weather review, containing the results of twelve representative stations; and (3) the annals, which have been issued in various forms for fifty-five years; they now contain (1) the results of the observations made in Holland, and at Paramaribo (Surinam), and (2) observations of terrestrial magnetism. The institute has from time to time published valuable works on marine meteorology, and is at present engaged on a meteorological atlas of the Indian seas and other useful investigations.

IN vol. i., part iv., of "Beiträge zur Physik der freien Atmosphäre," Prof. H. Hergesell gives an interesting account of the exploration of the upper air over the Atlantic Ocean north of the Tropic of Cancer, from the Prince of Monaco's yacht in the year 1905. The observations were made under Prof. Hergesell's superintendence by means of tandem sounding-balloons, between 26° and 38° N. lat., and 10° and 42° W. long., and therefore partly in the true region of the trade winds; the chief object was to determine whether the results obtained in the previous year by means of kite experiments between Gibraltar and the Canaries, along the African coast, would be found in the open ocean, beyond the influence of the continent and islands, and at much greater altitudes. The observations of temperature and humidity completely confirmed those obtained in 1904, and further showed that up to altitudes of 12,000 metres and more, winds with northerly components prevailed, and that the anti-trade wind supposed to exist in the adopted theory of atmospheric circulation was not found in those latitudes over the free ocean. Southerly winds were only observed on one day at altitudes of 2000 metres and upwards in lat. 25° 58′ N., the most southerly point reached, but the next day, in lat. 26° 41′ N., the northerly current had again set in. These results differ somewhat from those given by Clayton and Maurice, acting for Mr. Rotch and M. Teisserenc de Bort respectively, in the same latitudes, as they found southerly winds in the upper strata of air. It will be interesting to determine by further experiments whether this difference really exists, and whether in the observations near the Canaries especially it was possibly due to the proximity of the African coast.

A NEW apparatus for determining the mechanical equivalent of heat or thermal capacity of water is described by Prof. H. Rubens in the *Verhandlungen der deutschen physikalischen Gesellschaft*, viii., 5 (1906). In it the work is supplied by turning a cylinder 60 cm. long through 180° and allowing a weight to descend in oil, and the arrangements for the calorimetric determinations obviate the disadvantages of Grimsehl's apparatus.

REFORM of higher education in France forms the subject of a paper in the *Revue générale des Sciences* (xvii., 4) by Prof. A. Turpain. It would appear that the French statutes relating to the appointment of university professors are unsuited to the present times and operate to the detriment of the provincial universities, and, moreover, the new programme of the École Normale tends to draw students from the provinces to Paris.

A NOTE in the *Revue générale des Sciences* (xvii., 4) directs attention to a method of exploding mines by means of acoustic waves. The method is based on the property that when a disc, free to turn about its diameter, is placed in the interior of a cylindrical resonator and the fundamental note sounded, the disc will place itself in a plane perpendicular to the cylinder. By causing the turning disc to complete an electric circuit a mine can be exploded by means of a signal given by a syren on a warship, tuned to the same note as the resonator. The description is taken from the *Technische Rundschau*.

IN a note contributed to the *Atti dei Lincei*, xv., 6, Dr. G. A. Blanc communicates some further results regarding the radio-active substance discovered by him in the thermal springs of Echaillon and Salins Moutiers, in Savoy, and of which an account was given at the congress of radiology at Liége last year. The experiments show the presence of hydrates in which the radio-activity at first increases instead of continually decreasing, thus reproducing the phenomena associated with thorium hydrate rather than those attributed to the element thorium X; but the radio-activity of the present element is far greater than that of ordinary thorium hydrate. In the same journal Messrs. R. Nasini and M. G. Levi give a preliminary note on the radio-activity of the spring at Fiuggi, near Anticoli.

THE α rays emitted by Prof. Marckwald's radio-tellurium are shown by Mr. H. Greinacher in No. 7 of the *Physikalische Zeitschrift* to be capable of causing a marked fluorescence in glass, and a similar but smaller effect in mica and quartz. The observation is of interest inasmuch as the α rays of radio-tellurium have also been shown to possess the property of causing air to fluoresce.

PROF. NERNST and Mr. H. von Wartenberg describe in the *Verhandlungen* of the German Physical Society a new determination of the melting points of platinum and palladium. The method used was an optical one employing a Wanner pyrometer which was specially calibrated

for the purpose; the melting point of gold (1064° C.) was taken as the standard of reference. Pure palladium was found to melt at 1541° C. and pure platinum at 1745° C. Dr. Harker's recent determination of the melting point of platinum gave a value of 1710° C.

IN spite of its importance as a fundamental physical constant, the latent heat of fusion of ice is known only very approximately. The value obtained by Bunsen was 80·03 cal., whilst Regnault found it to be 79·25 cal. In the *Journal de Physique* (vol. v., p. 157) M. A. Leduc points out that Bunsen's result is subject to an error due to an incorrect determination of the density of ice at 0°. A re-determination of this constant gave a value of 0·9176, and a re-calculation of the latent heat of fusion from Bunsen's data, using this value, gave a result of 79·2 cal. This is in close agreement with Regnault's determination. The principal difficulty experienced in determining the density of ice is in eliminating gas bubbles completely. M. A. Leduc describes an arrangement by which he was enabled to minimise this source of error.

SOME remarkable specimens of phosphorescent calcite from Joplin, Missouri, are described by Mr. W. P. Headden in the April number of the *American Journal of Science*. Some of the crystals, after being exposed to sunlight, were found to become highly phosphorescent, and to retain this property for a period of thirteen hours. The specimens of calcite which showed prolonged phosphorescence were always yellow in colour, and contained 0·007 per cent. of ceria, 0·012 per cent. of the didymium earths, and 0·013 per cent. of yttrium and erbium; the spectrum of the latter was very distinct. Purple-coloured specimens of calcite found in the same neighbourhood were shown to owe their colour to the presence of didymium, and to differ from the yellow calcite in being non-phosphorescent. So far as the analytical evidence goes, the phosphorescence of the yellow calcite seems to be associated with the presence of earths of the yttrium group.

A NUMBER of foliaceous and fruticose lichens collected by Mr. A. W. C. Herre on the Santa Cruz peninsula, in proximity to San Francisco, are described by him in vol. vii. of the Proceedings of the Washington Academy of Sciences. Parmelia is an important genus, as the species are both numerous and conspicuous; *Parmelia enteromorpha* is a characteristic lichen of the red-wood forest, and *Parmelia Herrei* provides a new species. The new species *Gyrophora diabolica* forms in its locality, the Devil's Cañon, the dominant feature of the lichen rock-flora; another interesting species is the lace lichen, *Ramalina reticulata*, that festoons the oaks. The writer has drawn up a useful key for the determination of genera, and keys to the species.

A PUBLICATION just received from the Harvard College Observatory describes in detail, and with examples, a telegraphic cipher code devised by Mr. W. P. Gerrish, of that observatory. Numerous advantages are claimed for this system over other systems now in use, its chief characteristic being the ready transmission of groups of figures in a form at once simple to dispatch and readily translatable. A test of the system between the Harvard and Lick observatories gave great satisfaction.

MESSRS. ARCHIBALD CONSTABLE AND CO., LTD., will publish shortly a new book by Prof. H. C. Jones, of the Johns Hopkins University, entitled "The Electrical Theory of Matter and Radio-activity."

MESSRS. DAWBARN AND WARD, LTD., are preparing a new issue of their "Directory of Photographic Dark Rooms," and will be glad to receive from photographers information as to any public dark room not included in their directory.

SOME of the natural attractions of Norway are described in an illustrated booklet just received from the Albion Steamship Co., Ltd., Newcastle-on-Tyne, containing the itinerary of fortnightly pleasure cruises to the Norwegian fiords by the steam yacht *Midnight Sun*. The cruises are arranged so that passengers may see the most interesting scenery on or near the fiords from the Ryfylke to the Romsdal, and ample time is allowed for excursions away from the ship.

MR. C. L. MULLER has published a pamphlet giving an illustrated description of Dr. Looser's double thermoscope and some of the experiments possible with it. The instrument is an ingenious form of differential thermometer in which great sensitiveness is secured, and so arranged that it is possible to use it in making quantitative determinations. The booklet contains instructions for the performance of fifty-seven experiments in which the thermoscope can be employed.

OUR ASTRONOMICAL COLUMN.

THE EXPECTED RETURN OF HOLMES'S COMET.—From the observations of Holmes's comet in 1899–1900, Dr. H. J. Zwiers has computed a set of elements of the comet's path and an ephemeris for the probable reappearance of the object during the present year.

Having computed the elements for the epoch 1899, Dr. Zwiers applied the Jupiter perturbations for the period January, 1899, to April, 1906, and for January 16·0 (G.M.T.), 1906, found the following elements:—

$$\left.\begin{array}{ll} M = 351^\circ\ 46'\ 52''.14 & \\ \pi = 346\ \ 2\ 31.63 & \\ \Omega = 331\ 45\ 40.75 & 1906{\cdot}0 \\ i = \ 20\ 48\ 53.30 & \end{array}\right| \quad \begin{array}{l} \phi = 24^\circ\ 20'\ 25''.55 \\ \mu = 517''.447665 \\ \log a = 0.5574268 \end{array}$$

The ephemeris computed from these elements extends from May 1 to December 31, 1906, and is given, for every alternate day, in No. 4085 of the *Astronomische Nachrichten*.

According to the above elements, the perihelion passage should have taken place at March 14·1804 (G.M.T.), 1906, but, in a supplementary table, Dr. Zwiers gives the ephemeris corrections which will become necessary should it occur either four days earlier or later.

THE LUMINOSITY OF THE BRIGHTER STARS.—An interesting discussion of the luminosity of the brighter stars is published by Mr. George C. Comstock in No. 3, vol. xxiii., of the *Astrophysical Journal*.

Of twenty-five stars discussed, the brightest in the heavens, Mr. Comstock finds that twenty-two have luminosities less than 1000, whilst three, β Crucis, Rigel, and Canopus, have luminosities *greatly* exceeding this value, the luminosity of the sun being taken as unity.

In Mr. Comstock's opinion, this irregular distribution of values and the enormous excess of the three exceptions above the mean value render it unlikely that the parallaxes hitherto accepted for these three stars are entirely trustworthy, for it is on them that the values obtained for the luminosities are based.

Surveying the whole discussion, Mr. Comstock arrives at the conclusion that there is no adequate evidence that the maximum of stellar luminosity exceeds 1000, and, further, he opines that the mean luminosity of first-magnitude stars is not less than 100.

THE VARIABLE RADIAL VELOCITY OF ϵ AURIGÆ.—In No. 4084 of the *Astronomische Nachrichten* Dr. H. Ludendorff discusses the variable radial velocity of the star ϵ Aurigæ.

The variability of this object was discovered by Fritsch in 1821, and its variable velocity by Vogel and Eberhard in 1902.

The present discussion is based on the measurements of

twenty-six plates obtained between November 9, 1901, and March 23, 1905, with the No. iv. spectrograph and the 32·5 cm. refractor of the Potsdam Observatory.

The values obtained for the velocity, referred to the sun, vary between +5·3 km. (on November 9, 1901) and −16·9 km. (on December 11, 1902).

EARLY OBSERVATIONS OF EROS.—No. 10, vol. liii., of the Harvard College Observatory Annals contains the details of a number of observations of Eros made at Harvard from twenty-one photographs obtained during the period 1893 (October) to 1896 (June).

The measurements of these plates were published in Circular No. 51 of the observatory, but in the present publication the whole of the data relating to the plates, the original measurements of the photographs, the positions of the standard stars employed, reproductions of the photographs, and many other important matters are dealt with in great detail.

As this number forms the concluding part of vol. liii. of the Annals, several reproductions previously given in the text are now reproduced on plates in a much more satisfactory manner, and published as an appendix.

OBSERVATIONS OF SATELLITES IN 1904 AND 1905.—In No. 94 of the Lick Observatory Bulletins Prof. R. G. Aitken publishes the results of the observations of satellites made at Lick during 1904 and 1905.

Forty-seven observations of the satellites of Uranus were made, the position angle and distance of each object being referred to those of another satellite.

The second part of the publication refers to the observations of Saturn's satellites during 1905, which were, in some measure, a continuation of Prof. Hussey's work in previous years. Only those combinations most likely to improve our knowledge of the orbits of the inner satellites, *i.e.* Rhea with Dione, Tethys with Enceladus, and, as a check, Tethys with Rhea, were, however, measured. Four eclipses of Saturn's satellites were also observed.

Observations of Jupiter's fifth satellite, made during 1904 and 1905, referring this object to the three inner satellites, form the subject of the concluding section of the Bulletin.

NEW VARIABLE STARS IN ORION.—From a study of the Heidelberg 6-inch plates, Prof. Max Wolf has discovered seven new variables in Orion.

Photomicrographic reproductions, through a microscope, of the regions containing the stars on the 6-inch plates are given, together with the positions and observed variations of the seven objects, in No. 4085 of the *Astronomische Nachrichten*.

RECENT ADVANCES IN SEISMOLOGY.[1]

THE most remarkable development in modern seismology is not the seismic survey of a city, or even of a country, but of the whole world. This branch of inquiry is now in active progress. Since the time of the great earthquake of Lisbon in 1755 it has been known that disturbances of the magnitude of that event, although not directly recognisable as earthquakes in regions distant from the origin, have nevertheless given evidence of commotion by causing the water in lakes and ponds to oscillate. By observing and timing the movements of the bubbles of sensitive levels, astronomers have recorded unfelt pulsatory movements of the ground which they showed to be the result of seismic disturbances in far distant countries. In Japan these unfelt movements have been automatically recorded since 1884 (Seis. Soc. Trans., vol. x., p. 6). They were recognised to have originated at a great distance, but the centres from which they sprang were not determined. Some years later, while seeking for a gravitational influence of the moon, the late Dr. E. von Rebeur-Paschwitz found on his records abnormal movements, several of which he traced to definite but very distant seismic centres. Before this, indeed, it had been predicted that a large earthquake occurring in any one part of the world would produce movements which, with proper instruments, would be recorded in any other part,[2] but it was not until after von Rebeur's announcement that serious attention was directed to what has proved to be a line of research open to workers in all countries. Many instruments have been designed to record these unfelt breathings of our earth, but there is still much uncertainty in the interpretation of all their records.

Observations also show that large earth-waves are from time to time propagated over the whole surface of the globe. These far-reaching commotions lead to the inference that their originating impulse must have been delivered over a large region. Harboe has shown that within a meizoseismic area blows of varying intensity have been struck in quick succession at points long distances apart. A district appears to have given way, not simply along the line of one large fault, but along many minor faults. Oldham estimated that the Assam earthquake of 1897 had been accompanied by the bodily displacement of 10,000 square miles of country along a thrust plane. If we interpret the time observations made in connection with this disturbance in the light of the suggestion made by Harboe, then this relief of seismic strain originated over an area of 500,000 square miles.

Although a large block of the earth's crust may thus be fractured, our knowledge of the depth to which the effects of fracturing descend is largely one of inference. From the observations hitherto published, which are now in progress at Przibram, it would seem that a seismogram obtained at a depth of 1150 metres differs but little from one obtained on the surface. This is contrary to observations on small earthquakes, which, although they may alarm the inhabitants of a town and shatter chimneys, may pass unnoticed in shallow mines.

The fact that the large earth-waves have what is practically a constant arcual velocity of approximately 3 km. per second, whether the path be across continents, over ocean floors, or over districts which vary greatly in their geological structure, suggests the idea that the crust of the earth is moved as a whole, and that under the influence of its own elasticity and gravity it behaves in a manner similar to a sheet of ice upon an ocean swell. An alternative view is to assume that the wave motion is due to energy retained within the crust itself, the heterogeneity of which is superficial. Whichever be the case, we may picture a crust yielding irregularly, and possibly through its total thickness, until it gives up its energy to a medium which transmits undulatory movements with uniform velocity.

Many hypotheses have been adduced which suggest thicknesses for the superficial covering of our globe. To these as an outcome of recent seismological research we may add one more. Preceding the large waves of a teleseismic disturbance we find preliminary tremors. These are apparently propagated through the body of the globe with an average speed along paths which are assumed to be chords at about 10 km. per second. This high and nearly constant rate of transmission, however, only obtains for paths which represent arcs greater than 30°. For chords which lie within a depth of thirty miles the recorded speeds do not exceed those which we should expect for waves of compression in rocky material. This, therefore, is a maximum depth at which we should look for materials having similar physical properties to those we see on the earth's surface. Beneath this limit the materials of the outer part of this planet appear rapidly to merge into a fairly homogeneous nucleus with a high rigidity. Following closely on the heels of the preliminary tremors, but in advance of the large undulations, a second phase of motion appears, the chordal velocity of which up to distances of 120° is approximately 6 km. per second. These are tentatively regarded as the outcrop of distortional waves. When these are better understood it may be expected that they also will play their part in shedding fresh light upon the physics of the earth.

I will now turn to a consideration of the regions in which these sudden accelerations of geological change are in operation. They may be grouped as follows:—

Regions which lie on the western suboceanic frontier of the American and the eastern frontier of the Asiatic continents, and regions which lie on a band passing from the West Indies through the Mediterranean to the Himalayas.

In addition to these there are two minor regions, one following the eastern suboceanic frontier of the African continent, which I have called the Malagasy region, and

[1] Abridged from the Bakerian Lecture delivered by Prof. John Milne, F.R.S., at the Royal Society on March 22.

[2] See "Earthquakes," p. 226, International Scientific Series, 1883.

an Antarctic region which lies to the south-west of New Zealand.

Generally it would appear that regions of instability are to be found along the margins of continents or tablelands which rise suddenly to considerable heights above oceanic or other plains.

At the present time we may, therefore, say that mega-seismic disturbances do not occur anywhere, but only in districts with similar contours. Are we dealing with primitive troughs and ridges which are simply altering their dimensions under the continued influence of secular contraction, or do these reliefs of seismic strain represent isostatic adjustments which denudation and sedimentation demand?

These and other activities may be looked to as primal causes leading up to displays of pronounced seismic activity. Their frequency, however, may be dominated by influences which at certain seasons or times cause an increase or decrease in seismic strain.

In the wide variations in position and rapidity of flow of ocean currents and in measured oscillations of sea-level which appear to be seasonal in their recurrence, we see influences which may give rise to seismic frequency in districts that possess a high degree of seismic sensibility. Other causes affecting large areas, and also possibly the frequency of small or after-shocks in different seismic districts, have by Knott and others been sought for in the loads due to the accumulation of snow, and in the seasonal fluctuations in the direction of barometric gradients. It does not seem likely, however, that stresses due to such influences have any marked effect upon the frequency of those reliefs of seismic strain which shake the world.

The data which we possess bearing upon this question are as yet far too meagre to admit of satisfactory analysis. It is, nevertheless, interesting to note the direction in which they point. In the six years ending in 1904 we find that off the west coast of North America fifty-one large earthquakes originated during the winter months (October to May) and thirty-five during the summer months. Off the east coast of Asia, north of the equator, the numbers for these seasons were forty-nine and forty-three. These numbers added together show that for the North Pacific, as a whole, 100 disturbances took place in winter and seventy-eight in summer, while in the Central Asian or Himalayan region the corresponding numbers are twenty-five and twenty-seven. Beneath an ocean, therefore, some indication has been obtained of seasonal seismic frequency, while on a continental surface no such frequency has yet been indicated.

If we take a chart showing the varying position of our earth's North Pole in relation to its mean position, we see that the secular movement of the pole is by no means always uniform. Although it may at times follow a path about its mean position which is approximately circular, at other times there are comparatively sharp changes in direction of motion which may even become retrograde. If now on a chart of this description we mark the time-positions of very large earthquakes, we find that they cluster round the sharper bends of the pole path.

In a period of nearly thirteen years (1802 to 1904) I find records for at least 750 world-shaking earthquakes, which may be referred to three periods continuous with each other, and each two-tenths of a year or seventy-three days' duration. The first period occurs when the pole movement followed an approximately straight line or curve of large radius, the second equal period when it was undergoing deflection or following a path of short radius, and the third when the movement was similar to that of the first period. The numbers of earthquakes in each of these periods taken in the order named were 211, 307, and 232, that is to say, during the period when the change in direction of motion has been comparatively rapid, the relief of seismic strain has not only been marked, but it has been localised along the junctions of land blocks and land plains where we should expect to find that the stress due to change in direction of motion was at a maximum. Until the magnitude of these induced stresses has been estimated, it would be premature to assume that the frequency under consideration is directly due to change in direction of pole movement, it being quite as likely that both phenomena may result from a general cause.

A world-shaking earthquake, wherever its motion is pronounced, gives rise to movements which may extend over three or four hours. They come to a close as a series of pulsations, each lasting a few minutes, and separated from each other by approximately equal intervals of rest. The expiring efforts of an earthquake present something more akin to musical reverberation than to intermittent and irregular settlement of disjointed material.

If instead of studying the life-history of an earthquake as recorded at a given station, we compare the seismograms it has yielded at different distances from its origin, we learn something of the manner in which its energy has been radiated and dissipated. An earthquake which in the vicinity of its origin has a duration of sixty minutes may appear at its antipodes ninety or 100 minutes later as a feeble movement with a duration of only four or five minutes. From the time this movement has taken to travel the half circumference of the globe the inference may be drawn that the surviving phase of such an earthquake is that of the large waves. The compressional and distortional precursors, together with the rhythmical succession of followers, are no longer visible on seismograms. The importance of this knowledge to those who are engaged in the analysis of earthquake registers is apparent.

The paucity of available data renders it premature to

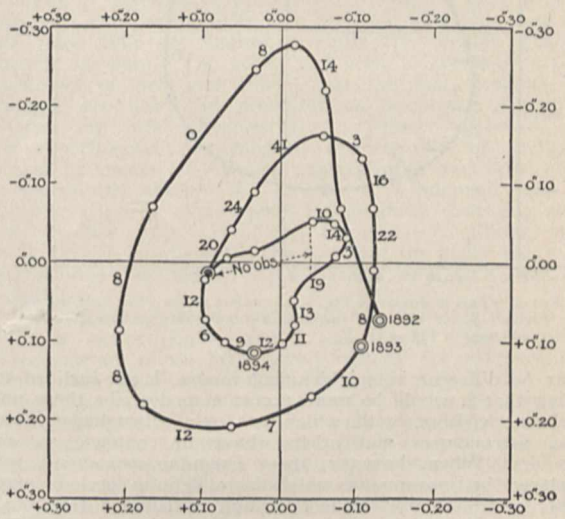

FIG. 1 shows, after Th. Albrecht, the path of the North Pole from 1892 to 1894 inclusive. Each year is divided into tenths or periods of 36·5 days. Numerals indicate the number of large earthquakes which occurred in each of these divisions, commencing with the third tenth of 1892.

make deductions respecting possible alternation in seismic frequency in various localities. But if, instead of confining our attention to a relationship between earthquakes, we consider the question of the relief of volcanic strain, many illustrations may be adduced which indicate a close connection between such activities. For example, all the known volcanic eruptions which have occurred in the Antilles, from the first which took place in 1692, have been heralded or closely accompanied by large earthquakes in that region, but more frequently by like disturbances in neighbouring rock-folds, particularly that of the Cordilleras. This was notably the case in 1902. On April 19 of that year an unusually large earthquake devastated cities in Guatemala. Small local shocks were felt in the West Indies, and on April 25 it was noticed that steam was escaping from the crater of the Mont Pelée, in Martinique. These activities continued to increase until May 8, when they terminated with terrific explosions, submarine disturbances, and the devastation of great portions of the islands of Martinique and St. Vincent.

The last illustration of hypogene relationship between these regions occurred on January 31 of the present year. On that date a heavy earthquake originated off the mouth of the Esmeralda River, in Colombia. Sea-waves inundated the coast, islands sank, and a volcano erupted. The news-

papers of February 2 announced that cables between Jamaica and Puerto Rico had been interrupted, and on later dates it was reported that severe shocks had been felt among the West Indian islands, that six or seven submarine cables had been broken, and that Mont Pelée and La Soufrière, in St. Vincent, were again active.

In concluding this short discourse, I wish to direct attention to a class of phenomena from which the working seismologist cannot escape. At certain times horizontal pendulums may be fitfully moving continuously for hours or even days. Similar movements have often been noticed with balances and with other instruments. They are frequently referred to as microseismic disturbances. Inasmuch as they vary with varying meteorological conditions, and

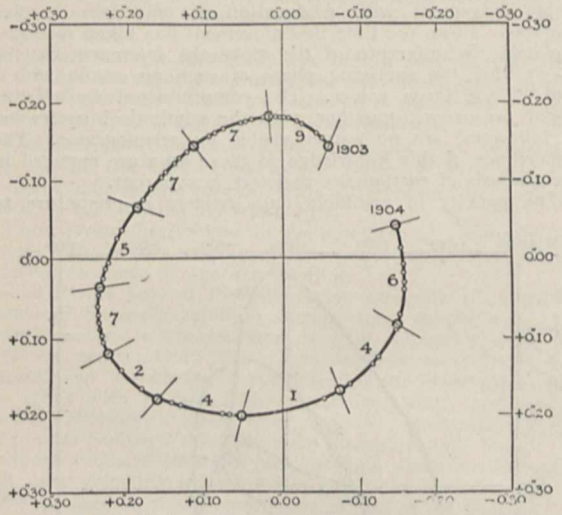

FIG. 2.—This is similar to Fig. 1, but refers to the year 1903, during which period the pole displacement was more uniform than that indicated in Fig. 1.

may be different in neighbouring rooms, I am inclined to think that it would be more accurate to describe these unwelcome visitors, with which not only seismologists, but also astronomers and others, have to contend, as air tremors. When, however, these irregular movements are replaced by movements which have definite periods very different from those of the recording instrument itself, and are at the same time regular in amplitude, it seems possible that they may be connected with actual pulsatory motion of the surface of the ground.

In addition to tremors and pulsations, the records on the films from seismographs show that nearly at all times a slow change of level is taking place. For years a pier may be undergoing a tilt in one direction. Besides this general movement the instruments reveal the existence of waves that indicate a difference in the direction of movement in different seasons. Superimposed upon these again we find records of changes of level which may be associated with variations in the difference in loads on two sides of an observing station. When a horizontal pendulum swings towards the area of greatest atmospheric pressure it apparently indicates a change directly or indirectly connected with barometric loading. The quantity of water in wells and that flowing in drains and from springs has been observed to vary with fluctuations in atmospheric pressure. Where this takes place, subsurface operations are revealed which may be sufficient to give rise to changes in surface level. Very marked changes of level take place at certain stations during wet weather. In the Isle of Wight, at Shide, which is situated on the side of a valley cut through an anticline of chalk, when heavy rain occurs, levels and horizontal pendulums indicate a tilting towards the bed of the valley. An instrument on the opposite side of the valley behaves in a corresponding manner. In other words, if these observed movements can be regarded as extending to the bed of the valley, it may be said that with rain the steepness of each of its sides is increased. During fine weather the direction of movement is reversed. A more regular movement is, however, found in a tilting known as the diurnal wave. With the same assumption as to the extent of corresponding motion we find, but only during fine weather, that the direction of movement of the sides of the same valley during the night corresponds to that observed during wet weather. During the day it is the same as that which takes place during fine weather. For convenience we may regard the valley as opening and closing. Similar observations have been made on the two sides of a valley which has been cut through alluvium in Tokio.

Probably an important part in the production of these diurnal movements is played by the differential loading and unloading of neighbouring areas by solar influences. During wet weather, in virtue of subsurface percolation and lateral drainage generally, the sides and bottom of a valley where water-level is raised carry a greater load than the bounding ridges. Under these conditions the bottom of a valley may sag and its sides close inwards. During fine weather, in virtue of evaporation and drainage, a movement in the opposite direction may be established. The fine-weather diurnal movement corresponding to the opening of a valley may find a partial explanation in the removal of load by evaporation, but more particularly by plant-transpiration. These activities are more pronounced during the day than at night, and they tend to reduce subsurface percolation and drainage towards the bed of a valley. The comparatively small retrograde nocturnal movement may be partly attributed to an increase of valley load at night, at which time transpiration and evaporation are replaced by surface and subsurface condensation. Transpiration and evaporation being at a minimum at night, it may be assumed that lateral percolation and surface drainage towards the bed of a valley are increased, and, possibly as a consequence of this action, the volume of water in certain wells and that flowing in certain streams and drains has been found to be greater at night than during the day.

Another activity which may result in a nocturnal increase in the subsurface flow of water is the expansion of the air in soil by the slowly descending heat of the previous day, this expansion forcing soil-water into passages of easiest escape.

The explanation offered for the phenomena under consideration may be found wanting; but the facts remain that round the face of the globe diurnal superficial distortions can be observed which vary in magnitude and direction, and that rainfall is accompanied by measurable changes in the slopes of certain valleys.

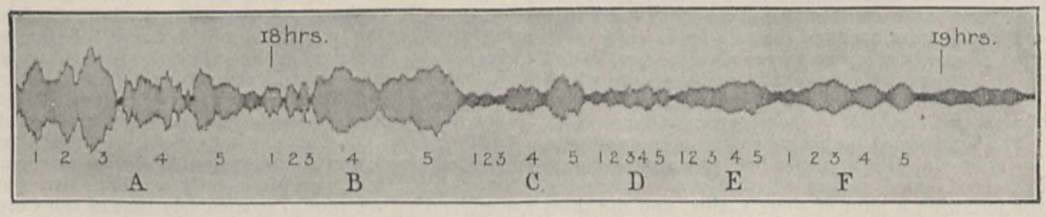

FIG. 3.—Recurrences of Wave Groups A to F in the terminal vibrations of the Colombian Earthquake of January 31, as recorded at Shide, Isle of Wight. Scale 108 mm. =1 hour.

GERMAN CONGRESS OF EXPERIMENTAL PSYCHOLOGY.

THE second congress of the German Society for Experimental Psychology took place on April 18–21 in the picturesque old town of Würzburg, partly at the old university and partly at the well-known psychological laboratory of Prof. Külpe. Two visits were paid to Prof. Rieger's nerve hospital. The attendance amounted to nearly 200, and thus was even more numerous than at the first congress two years previously in Giessen. Prof. G. E. Müller was in the chair. Fewer papers were read than before, but nevertheless they could with difficulty be got through in the three and a half days available, reading eight hours a day.

A new feature in this congress—and one that indicates the rapid growth and advancing specialisation of experimental psychology—was that several members of the society had been commissioned to make general reports (Sammelreferate) on particular branches of research with which they were known to have an exhaustive acquaintance. Conspicuous among these reports was that of Külpe (Würzburg), on the general state of experimental æsthetics. The methods of experiment were grouped under three general heads, impression (Eindruck), formation (Herstellung), and expression (Ausdruck); each of these admitted of many further subdivisions. The interesting results communicated were mostly of American and very recent origin. In general, Külpe emphatically maintained that æsthetic values are not wholly of a subjective nature (Einfühlung, zuständlich, &c.), but are to some degree at least objective (gegenständlich). The time was near, he said, when these experimental investigations would claim serious attention from both art critics and artists.[1] Sommer (Giessen) gave a very interesting report on psychiatry and individual psychology, tracing back the modern close union and wonderful development of these two sciences to ideas which arose in the eighteenth century, as the natural sequel to the psychological researches of Descartes and, above all, Locke. The execution of these ideas has only been delayed until now for want of adequate methods. Sommer indicated the essentials of good methods of psycho-pathological investigation, particularly insisting upon the necessity of a uniform system of tests, thoroughly tried in normal, border, and distinctly pathological cases. Weygandt (Würzburg) presented a full report on the psychological examination of weak-minded children. Krueger (Leipzig) reported on the relation between phonetics and psychology. In the course of an exhaustive and lucid exposition of the previous methods and results, he showed that hitherto attention had been almost exclusively confined to the bare morphological elements of speech, as represented by the letters of the alphabet. He himself had chiefly investigated how one and the same syllable can be represented by very varying sounds, according to nationality, emotion, or shade of meaning; his graphic registrations of the modulations of voice as regards speed and pitch excited considerable interest among the audience. On a subsequent day Krueger gave a practical demonstration of his ingenious apparatus for registering the vibrations of the larynx (Kehltonschreiber), designed by himself together with Wirth. Schumann (Zürich) gave a report on the psychology of reading. He described the remarkable success with which reading had been taught by whole words, instead of by single letters. A large portion of the paper dealt with tachistoscopy, and especially with the best means of exposing letters to view for very short periods of time; the difficulty is to prevent a persistent after-image, and the remedy recommended is to let the exposed letters be replaced, not by a blank surface, but by another arrangement of letters.

Turning to the exclusively original papers, a remarkable one was read by Stumpf (Berlin) on the "sensations of feeling" (Gefühlsempfindungen). The feeling (*i.e.* the pleasantness or unpleasantness) that characterises a sensation must be sharply distinguished, he finds, from the feeling characterising intellectual states. The former may be conceived in three ways: first, as a "feeling-tone" or mere quality of the sensation; secondly, as a peculiar element of consciousness, closely associated indeed with the sensation, but just as self-existent as the latter; and thirdly, as only another kind of sensation in addition to, and independent of, those of touch, sight, sound, taste, and smell. He expounded the grounds which had now at last compelled him to adopt the *third* alternative. The paper found warm appreciation, but very little acquiescence. Dürr (Würzburg) had, by means of reaction experiments, investigated voluntary action and association. These two had proved themselves perfectly different from one another; the former was either a making distinct (Verdeutlichung) or else a production (Produktionserfolg); the latter was a *re*production (Reproduktionserfolg). Further, his results were in flat contradiction to the popular theory that the ultimately victorious motive must be the one accompanied by the idea of greatest pleasure or least pain. At the same time, he attributed little causal importance to the consciousness of self (Ichbewusstsein). In harmony with his results was a notable experimental investigation of the will by Ach (Marburg). Here too reaction experiments were used, but cleverly devised so that the force of the will and that of association acted in direct opposition to one another. By this means the manifestations of the two forces could be vividly contrasted, and even subjected to a certain degree of measurement. Ach, like Dürr, finds the pleasure-pain theory to be totally discordant with actual observation. Bühler (Würzburg) discussed the experimental analysis of complicated processes of thought. Each of his observers had had to reply to a series of questions, and at the same time to observe carefully the mental process thereby involved. The result had been to corroborate the statement of Ach and Binet, that the real elements of thought are not faint presentations (verblasste Vorstellungen), but ideas (Bewusstheiten). Messer (Giessen), in his experimental psychological investigation of thought (again by means of reaction experiments), had been able to detect and observe the process of "judgment" as a specific conscious experience. He admitted that this was only possible under certain very favourable conditions, and to this cause he attributed the fact that the experiments of Marbe had resulted in a denial of any such specific experience.

Wirth (Leipzig) dealt with the distribution of attention in different senses (sight, sound, and touch). The allotted three-quarters of an hour barely sufficed for enumerating swiftly the chief features of his wonderfully skilful and complicated mechanical arrangements. Of his rich harvest of psychological results he had only time left to exhibit some numerical tables, showing that all parts of each sensory field presented a regular gradation of sensibility, the maximum of which lay wherever the attention happened to be focused. Fortunately, this research will very soon find more adequate expression in print (*Psycholog. Studien*, ii., 2). Unexpected results had been obtained by Specht (Leipzig) concerning the divergence of the relative and absolute thresholds of sensibility under the influence of alcohol; though the power of discriminating between two sounds of different intensity is much weakened by alcohol, the power of hearing a sound at all is actually increased by it. Rupp (Göttingen) had analysed (by reaction experiments) the localisation of touch stimuli on the fingers into two distinct processes: the localisation of the sensation in space, and its attribution to a particular finger. The former process was the quicker one. By means of certain unusual postures the two processes could be brought to give contradictory indications; thereupon the reaction-time was always lengthened, and sometimes the sensation was even attributed to the wrong finger. Linke (Naumburg) showed by his new stroboscopical experiments that stroboscopical effect is not wholly due to after-images, but also in large measure to causes of a more intellectual nature. The investigation by Veraguth (Zürich) of the galvanic psychophysical reflex had revealed that mental excitement has a marked effect on an electric current passing through any part of the body; but Sommer explained that these electric phenomena were of a secondary character, arising from changes of pressure and sweat-excretion. Marbe (Frankfort) exhibited an ingenious, practical, and comparatively inexpensive experimental arrangement for brief optical stimuli; a ray of light of any desired briefness, intensity, or colour is projected beside another similar but continuant ray. Ebbing-

[1] Külpe's paper will be somewhat amplified in the official account of the proceedings of the Congress. (Published by Barth, Leipzig.)

haus demonstrated his new, but already widely adopted, fall apparatus for the control of chronoscopes and other time-measuring instruments (for full description, see *Zeitschr. f. Psychologie*, xxx., 292). Several other apparatus were exhibited, but unfortunately not in such rich variety as at Giessen.

The other papers were those of Jerusalem (Vienna), on remembering and forgetting; Witasek (Gratz), on the methodics of measuring memory; Pfeiffer (Würzburg), on a method of determining qualitative types in school-work; Lipmann (Berlin), on the effect of suggestive questions; Asher (Bern), on the law of the specific energies of the senses; Detlessen (Wismar), on colour-values and colour-measurement; Hughes (Soden), on single affective states; Schultze (Würzburg), on accentual effects (Wirkungsakzente); Decroly (Brussels), on anthropometrical and psychological tests for children; v. Aster (Munich), on the third dimension of the spatial presentation (visual); and Kobylecki (Cracow), on psychological experiment without introspection.

On the whole, the congress showed itself strongly influenced by the universal and increasing reaction against the materialistic atomism of the early days of experimental psychology. The admission is ever gaining ground, that consciousness is something more than a mechanically changing conglomeration of sensations and feelings in varying quality, intensity and complication.

The earnest scientific tone and strict attention to business which had so favourably distinguished the Giessen congress from the international ones was on the present occasion even more marked. The members allowed themselves no relaxation until after the close of the proceedings, when a general picnic was made to the beautiful Veitshöchheim "Pleasure Palace" of the former Prince-Bishops. The next congress will be held at Frankfort (on the Main) on April 22–25, 1908. C. SPEARMAN.

THE MILAN INTERNATIONAL EXHIBITION.

THE Milan exhibition, which was opened in state by the King and Queen of Italy on April 28, is still far from complete. The reason for its unfinished condition is to be found in the increased scope of the exhibition. As originally planned, it was intended to commemorate the opening of the Simplon Tunnel by confining the exhibition to a display of progress in transport by land and water. Gradually other branches of industry were added, and support has been accorded by the leading European countries, France predominating with an area of 250,000 square feet. Austria follows with 180,000 square feet, Germany with 160,000 square feet, Belgium with 108,000 square feet, Great Britain with 75,000 square feet, and Hungary with 32,000 square feet. The exhibition covers an area of 400 acres, of which more than half is covered by buildings of a decorative character. Italian exhibitors occupy about one-half of the space, and the exhibits afford striking evidence of the remarkable industrial progress that has been made in Italy of late years. Altogether the exhibition is exceptionally attractive from a popular and a business point of view, whilst from a technical point of view its chief interest is due to the fact that it is the first international exhibition in which electricity has been used for driving the machinery shown in operation.

Of the exhibits of scientific interest, the most interesting are those of the Italian Admiralty. The methods employed in the preparation of charts and the manufacture of torpedoes are well shown. The retrospective exhibition associated with the transportation section is also of great interest. The early history of navigation and of steam transport is illustrated in an admirable manner. Exhibits of historical interest are contributed by the Board of Education, the Corporation of London, Lloyd's Register, the Institutions of Civil and Mechanical Engineers, and the Iron and Steel Institute.

In the various international sections valuable prizes are offered by the King of Italy. They include 400*l.* for the best exhibit of machinery, 400*l.* for the best type of workman's dwelling, 400*l.* for the best flying machine, 400*l.* for the best motor omnibus, 200*l.* for automatic railway couplings, 200*l.* for the best method of testing high-voltage electric currents, 200*l.* for motor-boats, and 200*l.* for the best motor-plough.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The University Alembic Club celebrated its hundredth meeting on Saturday, April 28, by holding a dinner in the banqueting room of the Town Hall. The professor of chemistry, the Lee reader, and the Aldrichian demonstrator were present. All the past-presidents of the club and a number of old members attended.

The 283rd meeting of the Junior Scientific Club was held on Friday, May 4, when papers were read on "Bubbles and Emulsions," by Dr. W. Ramsden, and "Who were the Greeks?" by Mr. J. L. Myres.

CAMBRIDGE.—The council of the Senate has nominated Prof. Woodhead, Mr. A. Sedgwick, and Mr. A. E. Shipley, and the special board for biology and geology has nominated Prof. Langley, Mr. J. J. Lister, and Mr. F. F. Blackman, to be members of the board of managers of the Quick fund. The election to the Quick professorship of protozoology rests with the board of managers, who will also control the expenditure of the income derived from the bequest of the late Frederick James Quick.

Mr. F. G. Hopkins, of Emmanuel College, and Mr. W. M. Fletcher, of Trinity College, have been elected examiners to the Gedge prize in physiology.

It is arranged that the voting on the proposals of the Studies and Examination Syndicate with reference to the doing away with compulsory Greek for mathematical and natural science students will take place on the afternoons of Friday, May 25, and Saturday, May 26.

Prof. Macalister, Prof. Langley, and Dr. Hill have published a time-table of courses in human anatomy, physiology, and histology to be held during the long vacation, beginning on July 4.

In addition to the ordinary classes in general pathology and pharmacology to be given at the New Medical Schools during the long vacation, the series of shorter courses dealing with more advanced work will be repeated this year. These courses are open to medical men and senior students only.

A COURSE of seven lectures on "The Morphology of the Bryophyta" was commenced by Prof. J. B. Farmer, F.R.S., at the Chelsea Physic Garden on Tuesday, May 8. Admission is free by ticket, obtainable on application to the Academic Registrar of the University of London.

A COURSE of eight lectures on the "Structure and Functions of the Central Nervous System," with special reference to the brain stem, will be commenced in the physiology department of University College, London, by Dr. W. Page May, on Wednesday, May 16. The lectures are open to all students of the University of London, also to qualified medical men on presentation of their cards.

THE following benefactions to higher education in the United States are announced in *Science*:—The University of California has received a gift of 20,000*l.* from the widow of the late Judge John H. Boalt. Mr. Andrew Carnegie has offered 8000*l.* to Denison University for a new library building on condition that a like sum is secured elsewhere for the endowment of the library. Through the generosity of Mr. Robert S. Brookings and Mr. Adolphus Busch, the medical department of Washington University (St. Louis) has received a gift of 10,000*l.*

AN earnest and well-informed plea for the provision of more adequate funds for the University of Cambridge is made in the current number of the *Quarterly Review*. Though it is a mistake to suppose that the flow of benefactions to the old universities has ceased entirely, the fact remains that Cambridge has twice appealed, once in 1898 and again in 1904, for help to meet her responsibilities. It is alleged that the demands of science have emptied the University chest, and yet there is a popular belief that the university of Newton and Charles Darwin, of Maxwell and Rayleigh, is still shrouded in mediæval shadow. When it is remembered that the expenditure on buildings devoted to science alone since 1862 must have exceeded 300,000*l.*, and that other great expenses have been incurred in the same direction, it is not difficult to understand that it has been done only with external help, and that unless more

funds are forthcoming due growth and development in the scientific departments are impossible. There certainly appears to be an absence of extravagance. The average annual income of the forty-four professors is not more than 550*l.*, and the average income of university teachers, other than professors, is only 250*l.* a year. The needs of the University, as detailed in the article, are indeed numerous, and the means of satisfying them are at present ludicrously inadequate. As has been done with wearisome iteration in these columns, the article refers to American and German munificence on behalf of higher education, and points out the tempting chance of sensible generosity the needs of Cambridge offer to our men of wealth. The generous provision made for university education in Germany and the United States, the part played by such education in the progress of a modern State, and the need that exists to strengthen our intellectual defences if we are to take a leading position in the struggle toward efficiency, were described by Sir Norman Lockyer in his presidential address to the British Association at Southport in 1903. The warning uttered on that occasion, and the position taken as to the significance of higher education to national progress, have been the means of directing attention to our educational deficiencies, and a beginning has been made to remedy them by increased grants to university colleges. A capital sum of a million and a half sterling would solve all difficulties at Cambridge, but wealthy benefactors tarry, probably because the State has not in the past shown its belief in the value of university education; meanwhile the work of a great university languishes.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 15.—"Reciprocal Innervation of Antagonistic Muscles. Ninth Note. Successive Induction." By Prof. C. S. **Sherrington**, F.R.S.

In various reflex reactions inhibition is succeeded by marked exaltation of activity in the arcs inhibited. This after-effect may be figured as a rebound from inhibition.

An example is the following. When a dog in which the spinal cord has been transected in the thoracic region is, the period of shock having passed, supported so that its spine is vertical and its hind limbs hang freely, these latter begin to perform a rhythmic stepping movement.

Suppose this reflex is in regular progress and is being recorded from one knee, *e.g.* right, by a thread passing thence to a pulley and light lever, if then the other thigh (left) be gently supported from behind the knee the record shows that the stepping reflex at once ceases in the right limb. The reflex, on recommencing after this pause, continues as it ceases, that is, its tempo and amplitude are practically the same as before the interruption.

This result contrasts with the following. The reflex can be cut short by a strong squeeze of the tail.

The application of this stimulus to the tail does not in any way interfere mechanically with the stepping movement. Suppose the reflex to be in regular progress and recorded as before, if then the tail stimulus be applied the stepping reflex is almost immediately arrested, and in both limbs. The reflex remains in abeyance while the tail stimulus is continued. On the cessation of the latter the reflex returns, and on its return soon shows indubitable increase in activity as compared with its activity before the inhibitory arrest. The increase is chiefly seen in the amplitude of the movement, but there is also often marked quickening of the tempo of the rhythm. The author has seen the rhythm on some occasions quickened by 30 per cent. The after-increase of the reflex may persist in evidence for many seconds. Its decline is gradual.

The arrest of the stepping reflex by tail inhibition cannot be prolonged indefinitely. The reflex tends to return in spite of the inhibitory stimulation when the latter is long persisted in. It is different when the stepping reflex is arrested by lifting one knee; the reflex does not then tend to break through the arrest, however long the latter be continued. In this form the arrest seems referable simply to cessation of the stimulus which excites the reflex. In tail inhibition the arrest seems referable to a central inhibition, the peripheral stimulus excitatory of the reflex remaining in action all the time.

The after-increase consequent upon inhibition may be conveniently termed "*successive spinal induction*," the more so as that term directs attention to the likeness between the spinal process and certain visual phenomena commonly designated "induction."

Again, it is easy to evoke reflex extension of the hind limb by stimulation of the skin of the opposite hind limb. With the spinal dog laid on its side (*e.g.* left) and a thread attaching the knee of the slightly flexed right limb to a recording lever, the delivery of a stimulus at a skin-point of the left foot evokes reflex extension at right hip and knee. If this stimulus, at moderate and unchanged intensity, be given at regular intervals, a series of extension reflexes of regular height and duration is obtained. If in the course of such a series the right limb is, during one of the intervals, thrown into strong reflex flexion, the next extension-reflex following on the intercurrent flexion differs from those prior to it in being more ample and more prolonged. Its after-discharge is greatly increased and its latency is sometimes diminished. If the test stimulus for the extension-reflex be adjusted at just subliminal value, the intercurrent flexion-reflex will make it supraliminal. The exaltation of the extension-reflex may remain perceptible for five minutes.

Successive spinal induction seems to be a process qualified to play a part in linking together simpler reflexes so as to form from them reflex cycles of action. It appears especially fitted to combine the successive opposite phases of such cyclic reflexes as have been termed "alternating," and shown to be particularly characteristic of the locomotor activity of the mammalian spinal cord. If a reflex, A, not only temporarily inhibits the action of an antagonistic reflex, B, but also as an immediately subsequent result induces in arc of B a phase of superactivity, the central organ is in that way predisposed for a second reflex opposite to A to occur in immediate succession to A itself. Such an effect seems proved by the observations in this and a preceding communication.

"On the Existence of Cell Communications between Blastomeres." By C. **Shearer**. Communicated by Adam Sedgwick, F.R.S.

In cutting sections of a number of segmentation stages of Eupomatus and Polygordius eggs, delicate protoplasmic strands were frequently observed connecting the blastomeres. Experiments with different fixing reagents demonstrated that they were not of the nature of coagulation artifacts, or the result of disintegration of the protoplasm, for in many of the sections in which they were to be seen all the finer details of histological structure were well preserved. Under favourable conditions they could be observed during the living state, and were similar in all respects to the filose strands described by Andrews in a number of Metazoan eggs. They possibly afford a means of coordinating the various cell activities.

PARIS.

Academy of Sciences, April 23.—M. H. Poincaré in the chair.—The president announced the accidental death of M. Curie, and gave a short account of his work.—The eruption of Vesuvius, and in particular, remarks on the explosive phenomena: A. **Lacroix**. A general account of the recent eruption, with particulars of the lava outflows and the nature of the explosions.—A method allowing of the study of the solar corona at other times than during eclipses: G. **Millochau** and M. **Stefanik**. It is proposed to photograph the regions near the sun's edge by means of the spectroheliograph, isolating the line λ 4303 in the second slit, and eliminating the light from other radiations by means of an appropriate green screen. Preliminary attempts have been made at Meudon with encouraging results, and the authors hope to be able to complete the work at the summit of Mt. Blanc.—Algebraic curves of constant torsion: Eugène **Fabry**.—Reducible groups of linear and homogeneous transformations: Henry **Taber**.—The equation of Laplace with two variables: Georges **Lery**.—The use of an electrical tuning-fork as a generator of alternating currents: M. **Devaux-Charbonnel**. Some anomalous results obtained with the currents generated in the electromagnet of an electrical tuning-fork were examined with a Duddell oscillograph. The effects produced

appear to be due to the electrostatic capacity, and cause difficulty when tuning-forks are used in multiplex telegraphy.—Diffusion of solutions and molecular weights: Michel **Végounow.**—The atomic weight and spark spectrum of terbium: G. **Urbain.** The atomic weight was determined by estimating the amount of water in the carefully purified sulphate $Tb_2(SO_4)_3,8H_2O$, and was found to be 159·2. The spark spectrum of terbium is rich in lines, the wave-lengths of some thirty-seven of the most characteristic being given.—The estimation of cadmium in a volatile or organic salt: H. **Baubigny.** Cadmium sulphide precipitated in the presence of hydrochloric or hydrobromic acids obstinately retains some of the haloid salt, and this, on ignition, owing to the volatility of the chloride and bromide, gives rise to serious losses. The author proposes to convert the impure sulphide into sulphate, and weigh in this form with certain necessary precautions.—Distemper in dogs: H. **Carré.** Dogs which had been kept isolated from birth remained free from distemper, but were always sensitive to inoculation with the disease, whatever mode of inoculation was used. The blood of the animal, collected when the fever is at its height, is sterile, but communicates the disease.—The Tertiary strata at Turritelles and Congeries, Panama: E. **Joukowsky.**—The phenomena of slipping in Sicily: Maurice **Lugeon** and Émile **Argand.**

DIARY OF SOCIETIES.

THURSDAY, MAY 10.

ROYAL SOCIETY, at 4.30.—On Adsorption and Occlusion: the Law of Distribution in the Case in which one of the Phases possesses Rigidity: Prof. M. W. Travers, F.R.S.—Cyanogenesis in Plants, part iv., The Occurrence of Phaseolunatin in Common Flax (*Linum usitatissimum*), part v., The Occurrence of Phaseolunatin in Cassava (*Manihot Aipi* and *Manihot Utilissima*): Prof. W. R. Dunstan, F.R.S., Dr. T. A. Henry, and Dr. S. J. M. Auld.—A Variety of Thorianite from Galle, Ceylon: Prof. W. R. Dunstan, F.R.S., and B. Mouat Jones.—The Mechanism of Carbon Assimilation in Green Plants; the Photolytic Decomposition of Carbon Dioxide *in vitro*: F. L. Usher and J. H. Priestley.—The Action of Anæsthetics on Living Tissues, part ii., The Frog's Skin: Dr. N. H. Alcock.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Long Flame Arc Lamps: L. Andrews (Adjourned Discussion).

MATHEMATICAL SOCIETY, at 5.30.—On the Substitutional Theory of Classes and Relations: Hon. B. Russell.—On Linear Differential Equations of Rank Unity: E. Cunningham.—On the Motion of a Swarm of Particles whose Centre of Gravity describes an Elliptic Orbit of Small Eccentricity about the Sun: Dr. E. J. Routh.—The Theory of Integral Equations: H. Bateman.—Singularities of Power Series in Two Variables: G. H. Hardy.

FRIDAY, MAY 11.

ROYAL INSTITUTION, at 9.—Some Astronomical Consequences of the Pressure of Light: Prof. J. H. Poynting, F.R.S.

PHYSICAL SOCIETY, at 8.—The Dead Points of a Galvanometer Needle for Transient Currents: A. Russell.—Exhibition of Lippmann Capillary Dynamo and Electromotor: Prof. H. A. Wilson.—Exhibition of an Apparatus for demonstrating the Movements of the Diaphragms of Telephonic Transmitters and Receivers and the Current flowing into and out of the Cable during Speech: W. Duddell.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Observations of *Uranus* at Windsor, New South Wales: John Tebbutt.—Observations of Comet *c* 1905: Natal Observatory.—Note on the Parallax and Proper Motion of the Central Star in the Annular Nebula in Lyra: B. L. Newkirk.—On the Ratios of the Triangles in the Determination of the Elliptic Orbit from Three Observations: S. Hirayama.—Some Considerations regarding the Number of the Stars: Miss W. Gibson.—On the Ancient Eclipses of the Sun: E. Nevill.—Elements of Five Long-Period Variable Stars: A. Stanley Williams.—On the Orbit and Mass of 85 Pegasi: W. Bowyer and H. Furner.—Some Points arising out of a Discussion of the Double Stars in Struve's Mensuræ Micrometricæ: T. Lewis.—Exhibition of Stereoscopic Star Charts North of 20° N. Decl., and South, if near the Milky Way: T. E. Heath.

MALACOLOGICAL SOCIETY, at 8.—Notes on the Subgenus Malluvium: E. A. Smith, I.S.O.—Notes on some Species of the Genus Mitra, with the Description of *M. Brettinghami*, n.sp.: E. A. Smith, I.S.O.—On some Land- and Fresh-water Mollusca from Sumatra, part ii.: Rev. R. Ashington Bullen.—Notes on a Collection of Nudibranchs from the Cape Verde Islands: C. Crossland and Sir Charles Eliot, K.C.M.G.—Notes on Indian and Ceylonese Species of Glessula: Col. R. H. Beddome.

TUESDAY, MAY 15.

ROYAL INSTITUTION, at 5.—Glands and their Products: Prof. William Stirling.

UNIVERSITY OF LONDON, at 5.—The Atmospheric Circulation and its Relation to Weather: Dr. W. N. Shaw, F.R.S.

ZOOLOGICAL SOCIETY, at 8.30.

FARADAY SOCIETY, at 8.—The Electrolysis of Fused Zinc Chloride in Cells Heated Externally: Julius L. F. Vogel.—Sensitiveness of the Platinum Electrode: H. D. Law.

WEDNESDAY, MAY 16.

SOCIETY OF ARTS, at 8.—The Development of Watermarking in Hand-made and Machine-made Paper: Clayton Beadle.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Exhibition of Pond Life.

ROYAL METEOROLOGICAL SOCIETY, at 4.30.—An Instrument for Testing and Adjusting the Campbell-Stokes Sunshine Recorder: Dr. W. N. Shaw, F.R.S., and G. C. Simpson.—The Development and Progress of the Thunder Squall of February 8, 1906: R. G. K. Lempfert.

THURSDAY, MAY 17.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Determinations of Wave-Length from Spectra obtained at the Total Solar Eclipses of 1900, 1901 and 1905: Prof. F. W. Dyson, F.R.S.—Some Stars with Peculiar Spectra: Sir Norman Lockyer, K.C.B., F.R.S., and F. E. Baxandall.—An Apparent Periodicity in the Yield of Wheat for Eastern England, 1885–1905: Dr. W. N. Shaw, F.R.S.—Some Physical Constants of Ammonia, a Study of the Effect of Change of Temperature and Pressure on an Easily Condensible Gas: Dr. E. P. Perman and J. H. Davies.

CHEMICAL SOCIETY, at 8.30.—The Relation between Absorption Spectra and Chemical Constitution, part vi., The Phenyl Hydrazones of Simple Aldehydes and Ketones: E. C. C. Baly and W. B. Tuck.—Aromatic Compounds obtained from the Hydroaromatic Series, part ii., The Action of Phosphorus Pentachloride on Trimethyldihydroresorcin: A. W. Crossley and J. S. Hills.—Studies of Dynamic Isomerism, part v., Isomeric Sulphonic-derivatives of Camphor: T. M. Lowry and E. H. Magson.—Studies on Basic Carbonates, part i., Magnesium Carbonates: W. A. Davis.

ROYAL INSTITUTION, at 5.—The Influence of Ptolemaic Egypt on Græco-Roman Civilisation: Rev. J. P. Mahaffy.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Notes on Overhea Equipment of Tramways: R. N. Tweedy and H. Dudgeon.

FRIDAY, May 18.

ROYAL INSTITUTION, at 9.—International Science: Prof. A. Schuster F.R.S.

SATURDAY, MAY 19.

ROYAL INSTITUTION, at 3.—The Old and New Chemistry: Sir James Dewar, F.R.S.

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