THURSDAY, JANUARY 30, 1908.

THE FUNCTION OF THE STAPES.

On the Impulses of Compound Sound Waves and their Mechanical Transmission through the Ear. By Sir Thomas Wrightson, Bart. Pp. 40, and portfolio of diagrams. (London: Thomas Kell and Son, 1907.)

LITTLE has been added to our knowledge of the auditory ossicles since the classical researches of Helmholtz, although the subject is of much interest. Sir Thomas Wrightson shows that, owing to the peculiar arrangement of the footplate of the stapes and the formation of the annular membrane, to and fro movements of the stapes are accompanied by vigorous transverse vibrations of its frame. These movements will be represented in any compound wave form by the points at which "the compound curve cuts across the average line representing the central or normal position of the membrane."

With the help of a very ingenious model, evidence is adduced that this complex of motions affords a reasonable basis for the analysis of compound notes, which is usually attributed to the fibres of the basilar membrane. Careful examination of the numerous wave forms reproduced by the author will, we think, make it clear that the theory advocated is worthy of attention. Sir Thomas Wrightson's criticism of the theory associated with the name of Helmholtz is not, however, entirely just. The statement that "In fact there is no intelligible explanation furnished by Helmholtz's theory why we can hear each note of a combination when all the component notes are sounded together" can be made with respect to any theory whatever. The real value of the hypothesis of Helmholtz is that it describes, not explains, a large series of phenomena which cannot easily be reconciled with rival theories. It remains to be seen whether Sir Thomas Wrightson's theory will better describe the facts. For example, the peculiar condition described by Jacobson under the name Diplacusis binauralis dysharmonica, in which the same note heard by the two ears simultaneously produces a dissonance, is most easily described by a theory of resonators in the cochlea. Again, if it be true that ossification of the fenestra ovalis is consistent with a partial preservation of hearing, as asserted by K. Schaefer (apparently on the authority of Frutiger), the function of the stapes would seem to be relatively unimportant; but evidence on this point is conflicting. The author assumes that an impulse is always imparted to the membrana basilaris by friction of the perilymph on its under surface; this is not necessarily the case. As Schaefer remarks:—

"It is conceivable that the fluid of the labyrinth, receding before the pressure of the stapes, flows from the Scala Vestibuli through the Helicotreme into the Scala Tympani, and conversely when rarefaction occurs in the auditory passage. But there is no time for this during the rapid sound vibrations, and it is far more probable that the membranous partition of the Cochlea bulges towards the Scala Tympani when the stapes moves inwards."

Whatever position may ultimately be assigned to the theory of stapedial analysis, Sir Thomas Wrightson and Dr. Arthur Keith, who is responsible for the anatomical part of the work, are to be congratulated on the performance of an interesting research which throws much light on the mode of action of a structure not readily accessible to the physiologist. M. G.

LIFE AND DEATH.

The Prolongation of Life. By Élie Metchnikoff. The English translation edited by P. Chalmers Mitchell. Pp. xx+343. (London: W. Heinemann, 1907.) Price 12*s.* 6*d.* net.

MOST people desire to live long, and hence Prof. Metchnikoff's book is sure to have many readers. He not only discusses the means by which life may be prolonged, but he also examines the question whether it is desirable to prolong it. About this he has no doubt; he is a confirmed optimist, and points triumphantly to celebrated men who have begun life as pessimists and have ended it as optimists. The chief of these is Goethe. Several chapters are devoted to the consideration of Faust, the sorrows of Werther, and Goethe's life. But this part of the book and that which treats of morality will probably appeal to fewer readers than the earlier part, for the subjects are so vast and so difficult that it is not easy to deal with them in the short space given to them by the author.

It is of interest to observe that Prof. Metchnikoff carries his optimism to the point of thinking that living has become easier from a moral point of view owing to the advances of science. For example, as science gets rid of or improves the treatment of plague and diphtheria, there will no longer be any need of the high moral courage of those who went freely among sufferers from these scourges in order that they might alleviate them. Life is already so difficult that this is a point of view we commend to the consideration of those who oppose scientific workers, and hinder them by vexatious restrictions.

"The Prolongation of Life" is a remarkable book in many ways. It and the "Nature of Man," of which it is an extension, treat of a subject about which little has been written. The whole range of literature is ransacked by the author, and the facts and opinions collected are discussed with an originality, a width of view, and knowledge that give the book an especial fascination and constantly arrest the attention.

Prof. Metchnikoff is of opinion that when old age approaches, the phagocytes, which have hitherto been man's friends, become his enemies, and hasten death by devouring the essential cells of the vital organs of the body, especially those of the nervous system.

These cells are rendered particularly vulnerable to phagocytes by the action of poisons manufactured by the bacteria of the large intestine, and Prof. Metchnikoff suggests that this might to a large extent be prevented by taking skimmed milk which has been boiled and rapidly cooled, and on which pure cultures of the Bulgarian bacillus have been sown. This produces a pleasant, sour, curdled milk containing about 10 grams of lactic acid per litre, the lactic acid of which prevents intestinal putrefaction.

The author is dependent mainly upon two kinds of evidence, experimental and numerical, and therefore his difficulties are chiefly two. Many experiments which might bear upon the prolongation of life must necessarily be observed for many years. For example, he devotes much space to the uselessness of the large intestine; so far as his facts go there is nothing to be said against them—indeed, from them and others we are probably justified in thinking poorly of the large intestine—but before we can certainly know much about this numbers of human beings who have been deprived of their large intestine will have to be observed for many years.

As the question is the prolongation of life, the numerical evidence as to how long certain animals and plants live is of the greatest importance, but the author has to depend largely upon hearsay. Very few of his statements are evidence in the technical sense of the word. We are more likely to be correct in our knowledge of very old human beings than very old animals, but even with regard to human beings the evidence of extreme old age—say over 100 years—often breaks down when carefully examined. Those in doubt on this point should read T. E. Young "On Centenarians." Sometimes the age is accepted because it is on the tombstone, but, as Johnson says, "In lapidary inscriptions a man is not upon oath." Prof. Metchnikoff is inclined to accept the commonly stated age of Parr, but there is no real evidence as to his age at death. Still, when we remember the extreme difficulty of getting suitable facts to support his views it must be admitted that the author has shown marvellous skill in the presentation of his case. No one can put down the book without feeling that it makes us think, will well repay careful critical reading, and induces gratitude to Dr. Chalmers Mitchell for his translation and excellent introduction.

PHILOSOPHICAL ESSAYS.

Proceedings of the Aristotelian Society. New Series, Vol. vii., 1906–7. Pp. iv+244. (London: Williams and Norgate, 1907.) Price 10*s*. 6*d*. net.

THIS volume contains the papers read before the society during the twenty-eighth session, 1906–7. The papers are eight in number, with titles and authors as follows:—(1) Nicholas de Ultricuria, a Mediæval Hume, by Hastings Rashdall; (2) on the nature of truth, by the Hon. Bertrand Russell; (3) on causal explanation, by T. Percy Nunn; (4) logic and identity in difference, by Miss E. E. Constance Jones; (5) Humism and humanism, by F. C. S. Schiller; (6) fact, idea, and emotion, by Shadworth H. Hodgson; (7) intuition, by A. T. Shearman; (8) philosophy and education, by Benjamin Dumville.

Both in the subjects chosen and in the standpoints adopted for their discussion, the series is quite representative of modern English philosophy. In the first paper, by the late president of the society, we find that element of historical appreciation, one might almost call it antiquarianism, without which English philosophy would be reft of half its distinctive charm. The second is virtually a criticism of Joachim's recent "Essay on Truth." The monistic theory championed in that book, viz. that "only the whole truth is wholly true," is shown to rest upon an assumed "axiom of internal relations," which may be formulated as follows:—"Every relation is grounded in the natures of the related terms." The arguments in its favour are shown to be fallacious, and the way is thus cleared for a return to the dualistic theory that facts are completely independent of our knowledge of them —that experiencing does *not* make a difference to the facts. Finally, two theories, each admitting the possibility of a plurality of truths, are mapped out as tenable, between which the author prefers not to decide. The third paper is a very thorough and lucid treatment of the methods of explanation adopted in the various sciences, and should be found useful by those interested in the more concrete side of epistemology. Miss Constance Jones's paper is good, but too technical in nature to receive further mention here. In his paper, Dr. Schiller devotes many pages to the orientation of the pragmatic philosophy, defending it especially against the charge of kinship with the empirical scepticism of Hume. Particularly good is his exposition of Hume's theory of "activity," a portion of Hume's system unduly slurred over by the historian of philosophy. To his own panegyric of voluntarism the best antidote is to be found in the following paper (No. 6), by Dr. Shadworth Hodgson. This paper is excellent. However untenable one may feel some of his conclusions to be, one cannot but admire the clearness of conception and the feeling for reality which Dr. Hodgson displays. The analysis is carried out under the influence of the fundamental antithesis of "real conditions" and "conditionates." It is attempted to show that consciousness is a conditionate of which the real conditioning is to be looked for in something which is not consciousness. "This 'something' is known to us as matter and motions of matter"; *therefore*, says Dr. Hodgson, it is not a thing-in-itself. His argument takes no account of the alternative possibility that the reality of which matter is the phenomenon is itself mental, and that the efficiency of matter is really mental efficiency.

Mr. Shearman's paper is an attempt to map out the position of intuition in philosophy, and is extremely suggestive. In the last paper of the series we meet the well-needed reminder that philosophy is still indispensable in any theory of education. Philosophy alone is fitted to preside over the ideals which all educational systems must recognise.

W. B.

PRIMITIVE INTERPRETATIONS.

(1) *Ancient Egypt the Light of the World: a Work of Reclamation and Restitution.* In twelve books. By Gerald Massey. Two vols. Vol. i., pp. vi+544; vol. ii., pp. iv+545–944. (London: T. Fisher Unwin, 1907.)

(2) *Primitive Traditional History: the Primitive History and Chronology of India, South-Eastern and South-Western Asia, Egypt, and Europe, and the Colonies thence sent forth.* By J. F. Hewitt. Two vols. Vol. i., pp. xxviii+448; vol. ii., pp. viii +449–1024. (London: James Parker and Co., 1907.)

(1) ONE of the recreations of an archæologist is the reading of the various remarkable works that are produced by persons of untrained mind who know a little of the subject on which they write and are possessed of violent prejudices either for or against some particular form of religion. The latter element adds spice to the recipe. The peculiar nature of the late Mr. Massey's preface to his present "work of reclamation and restitution in twelve books," as he called it, disarms the critic, however, to some extent. He does not know what he ought to say in the circumstances. Mr. Massey had in the course of a long life read much and noted much. Unluckily he had not read deeply enough. He never attempted to get his own knowledge, but depended on what others said. Hence in any case his book would be of no value except as a compilation. But, further, he had little idea of what is and what is not permissible in logical argument; very few of his syllogisms are without a flaw; he had no perception of what is possible or impossible in respect of philological comparisons, and he was dominated by a fanatical belief with regard to the origin of Christianity which at once takes his book out of the realm of science.

It is no use collecting anthropological data if all that one wishes to do with it is to prove that Christ and the evangelists and disciples were ancient Egyptian gods, whose names are twisted to suit the argument. For Mr. Massey, Jesus Christ is the deified scribe Imouthes or Iemhetep (why, we are not told), Thomas is the god Tum, Matthew is Maati ("The two Truths"), while for John he makes out an Egyptian equivalent called Aan. "The Ritual," he says (p. 905),

"preserves the sayings of the Egyptian Jesus who was Iu the Su, or Sa of Atum-Reï [? meaning] and Iusaâs [she was a goddess!] at Ou, and who was otherwise known as the Lord in different Egyptian religions. . . . This is the original *Evangelium Veritas* [*sic*: Mr. Massey's Latin was usually uninflected: cf. *jus prima noctis*]: the Gospel according to Mati=Matthew; to Aan=John; or Tum=Thomas," and so forth.

On p. 41 Mr. Massey says,

"In that [*i.e.* the Egyptian language] we find the word Ba signifies to be, Ba therefore is a form of to be. Also it is the name for the Ram and the Goat, both of whom are types of the Ba-er or Be-ing, both of whom say 'Ba.' The Cow says Moo. Mu (*e.g.*) means the mother, and the mythical mother was represented as a moo-cow."

Mr. Massey does not tell us the fact, which rather upsets his theory, that the Egyptians did not call a cow *mu*, but *ahu*. Apart from this, his statement that in Egyptian *ba* means "to be" is contrary to fact; in Egyptian "to be" is *un* or *iu*, and "to become" is *kheper*; there is no such word as *ba* meaning "to be." The word for mother was *m – t*: what the vowel was we do not know, probably *au* (*maut*). Mr. Massey goes on to say,

"The Ibis was one of the self-namers with its cry of 'Aah-Aah,' consequently Aah-aah is one name of the bird in the Egyptian hieroglyphics, and also of the moon which the Ibis represented."

Mr. Massey did not know that, though the word for "moon" (*not* for "ibis," which is *tekhen* or *hib*) is written conventionally *aah*, it was probably pronounced something like "*ioh.*" Do ibises say "ioh-ioh"?

These are simple misconceptions as to matters of fact, and they give us reason to doubt whether Mr. Massey has any right to speak patronisingly of the work of an anthropologist like Mr. Frazer, as he does on p. 672:—

"Here we may say in passing, that the *Golden Bough* contains a learned, large, and serviceable collection of data, but the theories of interpretation derived from the writings of Mannhardt are futile. Besides which, mythology is not to be fathomed in or by a folk-tale, and the *Golden Bough* is but a twig of the great tree of mythology and sign language—a twig without its root. The reception of the work in England served to show how prevalent and profound is the current ignorance of the subject-matter. It was hailed as if it had plumbed the depths instead of merely extending the superficies."

The last remark may be rather a point, but we can assure the Gallio, who may say, "How these anthropologists love one another," that Mr. Massey was no anthropologist, but a somewhat peculiar kind of mystic, and had no right whatever to criticise Mr. Frazer.

(2) Mr. Hewitt has unaccountably omitted China, Mexico, Peru, and Australia from his title. His work is comprehensive: it covers the whole world. And what it is all about it is difficult to discover. "History" it is not; there is no history known to science in it. But doubtless there is much known to Mr. Hewitt, and his Indian confidants, alone. The fact that Mr. Hewitt regards avatars of the Buddha "about 10,700 B.C.," and from "about 6700 to 4500 B.C.," as historical personages (p. 45) is enough to stamp him as a peculiar "historian." His book is an *omnium-gatherum* of primitive traditions truly, and from them Mr. Hewitt, the believer in the historical character of avatars of Buddha, essays to disinter the early history of the human race by the help of an astronomical key. The astronomy we leave to the astronomers; of the "history" the following excerpt may suffice as a specimen:—

"The worship of the left thigh was succeeded by the worship of the right thigh of the independent sun-god, who took his own path sun-wise through the heavens, in whose ritual the right thigh of the sacrifice was given as their perquisite to the Jewish priests of the house of Kohath, the wearers of the inspiring Ephod, and sons of the almond-tree. This age is historically most remarkable as that of the great moral upheaval which gave birth to the wide-spread movement towards individual regeneration, and the attainment of sanctity in mind and deed, which characterised the history of the Buddha, born as the divine physician Osadha-Dhāraka, the medicine-child in the age of the Yama Devaloko, the twin-stars Gemini, when the sun entered the Ashvin constellation Gemini in January-February, about 10,700 B.C., and which continued through the next succeeding periods of his Vessentara birth in the Tusita heaven of wealth. . . . This age was, as I show, contemporaneous with that characterised in Persian and Zend history as the introduction of the religion of Zarathrustra . . . during this period a wide-spread *régime* of active trade, under the guidance of affiliated managers in touch with the Indian trade-guilds, was extended round the world from India as the centre, to the west of Europe under the Phœnicians, and to America. During this time of universal peace the world was governed by traders and was undisturbed by tribal wars. . . ." (pp. 45, 46).

This sort of "history" is worthy of a Mahatma. We have heard it from Indian and "theosophical" lips before, and we do not believe a word of it. This age of universal peace about 10,700 B.C. "under the guidance of affiliated managers in touch with the Indian trade-guilds" is as unknown to scientific historians as Mr. Ignatius Donnelly's story of "Atlantis." It will be news to them, also, to hear that Zoroaster lived about 10,700 B.C.!

OUR BOOK SHELF.

Cyclopedia of American Agriculture. Edited by L. H. Bailey. Vol. ii., Crops. Pp. xvi.+690. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1907.) Price 21*s*. net.

THE second volume of Dr. Bailey's "Cyclopedia" deals with the field crops of North America, and opens with some interesting chapters on the economic side of plant life in general—the control of diseases, the principles of plant breeding and introduction, seeding, and the management and preservation of the crop. Though the plants dealt with in the main section of the book include the staple farm crops of this country, one cannot but be struck with the enormous diversity of the production of the United States. Its agriculture started practically on the basis of our own, with crops characteristic of temperate and humid climates, cotton being the only early addition on a large scale; but as population spread south and west, all the products of the Mediterranean region became included, and latterly the addition of the Sandwich Islands, Cuba, and Porto Rico to its territory has brought tropical and subtropical plants into the United States list. The valuable work done by the plant introduction division of the United States Department of Agriculture finds ample recognition here; the navel orange, Egyptian strains of cotton, with the date palm, the olive, and durum wheat for the arid regions, are striking examples of successful acclimatisation, and elaborate attempts are now being made to introduce tea.

The account of any individual crop is perhaps hardly full enough to be of much value to the farmer who is already engaged in that particular industry, and American conditions of climate and labour render much of the information inapplicable to British agriculture; but this volume of the "Cyclopedia" would be of the greatest service to any settler breaking ground in a new country, and looking round for profitable crops outside the accepted routine. As in all cyclopedias, many of the illustrations are rather trivial and pointless, but the full-page reproductions from photographs are of real value and often of beauty.

Penrose's Pictorial Annual, 1907–8. Vol. xiii. Edited by William Gamble. Pp. xvi+184. (London: A. W. Penrose and Co., Ltd., n.d.) Price 5*s*. net.

THIS annual has now reached its thirteenth volume, and although its predecessors have attained a very high order of excellence as regards text, illustration, and style, the present issue eclipses them all.

The volume before us is of perhaps more than usual interest, because a fundamental and important change has been made throughout the whole book. The editor, in his excellent and interesting summary of the year's work, tells us that on previous occasions the chief difficulty which became apparent in preparing these volumes was to present something conspicuously new in process work. The difficulty arose through the wonderful standard of excellence which had already been reached in photo-mechanical processes.

Owing to certain criticisms which indicated that the best effects from half-tones and three-colour blocks could only be obtained on highly-glazed paper, and with brilliant inks, and this did not comply with the canons of good art, an attempt has been made in the present volume to meet these views. The paper-maker has been asked to make a paper which should have a perfect surface without the gloss, and the ink-maker has been requested to prepare inks that would be suitable to the new kind of paper. To give the text illustrations a better chance, screens with 133 instead of 150 lines to the inch have been employed. The result of this combined effort, which is presented in these pages, is distinctly good, and throws great credit on all concerned in the endeavour. As in former years, the volume teems with a great number of excellent illustrations by various processes, and the text contains a wealth of information on allied topics.

The frontispiece is a fine heliotype reproduction from an old copper engraving, and the general appearance of the book leaves nothing to be desired.

The book should be found more useful than ever to anyone who wishes to seek the best process for book or catalogue reproduction, no matter whether the illustrations have to deal with the reproductions of oil paintings, photographs, black-and-white drawings, or such subjects as machinery, woodwork, or china.

The Education of To-morrow. By John Stewart Remington. Pp. 115. (London: Guilbert Pitman, 1907.) Price 2*s*. net.

"IT is my honest belief," says Mr. Remington towards the end of his book, "that at the bottom of almost all British failure in business or in industry is the nightmareish, unpractical nature of British education." Though he does not appear to be familiar enough with the progress which has been made during the last ten years in devising and introducing practical methods into our schools, Mr. Remington has much to say that deserves the earnest attention of schoolmasters and educational authorities generally. "The education of to-morrow will be an education for practical men, every branch of which will have to justify itself by ultimate usefulness." He combats successfully the common criticism that this would be to make education merely utilitarian and to ignore the need for culture. To foster in public schoolboys the belief that "the best people" cannot go in for trade, he describes as "suicidal." Altogether the little book provides much material for thought, and it may be commended to all who desire the welfare of their country. We hope, however, the education of the future will teach that it is unpardonable for a book of this kind to be published without an index.

Scouting for Boys. A Handbook for Instruction in Good Citizenship. By Lieut.-General R. S. S. Baden-Powell, C.B. Parts i. and ii. (London: Horace Cox, 1908.) Price of each part, 4*d.* net.

IN an earlier volume, "Aids to Scouting," Lieut.-General Baden-Powell has shown that the characteristics of the good scout are those which distinguish the successful man of science. In his appeal to headmasters in 1901, Prof. Armstrong pointed out how full of good advice in the training of children that book is. The present book, which is to be completed in six parts, two of which have now appeared, also may be recommended as likely to result in the development of faculties of observation, regard for accuracy, conscientiousness, and other desirable characters.

Photograms of the Year 1907. Text, pp. 48; illustrations, pp. 112. (London: Dawbarn and Ward, Ltd., 1907.) Price 2*s.* net.

BETWEEN the covers of the book we have a collection of reproductions of about 200 different pictures, about one-fourth of which are selections from the exhibitions held recently in London, while the remainder serve as examples of the pictorial work of the year, not only by home, but by colonial and foreign workers. The pictures are excellently reproduced, on stout paper, and every care seems to have been taken to ensure their being as true as possible to the originals.

In the text Mr. H. Snowden Ward gives us an interesting critique of the "Work of the Year," and contributions are included from the pens of various well-known colonial and foreign photographers.

Those who wish to make themselves acquainted with the main features of last year's work in pictorial photography will find much to interest them in the present issue.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Stability in Flight.

Now that two or three people have succeeded, by skilful manipulation, in travelling on a more or less determinate course in the air, it would be well that inventors should turn their thoughts to securing stability in flight without the demand of constant attention on the part of the aëronaut.

In a note written some years ago on this subject, I said:—"No flying machine will be satisfactory which does not contain some automatic device for securing stability. The principles which must be embodied in such a governor are in themselves simple, and may be realised in many ways.

"The principal axes of the flying machine have to be kept related in a definite way to the direction of the force of gravity and of the accelerations.

"To do this, the action of the governor must depend on the position of the axes of the machine in relation to the direction of two pendulums (or their equivalents), one having a very long and the other a very short period. In this connection, 'long' and 'short' have reference to what may be called the rate of instability." (A twenty-second period for the long, and a tenth of a second for the short pendulum, would be the sort of thing required.)

The long pendulum presents the greatest practical difficulties, but they can be met.

Until something of this kind is done, flying will remain a feat of personal skill. Probably most people could acquire this skill if they could practise when young, but, in learning to fly, any accident generally puts an end to the power of gaining further experience.

A. MALLOCK.

6 Cresswell Gardens, Kensington, S.W.

The Inheritance of "Acquired" Characters.

MAY I have space for a communication dealing, not with Mr. Spicer's letter (p. 247), but with some problems it suggests?

An individual develops from the germ-cell under the influence of various stimuli, of which the principal are nutriment, use, and injury. Nutriment supplies the material, but *not* the stimulus, for *all* growth. Up to birth, the human being, for example, develops wholly or almost wholly under this stimulus. Subsequently some of his structures continue to develop under it, for instance, his hair, teeth, external ears, and organs of generation, which grow whether or not they be used. But most of his structures now develop mainly, if not solely, under the stimulus of use, for example, his voluntary muscles, limbs, heart, and brain. Thus if the limb of an infant be paralysed it grows comparatively little, and the muscles atrophy. If the individual be injured, as by a cut, the injury supplies the stimulus for the growth (scar) which repairs the damage.

Scientific writers are accustomed to divide the characters of a living being into those which are "inborn" or "innate" and those which are "acquired," and are in the habit of declaring that the former tend to be "inherited" by offspring, but not the latter. I doubt if anything in science has been provocative of more confusion, misunderstanding, and futile controversy than this use of inaccurate terms. All our evidence indicates that the structures of the child are derived, not from the corresponding structures of the parent, but wholly from a germ-cell which dwelt as a parasite within the parent. Only in a purely metaphorical sense, then, does the child inherit from the parent. It resembles the parent merely because parent and child are derived from very similar germ-plasms which have been acted on to a very similar extent by very similar stimuli.

If we analyse the words of biologists carefully, we find that by an inborn character they imply one which has developed under the stimulus of nutriment, and by an acquirement one which has developed under the stimulus of use or injury. When they speak of the "transmission" of an "inborn" character, they imply that it has developed in both parent and child under the stimulus of nutriment; when they speak, as is still sometimes done, of the transmission of an acquirement, they imply that a character which developed in the parent under the stimulus of use or injury has developed in the child under the stimulus of nutriment. Apart from the immediate effects of injury (*e.g.* loss of tissue), I think it would puzzle anyone to indicate in what respects an "inborn" character is more innate and inherited than an acquirement. Obviously these vitally useful powers of growing, of developing in certain fixed directions under the stimulus of use and injury are just as truly inborn and rooted in the germ-plasm, just as truly products of evolution, as the power of growing under the stimulus of nutriment. It follows that the so-called acquirements are "innate" and "inherited" in precisely the same sense as the so-called inborn characters.

It is true that, since no character can be used or injured until it exists, all structures begin to develop under the stimulus of nutriment, and therefore that all acquirements are modifications of innate characters. But early development is no evidence of innateness, and most acquirements, like most of the growth made under the stimulus of nutriment, are nothing other than extensions of growth previously made. It is true also that innate characters arise inevitably as the child develops, whereas some acquirements are more or less rare. But this is only because the stimulus of nutriment is inevitably received, whereas the stimulus of a particular use or injury may not be received. If, however, the latter be received, the acquirement arises just as inevitably as the innate character. Thus if the child receives a like injury, it reproduces the scar on its parent's nose as certainly as the nose itself. If the nose is inborn and inherited, then the scar is inborn and inherited in the same sense.

Had the true nature of the distinction between innate and acquired characters been realised, had it been realised that the difference is one of stimuli, not of innateness or inheritability, and that acquirements are just as much products of evolution as innate characters, it is impossible that the controversy as to the alleged "transmission" of the former could have endured so long as it did. In effect, it was maintained by Lamarckians that a character (*e.g.* a scar) which the parent was able to acquire in a certain way (as a reaction to injury) because a long course of evolution had rendered such acquisition possible to the members of his race is reproduced by the child in a different category of characters, and in a way (as a reaction to nutriment) that no member of his race had ever acquired it before, and with which, therefore, evolution had nothing to do. An actual miracle was supposed to happen, the miraculous nature of which was concealed under a misuse of terms.

At the present day the majority of biologists are apt to regard "acquirements" as mere accidents, as things inferior to and less worthy consideration than "inborn" traits. Very little study has been given to the evolution of the power of making acquirements, especially use-acquirements, and hardly any attempt has been made to ascertain in what proportions the "normal" individual of any species is compounded respectively of innate and acquired traits. Lloyd Morgan, Baldwin, and Osborn have certainly dealt with this power under the name of "plasticity." But plasticity is not the same as growth, as development, and the fact that they have regarded acquirements as useful to the species mainly as affording time and opportunity for the evolution of corresponding inborn traits indicates an adherence, even if only a modified adherence, to the prevailing biological view. The evidence seems clear that animals low in the scale of life have little or no power of making use-acquirements, but that this power increases as species are more highly placed until in man the main difference between the infant and the adult is due to the use-acquirements made by the latter during development. The power of making use-acquirements is present only in structures where it is useful, and only to an extent that is useful. Great adaptability is thus conferred on the individual, for he develops only those traits which are useful to him in his particular environment, and is burdened with no others. We have a special name, memory, for the power of making mental use-acquirements. Memory is nothing other than the power or faculty of storing mental experiences, and so adding to the mental growth. It is strictly analogous to the faculty of storing physical experiences, and so adding to the physical growth. Without memory there could be feeling and (instinctive) emotion, but no thought, for the materials of thought would be lacking. Animals low in the scale of life appear to have little or no memory; they are guided more or less entirely by instinct. Man is intelligent and adaptable because he has a memory. He is the most intelligent of animals because he has the largest faculty for storing experiences. Memory, the *power* of learning, develops under the stimulus of nutriment, but intelligence and reason develop under the stimulus of use. They are amongst the *contents* of memory. We learn to think and reason just as surely as we learn the facts about which we think and reason. Reason, therefore, is an "acquirement."

Probably no problem in biology is of greater theoretical interest than that of the evolution of the power of making use-acquirements. Certainly no problem is of nearly such practical importance as that of determining the extent to which the individual develops, on the one hand, under the stimulus of nutrition, and, on the other, under the stimulus of use. From the times of Lamarck, Spencer, and Romanes, biologists have very generally assumed that use tends to cause development in all the structures of all animals, but that the amount of this modification is trivial. As a fact, use causes development in only some structures in some animals, and the major part of the development of the human being is due to it. If, for example, biologists had ascertained and were agreed as to the amount of this development, we should know to what extent races and generations of men differ "innately" and to what extent by acquirement, and therefore what effect could be produced by this or that system of mental training. Educationists could then apply this knowledge to the training of the young. At present the basis of bed-rock fact is lacking, and biology is shorn of much of the practical importance which is its right.

I venture to write this letter in the hope of directing attention to one, at least, of the great problems of biology which are neglected under present fashions. Experiment itself, for example, loses much of its value unless the worker has clear and comprehensive notions concerning the subject with which he deals.

G. ARCHDALL REID.

The Melanic Variety of the "Peppered Moth."

MR. SPICER asks (January 16, p. 247), among other questions, "how does the 'peppered moth' contrive to appear in the black country hatched with sooty wings that harmonise with the now smoke-stained bark whereon he must rest?" His point, I conceive, is that the melanic variety is due in some unexplained way to the inheritance of acquired characters.

If Mr. Spicer found that an actor whom he had seen perform the part of Hamlet on Tuesday was cast for Macbeth on the Wednesday, he would not necessarily, I suppose, conclude that the actor had added the part of Macbeth to his repertoire during the intervening time. Now there is more than a possibility that the black coloration of the variety Doubledayaria may in like manner be a repertoire pattern of the "peppered moth" evolved in the remote ages of the history of the species. The dark form is not necessarily atavistic in the general acceptation of the term, as it may only have been developed by some stocks of the species in a more or less restricted portion of its range, the stocks in question having reverted when the factor that put a premium on blackness gave place to the original conditions of their habitat. The facts of mimicry prove that the germ plasm of the Lepidoptera can carry more than one distinctive pattern, and the temperature experiments of Standfuss and Merrifield suggest that such latency may extend over long periods of the insect's history.

Mr. Spicer has tacitly assumed that the variety is confined to the black country, but this is by no means the case. The dark form is, I believe, taken in the Black Forest in Germany; certainly it occurs in Denmark, and records from our own southern counties are not wanting. It is by no means uncommon in and round London, and has been taken as far out as Brentwood and Bexley, both of which are outside the smoke limit as regards soot-stained bark. In the last-named district, my friend Mr. Newman has taken melanic forms of several other Geometriid moths in addition to var. Doubledayaria.

There seems to be no doubt as to the increase of melanism among the tree-resting species of Lepidoptera in certain districts of England during the past fifty years, but this increase is apparent outside the actual smoke-stained area, though not perhaps beyond the range of darker bark owing to the destruction of the lichens—a cause that may have operated locally on more than one occasion during the life-history of the species quite irrespective of a sooty civilisation.

Apart from lichens, even a change in the species of trees composing a forest might have a marked effect on the cryptic coloration of the bark-resting species of moths in the locality. Birch would favour a pale coloration; oak, cherry, and especially the thorns, a darker one; beech, with its dense shade and wide range of bark coloration, a darker or lighter pattern, according to the dampness of the situation and whether the particular species emerged before or after its full leafage was attained.

The time during which the dark form could have been evolved from the normal coloration of the species by the action, direct or otherwise, of smoke is less than a century, say from fifty to seventy-five generations—presumably a quite inadequate period for the evolution *and fixing* of the form by the selection of small chance variations. Certainly, if the analogy of language in the human race is permissible, the number of generations is far short of what would be required to impress any character on the heredity of a species *by the inheritance of acquired characters,* even if we could find any reasonable connection between soot-stained bark and darkened wings for the purposes of the theory.

But gradual adaptation during the present epoch does not fit the facts for another reason. The darkening, if gradual, would have been noticed by entomologists, as is the case with *Aplecta nebulosa* in Delamere Forest and *Hybernia leucophaearia* in Epping Forest. The species would be a beautiful example of a mutation if it were not for the fact that intermediates, though rare, have a puzzling habit of turning up; and, what is more serious, a careful examination of the melanic forms reveals the fact that on the upper margin of the hind wings, where they are covered by the fore wings when the moth assumes its normal resting position, there is an area of the original pale coloration. As in the reverse case of the exposed tip of the underside of the fore wings of many butterflies being coloured quite differently from the rest of the wing area, in order that it may match the cryptic pattern on the underside of the hind wings, the retention of the pale area in var. Doubledayaria can only be accounted for by the supposition that the variability is the work of natural selection.

If the above reasoning be correct, the black variety must either be regarded as the recurrence of a pattern slowly evolved in some previous epoch, or we must consider it as an example of the working of Weismann's germinal selection. The needs of cryptic adjustment to environment having put a premium upon darker, but not necessarily black forms, the determinants of the darkened characters tend by the operation of selection within the germ to increase progressively to a point where they are cut off by the operation of natural selection upon the individual. As a consequence, a few rare examples will always be thrown having such a progressive character in excess, and should any rare and sudden chance such as is afforded to melanism by our smoky civilisation occur, an enormous premium is placed upon the survival of their offspring. A. BACOT.

154 Lower Clapton Road, London, N.E.

Inductance in Parallel Wires.

A PROBLEM of some considerable importance to the practical engineer or physicist is that of calculating the effective self-induction of a circuit consisting of two parallel wires, the one being the return of the other. When the wires are not very close together, and their current is either steady or only very slowly alternating, satisfactory results are known to be given by the formula

$$\frac{L}{l} = 2\log\frac{c^2}{ab} + \tfrac{1}{2}(\mu_1 + \mu_2),$$

where L is the self-induction of a length l, c the distance between the wires, which have radii a, b, and μ_1, μ_2 the permeabilities of their materials. But if the current oscillates rapidly, this formula fails to give even approximately correct results. Now in many practical problems, such, for example, as the measurement of small inductances not greater than 1000 microhenries, it is necessary to employ long leads to keep them at some considerable distance from bridge and other circuits. A knowledge of the self-induction of such leads is very desirable. Some results which I have recently obtained are capable of finding this quantity in most useful cases, and it may prove of use to give a short statement of them, pending more detailed publication.

The self-induction has a simple expression only if the two wires be equal in radius. In this case it takes the form

$$\frac{L}{l} = 4\log\frac{c}{a} + \frac{4\mu}{x}\cdot\frac{\text{ber}\,x\,\text{ber}'x - \text{bei}\,x\,\text{bei}'x}{(\text{ber}'x)^2 + (\text{bei}'x)^2},$$

where ber x, bei x are the functions introduced by Lord Kelvin, and subsequently tabulated (*vide* Presidential Address to the Institution of Electrical Engineers, 1889).

If $\frac{n}{2\pi}$ be the frequency of alternation per second, σ the specific resistance of a wire, μ its permeability, then

$$x = 2a\sqrt{\frac{\pi\mu n}{\sigma}}.$$

This formula, passing naturally into the former when the frequency is small, becomes less accurate as c decreases and as the frequency or radius of a wire increases. So far as the first cause is concerned, it is subject to an error of not more than 1 per cent. when $c=10a$, and 4 per cent. if $c=5a$. If $c=3a$, which is the limiting closeness for most practical purposes, the error is about 10 per cent., which is not usually too great. The other causes of error may be considered together. The per cent. error they produce is of order $100.\frac{n^2a^2}{V^2}$, where $V=3\cdot10^{11}$. Practically, a is never more than about 2 millimetres, and thus, with a frequency of a hundred million per second, the error is not more than one-tenth per cent. The range of application of the formula is therefore extremely wide. A formula equally accurate may be given when the wires are unequal, but it is somewhat cumbrous. J. W. NICHOLSON.

Trinity College, Cambridge, January 21.

Stock Frost or Ground Ice.

DURING the recent frosty weather the subject of what is locally called "stock frost" has been much to the front in this neighbourhood. This phenomenon is known to the scientific world, I believe, as "ground ice," and the circumstances in which it appears and disappears present to the ordinary observer a very great many puzzling features.

I should be exceedingly glad if some of your readers would kindly give me, through the columns of NATURE, their opinion on several points which puzzle and interest me and others in connection with "stock" or ground ice.

(1) I wish to know, first of all, what are the *essential* conditions for the formation of ground ice on the bed of a river?

(2) Is it essential, or does it favour the formation of "ground" ice, that there should be no surface ice? We notice that when a very cold and very strong north-east wind is blowing, violently agitating the surface water, there is no surface ice, but a formation of ground ice at the bottom of the river.

(3) What are the circumstances to which is due the presence of ice-cold water at the bottom of a river, cold enough to be precipitated into ice?

This ice-cold water cannot reach the bottom of the river by gravitation, because its density is inferior to that of water at a higher level. To what, then, is due this cold temperature on the river bed?

(4) Can the bulk of water in the river bed be a conductor of cold from the surface to the bottom of the river in any other way than that of the mechanical action of running water? I assume that when ground ice appears in a river the whole of the water above it is of an ice-cold temperature, but it has not formed into ice because of the lack of the ice-precipitating conditions which exist on the bed of the river.

(5) Do the conditions necessary for the formation of ground ice operate more favourably in ice-cold still water or in that which is agitated, say, by passing through a mill? My own observation is that ground ice appears nearer to a mill on its upper side than on its lower side, and I want to know the reason of this.

There is quite a long list of questions which might be asked in connection with the formation of ground ice, but I fear that I have already trespassed too much upon your space. JOHN J. HAMPSON.

Costessey Vicarage, near Norwich, January 20.

THE PRODUCTION AND MANIPULATION OF INDIA-RUBBER.[1]

IN this work the author gives a description of the various stages through which india-rubber passes from the time when it oozes out of the tree until it leaves the factory, a finished article, fashioned and fit for the service of man. The book is expressly designed for the general reader. It does not, except incidentally, deal with the chemistry of india-rubber, nor with the minute details of manufacture; the volume is neither a laboratory guide nor a factory handbook. There are, however, many people interested in india-rubber who are neither chemists nor manufacturers, and the author thinks that a volume conceived on broad general lines to expound the natural and commercial history of rubber cannot be deemed a superfluity. Similarly it may, perhaps, not be amiss to give here a short outline of the matter for the benefit of those readers of NATURE who, likewise, are neither chemists nor manufacturers.

Many species of plants are now known to yield marketable rubber. They range from the lofty *Hevea braziliensis* of the Amazon swamps to the Landolphia creepers of West Africa and the Clitandra shrubs, a foot or two high, the rhizomes of which yield the "root-rubber" of the Congo. The chief genera are Hevea, Manihot, and Micranda (Euphorbiaceæ); Castilloa and Ficus (Artocarpaceæ); Hancornia, Funtumia, and Landolphia (Apocynaceæ); and Callotropis (Asclepiadeæ). The bark of the trees yields a milky latex, which is obtained generally by "tapping," though sometimes by the wasteful process of felling the tree. In various ways the latex can be caused to coagulate, much as ordinary milk is made to "curdle"; and the separated coagulum, after undergoing a process of "curing," is the "raw" rubber of commerce. This raw rubber, which comes here in various forms—loaves, biscuits, balls, cups, sheets, lumps, and slabs—contains water, sand, woody fibre, and other impurities, ranging in quantity from 15 to 50 per cent., which are removed by washing and rolling; and there are also present resinous bodies, relatively small in amount, but important in their effect upon the quality of the rubber, that are not eliminated by washing. The cleaned rubber is "compounded" where necessary (*i.e.* having regard to the purpose it is destined to serve) by kneading it with various mineral ingredients, such as antimony sulphide, iron oxide, litharge, and barium sulphate, and is eventually vulcanised by treatment with sulphur before it emerges in its final form as motor-tyre, cable, or other article.

Smoking Para rubber with palm nuts by the method which has recently superseded the paddle to a great extent. From "India-Rubber and its Manufacture."

Mr. Terry writes on these subjects with the authority of personal knowledge, though perhaps without the lightness of touch desirable in a work of this character. Probably the second and fifth chapters of the book will be found of the most general interest. They treat respectively of "the production of raw rubber" and of "india-rubber plantations," giving as fully as the scope of the work allows a sketch of the present aspect of these matters.

Among points mentioned as calling for special attention, it is urged that more care should be given to the "tapping" operations, so that other juices in the trees shall not be allowed to mix with the rubber latex. Further, the exudations of other trees are sometimes mixed with the rubber latex for the purpose of increasing the bulk. The author mildly stigmatises this as an "injudicious" practice; it is surely a fraud. Another important point to which the attention of producers is directed is the desirability of removing or sterilising the fermentable albuminous substances present in the latex. They give rise to evil odours and become a nuisance, even if they do not injuriously affect the quality of the rubber itself—a point which is perhaps debatable.

As regards plantation rubber, an estimate of the area under cultivation about two years ago gave a total of some 150,000 acres, and this, no doubt, has now considerably increased. The chief regions concerned are Ceylon (40,000 acres), the Malay Peninsula (38,000), Africa (33,000), Mexico (10,000), and India (8000). Young plantations in a more or less experimental stage, covering in the aggregate some 20,000 acres, are also found in Borneo, Java, Brazil, Venezuela, Ecuador, Central America, and the West Indies. As to the quality of the plantation rubber, recent experiments seem to indicate that, judged by vulcanisation tests on a small scale, some plantation rubber at least is not inferior to the best "hard cure" Para. The author, however, remarks that up to the present there is a unanimous opinion amongst experts that plantation rubber is deficient in "strength" compared with the Brazilian forest product. Nevertheless, it commands a higher price, owing to its greater freedom from waste.

"Never before," say some recent writers, "have brokers or manufacturers had presented to them a raw rubber of the purity of the best plantation rubbers."

For this very reason, they urge, it may well be that the present rough practical tests applied to the raw rubber are insufficient for proper valuation. At present the question of the relative merits is an open one; we shall probably know much more about it during the next year or two, when larger quantities of the plantation product are expected to come into the market.

C. SIMMONDS.

[1] "India-Rubber and its Manufacture; with Chapters on Gutta-Percha and Balata." By Hubert L. Terry. Pp. ix+294. (London: A. Constable and Co., Ltd., 1907.) Price 6*s.* net.

SCENERY AND NATURAL HISTORY OF NEW ZEALAND.[1]

FEW countries enjoy so many natural advantages of scenery and climate as New Zealand, and none of similar extent can compete with this favoured land in the variety and interest of its indigenous fauna and flora. The scenery of the Southern Alps, with their snow-fields and glaciers, rivals that of Switzerland, and it may be doubted if the fjords of Norway can be compared in romantic beauty with the west coast sounds. The weird volcanic district of the North Island, with its hot lakes and geysers and the still smouldering fires of Tongariro and Ruapehu, stands in startling contrast to the peaceful forest-girt lakes of the south, with the snow-clad mountain peaks reflected in their clear waters. The luxuriance of the subtropical vegetation in the far north, with its kauri forest, tree ferns, and nikau palms, is only eclipsed by the still more luxuriant mixed forest of the wet west coast, with its gigantic evergreen beeches, conifers, and crimson-flowered ratas. The peculiar alpine and subalpine floras, again, with their beautiful Celmisias, their magnificent species of Ranunculus, their Ourisias, and, most interesting of all, the so-called "vegetable sheep" of the genera Raoulia and Haastia, are probably unsurpassed in botanical interest in any part of the world.

By far the greater number, at any rate of the flowering plants, are endemic, and even the outlying islands have many species absolutely peculiar to them. Some of the more striking plants, such as the cabbage tree (Cordyline, known to English horticulturists as Dracæna), the flax bush (Phormium, shown in the foreground of our illustration), *Olearia haastii* (one of the many beautiful species of this genus found in New Zealand), and some of the shrubby Veronicas, have already found their way into English gardens; but no one who has not been in the country can form any idea of the wealth and beauty of its native flora.

Associated with this striking vegetation is a no less unique and interesting indigenous fauna, in which the ancient tuatara and the numerous flightless birds of divers families—kiwis, kakapos, wekas, and Notornis—form the most conspicuous features, to say nothing of hosts of remarkable invertebrates, such as Peripatus, land planarians and nemertines.

It was inevitable that the process of settlement of the country by Europeans, with the consequent clearing of the forests and the introduction of carnivorous animals—dogs, cats, rats, weasels, and so on—should have a disastrous effect both upon the scenery and upon the plants and animals. Already much of the forest has been destroyed, and many of the unique native birds are almost extinct, especially those which have lost the power of flight, while the tuatara is no longer found on the mainland, having, it is said, been exterminated there by the pigs introduced by Captain Cook, though still surviving on some of the small islands.

In these circumstances any attempt to arrest the progress of destruction must be heartily welcomed, and the New Zealand Government is to be congratulated upon the vigorous efforts which it is making in this direction. The report on scenery preservation recently issued by the Department of Lands is a most interesting document, with a wealth of beautiful photographic illustrations, one of the most striking of which we reproduce. We learn from this publication that already nearly three million acres have been set aside as national parks, and since the Land Act of 1892 came into force "the protection and preservation of the beautiful natural scenery with which New Zealand is so richly endowed has been steadily kept in view, and when any portion of Crown lands has been opened for settlement, areas of specially attractive forest, or land surrounding waterfalls, caves, or thermal springs, have been excluded from sale and set apart for all time by permanent reservation." In 1903 a special Scenery Preservation Act was passed, dealing with the acquisition and reservation of all suitable lands, whether Crown, freehold, or native. A further Act provided for the formation of "The Scenery Preservation Board," which now acts as an advisory board to the Government, and reports on all cases of suggested reservations. That this board is no mere shadow but a really efficient instrument for the purpose in view is proved by the amounts which have been paid by way of compensation for land acquired during the three years of its existence. In 1904–5 the amount was only 216*l.* 4*s.* 10*d.*, but in 1906–7 it had already risen to 7855*l.* 19*s.* 10*d.*!

Along the Route of the North Island Main Trunk Railway: Ruapehu Mountains, from Raurimu. (Photo. C. Spencer.)

No less important is the work which the Government has long had in hand in protecting the native animals and providing sanctuaries where they may remain unmolested, either by man or by the noxious animals which man has introduced. For this admirable purpose some of the small islands off the coast have been selected, such as Little Barrier Island in the north, Resolution Island in the south-west, and Kapiti Island in Cook Straits. These islands have been well chosen so as to give as great a range as

[1] (1) "Report on Scenery Preservation for the Year 1906–7." (Published by the New Zealand Government, 1907.)
(2) "Report on a Botanical Survey of Kapiti Island." By L. Cockayne. (Published by the New Zealand Government, 1907.)

possible in climatic conditions, nor has the purely scientific aspect of the question been neglected, for simultaneously with the document to which we have already referred, the New Zealand Government has just issued a detailed "Report on a Botanical Survey of Kapiti Island," by Dr. L. Cockayne, a botanist who is already widely known for his researches on the New Zealand flora. This exhaustive and painstaking piece of work deals with the physical geography and climate of the island, and with the introduced plants and animals, as well as with the indigenous flora. The latter is treated under the headings of the various plant-formations—classified as forest, shrub, coastal, meadow, and rock-formations—and much attention is devoted to ecological problems. The suitability of the island as a plant and animal sanctuary is discussed, and lists are given of the native and introduced plants. This report, again, is illustrated by numerous excellent photographs taken by the author.

The interesting monograph which we have thus briefly summarised is a good example of the activity and enthusiasm with which the representatives of natural science in New Zealand are carrying on the good work initiated by such pioneers as von Haast, Hutton, Hector, Kirk, Buller, and Parker, to mention only some among those who have already passed away from the scene of their labours.

ARTHUR DENDY.

LIEUT.-COL. R. L. J. ELLERY, C.M.G., F.R.S.

LIEUT.-COL. R. L. J. ELLERY, whose death we announced on January 16, was for many years the director of the Williamstown and Melbourne Observatories. To review his career is to recall the history of astronomy in Australia, so intimately was he connected with its progress. When he took up work as Government Astronomer in a rising colony, the instruments at his disposal were small, and the funds available for promoting astronomical research necessarily limited. The extension witnessed in the last forty years is due in no small measure to his initiative, and not the least of his services was to induce the colony to recognise the claims of science and to make more liberal provision for its needs. By his efforts arose the new observatory at Melbourne, and by his activity it became the centre for the prosecution of much useful work. There, too, at his instigation was mounted the four-foot reflector, at the time of its erection the most powerful instrument in the southern hemisphere. This instrument was much used for the examination of Herschel's nebulæ, but in a new society, intent upon material progress, such a telescope was perhaps of even greater use by the interest it aroused in science generally. It served as a permanent reminder of the progress of science, and of the necessity of meeting its demands. For as the colonies enlarged, the claims of science required increasing support. In climatology, Col. Ellery's powers of organisation were invaluable. Not only did he collect the necessary information which indicated the more valuable localities for settlement, but gradually issued isobaric charts and storm warnings, at first applicable to the coast, but afterwards, as other colonies joined in an uniform scheme, published daily weather charts extending over the whole continent. Terrestrial magnetism was another subject he pursued with great eagerness, and geodesy, including pendulum experiments and longitude determinations, also claimed the attention of the staff. In a word, the observatory was the centre of enterprise and activity, encouraging the scientific spirit in many directions.

Forty years ago, the condition of meridianal astronomy in the southern hemisphere was in a backward condition, and naturally much attention had to be paid to the determination of star places. Two standard star catalogues were issued from the Melbourne Observatory under Col. Ellery's direction, and, in addition to this special work, zone observations on a large scale were carried out. Taking part in the work of the International Star Chart has increased the meridian measures very considerably, since the observatory has loyally assisted others in providing the positions of guiding stars, where required, and for the final reduction of the measures on the photographic plates. Both in 1874 and 1882, Australia furnished a number of stations for the observation of the transit of Venus, and particularly on the former occasion the late director was instrumental in providing suitable equipment, and assisted the general programme very materially.

Col. Ellery retired from the office of director in 1895. Some portion of his leisure he devoted to the preparation of a history of the beginnings and growth of astronomy in Australia, and in various ways he was prominent in promoting scientific interests. He was elected a Fellow of the Royal Society in 1873, was a Fellow of the Royal Astronomical Society, and of many colonial societies for the promotion of scientific aims.

NOTES.

IN the Henry Sidgwick memorial lecture at Newnham College, Cambridge, on January 25, Mr. Balfour spoke on decadence, and remarked that progress is with the West and with the communities of the European type. "If our energy of development," he is reported to have said, "were some day exhausted, who can believe that there remains any external source from which it can be renewed? Where are the untried races competent to construct out of the ruined fragments of our civilisation a new and better habitation for the spirit of man?" He answered his own questions with the assertion that such nations do not exist. But Japan has been steadily assimilating what is most important in European civilisation for some years now, and her system of education is every year approaching in efficiency anything the West has to show. In the contingency of which Mr. Balfour spoke, it is easily conceivable that a people with a genius for development, such as Japan has shown, may take naturally the place of superiority and develop a system which is a distinct advance on any civilisation the world has yet known. Men of science will be pleased with Mr. Balfour's tribute, in the latter part of his lecture, to the achievements effected by science and to the extent science has assisted human development, but they will at the same time remember that the Government of which Mr. Balfour was the leader assisted scientific work no more than other Governments. Statesmen are eloquent in praising scientific work and methods, but few of them have sufficient courage of their expressed convictions to make adequate provision for the extension of natural knowledge which is the life-blood of the modern State.

WE regret to see the announcement of the death of Sir Thomas M'Call Anderson, regius professor of medicine in the University of Glasgow since 1900.

MR. MORRIS K. JESUP, who died last week, bequeathed 200,000*l*. to the American Museum of Natural History for its collections. Mr. Jesup was president of the museum for twenty-five years; his name is familiar to anthropologists, and naturalists generally, as that of one who gave generous assistance to various expeditions and other scientific enterprises.

LORD AVEBURY has been elected president of the Royal Microscopical Society, and will deliver an address on seeds, with especial reference to British plants, at the March meeting of the society.

WE learn from the *British Medical Journal* that the Secretary of State for the Colonies has appointed Dr. W. J. Simpson, professor of hygiene at King's College, London, to proceed to the Gold Coast to assist in combating the present outbreak of bubonic plague at Accra. Prof. Simpson left for the Gold Coast on January 18.

To the *Times* of January 22 Miss L. L. Veley contributes a letter on the subject of luminous barn-owls, in which it is suggested that the emanation is due to the feathers of the birds having come in contact with luminiferous decaying wood in their roosting-places. This suggestion, which has doubtless occurred to many naturalists, affords a probable and satisfactory explanation of the phenomenon.

THE Philosophical Society of Washington held its 643rd meeting at the Hubbard Memorial Hall, in the City of Washington, on January 18, the entire evening being devoted to commemorative addresses of the life and work of Lord Kelvin. Prof. A. G. Webster spoke of Kelvin's life and work, Prof. R. S. Woodward confined his address to Kelvin's contributions to geophysics, and Prof. Simon Newcomb devoted his remarks to Kelvin's character and personality, to which topic the British Ambassador also contributed some reminiscences. The president of the society, Dr. L. A. Bauer, presided.

DR. G. A. DORSEY, curator of anthropology in the Field Museum of Natural History, Chicago, has recently visited Cambridge before embarking on a protracted tour through the East Indian Archipelago, Australia, and Melanesia. After visiting the Philippines, where three of his students are engaged in ethnological researches, he will return to Chicago by way of China, Japan, and the Hawaiian Islands. He expects to be away from Chicago for about one year. This is merely a tour of inspection, but it may not unreasonably be expected that it will lead to future investigations by others in certain localities.

IN the Rev. Dr. Lorimer Fison, who died near Melbourne on December 29, 1907, Australian anthropology has lost one of its earliest scientific workers. He was born in England on November 9, 1832, and went up to Caius College, Cambridge, but never took a degree; after residing some time in Australia he became a Wesleyan missionary and went to Fiji, and it was from him that Lewis Morgan drew important information for his "Systems of Consanguinity." Returning to Australia, Dr. Fison met Dr. A. W. Howitt, and a joint work on Australian marriage customs, &c., "Kamibaroi and Kurnai," appeared in 1880. Whatever his views at that date, Dr. Fison subsequently dissented from Morgan's interpretation of the facts in favour of primitive promiscuity, for in an address to the Australasian Association for the Advancement of Science he took the view that the group marriage did not mean more than marital right or qualification by birth. Dr. Fison, unfortunately, found little time for writing; papers by him on Fijian customs and kinship systems appeared in the Journal of the Anthropological Institute; he dealt with Fijian land tenure in the *Expository Times* of 1905, and a year earlier he published in "Tales of Old Fiji" a small part of his great store of knowledge of that island. Some years ago he received a Civil List pension, but, to the loss of anthropology, broken health forbade him to do much literary work.

IN the *Engineer* and in *Engineering* of January 24 a large amount of space is devoted to the Board of Trade inquiry into the facts relating to a disastrous explosion of a thermal storage-drum in connection with a Babcock and Wilcox boiler at Greenwich. The explosion took place on December 20, 1906, and the inquiry (one of the longest on record) ended on January 22, 1908, when judgment was given by the commissioners. The finding was that the primary cause of the explosion was a crack which had been formed in the end plate, owing to the bad treatment to which the plate had been subjected while being fitted into the drum. Any fears that existed as to the peculiar liability of thermal storage-drums to fail were removed. Many points of scientific interest occurred during the inquiry, notably in the reports by Mr. W. Rosenhain and Dr. T. E. Stanton, of the National Physical Laboratory, showing from the results of chemical, microscopical, and mechanical tests that the plate in question was of good normal commercial quality, but that it had received severe treatment in the hands of the boiler-makers.

LAST spring Dr. J. Elberts, the German geologist, conducted an expedition to investigate further the fossiliferous deposits of the Bengawan River, near Trinil, in Java, rendered famous by the discovery of *Pithecanthropus erectus* by Dr. Eugene Dubois in 1891–2. Although extensive collections were made and fresh forms discovered, no trace of Pithecanthropus was found; but, according to the correspondent of the *Pall Mall Gazette* (January 17), Dr. Elberts found roughly fashioned implements of bone, "a fireplace, and the remains of extinct animals, from which he became convinced that the ape-man must have existed at a remoter period." Unfortunately, this statement is so vague that nothing can be accepted until more information comes to hand. The implication is that some beings made fires and cooked animals, now extinct, before the gravel beds were deposited which contain Pithecanthropus and other extinct forms. In the province of Madium a fireplace was discovered 20 feet below the surface containing stone arrow-heads and fragments of pottery, broken and partly burned bones, and charred teeth of a fossil buffalo, together with the bones of deer, pigs, and a fossil elephant (Stegodon); some of these bones had been split open in order to extract the marrow. Dr. Elberts computes that these people lived 20,000 years ago, but, as the correspondent of the *Pall Mall Gazette* does not give the data upon which this estimation is based, this date must await the publication of all the facts. It is evident that we may congratulate our German colleagues on having discovered remains of early inhabitants of Java who were apparently in their "Neolithic" stage of culture. It is to be hoped that when the finds are published in full it will be possible to learn what manner of men they were. We understand that the expedition is now in south Sumatra, where fossil plants will also be collected, in the hope of determining whether Sumatra had an Ice age.

THE correspondence on the winding of rivers in plains which followed the letter from Sir Oliver Lodge published in these columns on November 7 last (vol. lxxvii., p. 24), and to which Mr. J. Lomas contributed on December 5 (vol. lxxvii., p. 102), has led Dr. D. T. Smith, of Louisville, Ky., to remind us that the subject is discussed in a book of his entitled "Philosophy of Memory," which was reviewed in NATURE of May 18, 1899 (vol. lx., p. 51).

In his book a chapter on the laws of river flow is included, in which he expresses the opinions supported by Mr. Lomas. Dr. Smith's views were arrived at after many years of close observation of streams, ranging from rivulets to the Mississippi, on the banks of which he resides. As was said in the review of his book, his results merit careful consideration as an important contribution to the inquiry.

MR. R. I. LYNCH writes commenting on the review of "The Garden Beautiful" which was published (p. 217) in our issue of January 9. He takes exception to the remark:—"We cannot agree with the suggestion on p. 76 that trees growing in isolated positions on lawns have their roots robbed by the grasses! in anything like the measure that obtains when the trees are growing together in a plantation." Mr. Lynch reminds us of the experiments carried out at the Woburn Experimental Fruit Farm, and of the serious results that were found to follow when grass grows over the roots of a young tree. These experiments were personally inspected by our reviewer, who wrote with full knowledge of the results obtained. Mr. Lynch appears rather to have misunderstood the meaning of the sentence in the review. It was not intended to deny the deterring influence of the sward; the statement is that a tree growing on a lawn suffers less robbery at the roots from grasses than is suffered by a tree growing in a plantation, and therefore exposed to the competition caused by the encroachment of roots from adjacent trees, which in course of time must interlace. The question raised is, in fact, one of degree, and degree only.

IN the course of an article on the "Atlantic flora" of Scandinavia in *Naturen* for January, Mr. E. Jörgensen gives a figure, taken from a living specimen of the Lofoten variety of the fjord-horse, which affords a much better idea of this pony than does the one from a badly mounted skin in the Bergen Museum published last year by Dr. Stejneger in Smithsonian Miscellaneous Collections.

To the January number of the *Journal of Anatomy and Physiology* Dr. D. Forsyth contributes the first part of an important paper on the anatomy of the thyroid and parathyroid glands in mammals and birds, embodying the results of the examination of these organs in a large number of species. Since the conclusions are reserved for the continuation, a fuller notice of the paper may likewise be deferred. In the same issue Dr. W. L. H. Duckworth continues his account of the brain of native Australians, while Dr. Ramsay publishes additional observations on the dentition of the same race.

BULLETIN No. 56 of the University of Arizona Experiment Station is devoted to scale-insects infesting palms and the best means of exterminating these pests. One of the most troublesome, which much resembles the jujube-scale (*Parlatoria zizyphus*) commonly infesting oranges from the Mediterranean countries, and appears to belong to the same genus, was introduced on palms from North Africa. Unfortunately, it has been described independently by three different naturalists, in Italy, America, and New Zealand, under as many distinct names, of which *Parlatoria blanchardi* is entitled to stand.

To Dr. W. L. Abbott, who has previously done such good service to America by collecting in the Malay countries, the U.S. National Museum is indebted for a series of specimens of mammals from western Borneo, a notice of which is given by Mr. M. W. Lyon in No. 1577 of the Proceedings of that institution. The collection is noteworthy for the large number of skins of the proboscis-monkey. The animal referred to under the disguise of *Pongo pygmaeus pygmaeus* appears to be the orang-utan. Other recent issues of the same publication include an account of the North American parasitic copepod crustaceans of the family Caligidæ (No. 1573), by Mr. C. B. Wilson, and a list of the land-shells of the family Pyramidellidæ, with descriptions of new species, from the Oregon district (No. 1574), by Messrs. Dall and Bartsch.

A NOTABLE contribution to the botany of Texas is published in the eighteenth annual report of the Missouri Botanical Garden under the title of "Plantæ Lindheimerianæ, Part iii." Mr. F. Lindheimer was one of the early German pioneers in Texas, and from 1833 to 1851 made botanical collections that were to be named by Dr. G. Engelmann, of St. Louis, and Dr. Gray, and distributed among subscribers. Four fascicles were collected and distributed, and in the first two parts of "Plantæ Lindheimerianæ" determinations were given for the orders as far as Compositæ (Bentham-Hooker's sequence). The present part, prepared by Mr. J. W. Blankinship, contains a biography, the determinations for the remainders of the early fascicles, and for another series that may be regarded as fascicle v. Also the author has compiled a revised index of names for all the collections.

FERTILISATION in the genus Cypripedium forms the subject of a paper by Miss L. Pace published in the *Botanical Gazette* (November, 1907). The species *spectabile* and *parviflora* were examined, and the development of the embryo sac furnished results of peculiar interest. The original mother cell divides to form two daughter cells, one micropylar, the other chalazal. The nucleus of the micropylar cell rarely divides, but the nucleus of the chalazal cells divides, giving rise to two nuclei, so that three megaspore nuclei are usually produced. The chalazal cell becomes the embryo sac, in which two megaspore nuclei are used; another nuclear division completes development in the embryo sac, that contains then one egg cell, two synergids, and a polar nucleus. Fertilisation of the ovum is normal, and so-called double fertilisation is effected by the fusion of one synergid, the polar nucleus, and a male nucleus.

BOTANISTS, more especially those who favour the view that the derivation of the angiosperms should be traced through the gymnosperms, will be much interested in the theory with regard to the embryo sac advanced by Dr. O. Porsch in a small brochure published at Jena by Mr. Gustav Fischer. The original and essential points in the argument lie in the interpretation of the antipodal cells as an archegonial complex, and in homologising the polar nuclei with ventral canal cells. This postulates an archegonium consisting of an ovum and two neck cells, and a vestigial ventral canal cell nucleus at each end of the embryo sac. Dr. Porsch bases his arguments on a sequence starting from the condition of numerous archegonia found in Sequoia through types of the Cupressaceæ and Ephedra, where the archegonia are reduced in number and complexity, to a hypothetical case of two archegonia, at first juxtaposed, but subsequently located at the poles of the embryo sac.

IN the latest addition (No. 15) to the series of Bulletins issued by the University of Illinois, Mr. L. P. Breckenridge discusses the burning of Illinois coal without smoke. The fundamental principles that apply to smokeless furnace construction and working are enumerated, and, by means of units in actual operation, several ways are indicated in which these principles have been satisfactorily applied.

THE report of the Chief Inspector of Mines for the year 1904–5, issued by the Mysore Geological Department (Madras, 1907), has just been received. It contains the mineral statistics for 1904, and, as regards gold mining, is a record of steady progress. The value of the gold production in 1904 was 2,323,194*l*. The total value of gold produced from the commencement of mining operations up to the end of 1904 was 21,011,075*l*., and the total dividends paid amounted to 9,329,487*l*. In addition to gold, statistics are given of the production of salt, iron ore, corundum, soapstone, limestone, clays, laterite, granite, and other building stones.

IN a review of engineering in the United States last year, reference is made, in the *Engineer* of January 17, to the spectacular feature of building as an engineering work in the construction of the numerous steel-frame office buildings of enormous height in New York. The highest of these is the tower of the Manhattan Building, 75 feet by 85 feet, 660 feet high to the top of the cupola. This has forty-eight stories. Next to this is the tower of the Singer Building, forty-two stories, with a height of 612 feet. The main portions of these buildings are respectively eleven and fourteen stories high. On the other hand, the City Investing Company Building has the main building, twenty-five stories high, with a tower 70 feet square, having thirty-two stories, and rising to a height of 400 feet above the street. In all these cases the towers are used as offices, &c., like the main parts of the building. This requires very elaborate lift equipment, with high speeds. The city now has one building each of forty-eight, forty-two, and thirty-two stories; twenty buildings of twenty to twenty-six stories; fifty of fifteen to twenty stories; and 465 buildings of ten to fifteen stories in height.

WE have received from Dr. Eredia, of the Italian Central Meteorological Office, an article on the rainfall of the Ligurian Riviera, reprinted from the *Rivista Agraria* for October, 1907. This paper, like his other useful investigations of the meteorology of various Italian provinces, collects into convenient tables the most trustworthy data relating to the object in view, and discusses them in an interesting explanatory text, dealing with monthly and seasonal values. The latter clearly show that in all seasons of the year the rainfall along the eastern Riviera is greater than along the western, and that autumn is the wettest and summer the driest period. Next to the autumn season, winter is wettest at Genoa, Spezzia, and San Remo, *i.e.* near the centre and extremes of the province, but at other places the greatest fall occurs in the spring. The mean yearly values are 52·8 inches at Genoa, 57·7 inches at Spezzia, and 31·9 inches at San Remo; the period dealt with is 1880–1905.

THE Cantor lectures, delivered by Mr. Conrad Beck in November and December last, have been reprinted in recent numbers of the Journal of the Society of Arts (December 27, 1907, to January 17); they deal with the theory of the microscope, a subject of never-failing interest, whether it be considered from the theoretical or the practical standpoint. The first lecture deals with the problem of arranging lenses so as to obtain an enlarged view of an object; although most of the matter is well known, many points are considered in a most interesting and instructive manner, as, for instance, the interpretation of the Gauss surfaces for a thick lens or system of lenses. The second lecture is concerned with the quality of the image formed. The methods of correcting certain classes of lenses for spherical and chromatic aberration may be found in most books on geometrical optics, but the microscope objective is so complicated in its structure, and the conditions to be complied with in its design are so far different from those which determine the design of other lenses, that but scanty notice is generally given to this most important and interesting lens combination. Mr. Beck outlines the principles which must guide the designer of such a lens combination. The third lecture is devoted to the consideration of diffraction, so far as this applies to the microscope. The theory due to the late Prof. Abbe is outlined, and Mr. J. W. Gordon's criticisms of the theory are then explained; an experiment shown by Mr. Beck in his lecture proves conclusively that the Abbe theory is at fault in certain respects. The fourth lecture, which is concerned with the practical use of the microscope, should prove of great value to those who wish to employ that instrument to its greatest advantage.

MESSRS. E. B. ROSA and L. Cohen examine critically the formulæ given by different authors for the self-inductance of a circle in the Bulletin of the Bureau of Standards for December, 1907. They consider Wien's formula the most accurate, Maxwell's and Rayleigh's next, Minchin's, Hicks's, and Blathy's untrustworthy, and the simple formula of Kirchhoff, *i.e.* $L=4\pi a(\log 8a/r-1{\cdot}75)$, in which a is the radius of the circle and r the radius of its cross-section, as a very close approximation to the correct value.

THE *Journal de Physique* for December, 1907, contains Prof. Schuster's address to the Société française de Physique on some electrical phenomena of the atmosphere and their relations with solar activity. Prof. Schuster points out that the most important free periods of oscillation of the atmosphere of the earth are, according to the calculations of Lord Rayleigh and M. Margules, about twelve and twenty-three hours, and that in consequence the semi-diurnal motions are more pronounced than the diurnal. Assuming that the conductivity of the upper atmosphere is much greater than that of the lower, he shows that the electric currents produced in the atmosphere by its motion across the earth's magnetic field are capable of explaining the diurnal variations of terrestrial magnetism. The negative charges brought down by rain drops he considers account for the maintenance of the earth's negative charge. He points out that the evidence with regard to magnetic storms and sun-spots only establishes a general connection, and does not warrant us in attributing a particular storm to a particular spot. Finally, he urges the substitution of short organised attacks on definite problems for the present rather aimless accumulation of observations carried on for such long periods at so many places.

A COPY of the prospectus of Dr. J. W. Spengel's *Ergebnisse und Fortschritte der Zoologie* (see NATURE, January 16, p. 246), giving a sketch of the lines upon which that serial is to be conducted, and the names of the editors for special subjects, has been received from the publisher, Mr. Gustav Fischer, Jena.

GOOD pictures often serve to direct the attention of children to the beauties of nature and to encourage them to seek out the objects themselves in order to study them at first hand. A series of beautiful slides illustrating wild bird life, all of which have been made from photographs taken from nature, submitted to us for inspection by Messrs. Sanders and Crowhurst, should certainly succeed in attracting to the observation of birds in their natural surroundings those who are fortunate enough to see them.

MESSRS. MACMILLAN AND CO., LTD., have published a third edition of "Comparative Anatomy of Vertebrates," which has been adapted from the sixth German edition of Prof. R. Wiedersheim's work by Prof. W. N. Parker. The present edition has been almost entirely re-written, and with Prof. Wiedersheim's permission, alterations desirable in the interests of English students have been made. The general plan of the original has been retained, but some portions have been extended and others abridged. The second English edition was reviewed in the issue of NATURE of September 1, 1898 (vol. lviii., p. 409), when the characteristics of this widely known student's manual were described. The price of the new edition is 16s. net.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN FEBRUARY:—

Feb. 4. 4h. 11m. Moon in conjunction with ♀ and 3° 48′ S.
5. 6h. 22m. to 11h. 12m. Transit of Jupiter's Satellite IV. (Callisto).
,, 13h. 19m. to 17h. 1m. Transit of Jupiter's Satellite III. (Ganymede).
10. 7h. 50m. Venus and Saturn in conjunction.
11. 10h. 28m. Minimum of Algol (β Persei).
,, 12h. 22m. to 13h. 19m. Moon occults ζ Tauri (Mag. 3).
13. 2h. Mercury at greatest elongation (18° 9′ E.).
,, 11h. 45m. to 13h. 0m. Moon occults δ Geminorum (Mag. 3·6).
14. 7h. 17m. Minimum of Algol (β Persei).
15. 2h. 7m. Moon in conjunction with Jupiter and 1° 12′ N.
,, Illuminated portion of the disc of Venus = 0·797.
27. 12h. 48m. Moon in conjunction with Uranus and 0° 7′ N.

PHOTOGRAPHIC OBSERVATIONS OF ENCKE'S COMET (1908a).—Encke's comet was photographed at the Heidelberg Observatory on January 13, 14, 15, 18, and 19, and in No. 4229 of the *Astronomische Nachrichten* (p. 79, January 21) Prof. Wolf records the positions and magnitudes derived from the plates. On the first three dates the recorded magnitude was 12·0, on the last two 12·5. The observed positions have been compared with those given in the ephemeris, and corrections to the latter are appended; those for R.A. are fairly constant at +3m., but those for declination vary from −24′·0 (December 25, 1907) to +1′·4 (January 19).

SATURN, A NEW RING SUSPECTED.—Observing at an elevation of 1550 metres, at the Revard, Puy-de-Dôme, France, under exceptionally favourable conditions on September 5, 1907, M. G. Fournier suspected a faint, transparent, and luminous ring exterior to the principal rings of Saturn. On September 7 the same observer confirmed the presence of a very pale luminous zone sharply defined at its edges, but neither he nor M. Jarry-Desloges, who communicates the discovery to the *Bulletin de la Société astronomique de France* (p. 36, January), was able to find it on September 11. The latter observer suggests the possibility that the ring is subject to periodical fluctuations of brightness, and may, therefore, only become visible at certain intervals; he also suggests that observers situated in high altitudes, such as the Arequipa and Flagstaff stations, may, alone, be able to observe this difficult detail of the Saturnian appendage. A drawing accompanying the communication shows the nebulous ring, extending beyond the principal rings, as it appeared at 22h. 25m. on September 7.

DETERMINATION OF THE MOON'S LIGHT WITH A SELENIUM PHOTOMETER.—In a recent note in these columns (p. 258, January 16) reference was made to some results obtained by Messrs. Stebbins and Brown in a determination of the brightness of moonlight with a selenium photometer (*Astrophysical Journal*, vol. xxvi., p. 326). The result was given as 0·23 candle-power, but, as there seems to be some misconception as to the meaning of this, an explanation seems desirable. American observers state quantities of this kind in candle-metres, and thus interpreting the above result it means that the light of the full moon illuminates a white surface to the same extent as an illuminating source of 0·23 candle-power, placed at a distance of 1 metre, would illuminate it.

Owing to the colour-sensitiveness of the selenium cells being as yet unknown, this result must be accepted as purely preliminary; different cells gave results varying from 0·07 to 0·37, the mean being 0·22 candle-power, and very near to the 0·23 adopted by Müller ("Die Photometrie der Gestirne," Leipzig, 1897, p. 344) as the mean of several visual observations by different observers.

The method of observation adopted by Messrs. Stebbins and Brown was to determine at what distance from the selenium cell the standard candle would produce the same deflection as the light from the moon, and then to reduce this distance to terms of the standard candle-metre, afterwards applying the corrections for atmospheric absorption. The determinations of the variation of moonlight with the moon's phase gave consistent results for each cell, and forms the most valuable part of the work. The standard candle employed is by Max Kohl, and burns amyl acetate; the diameter of the round wick is 8 mm., and the height of the flame was regulated to 40 mm.

A USEFUL SUN AND PLANET CHART.—From the firm of Carl Zeiss we have received a copy of their chart for showing the position of the sun, or of any of the planets, at any epoch during the present year. The chart is constructed on a principle employed by Mr. R. H. Bow, of Edinburgh, and consists of two sets of curves and a star map. On the one set of curves, which is placed to the right of the star map, the declinations of the various bodies during the twelve months are shown, whilst the second set, placed directly below the star map, shows the right ascensions. To find the position of a planet on any date, the declination of the planet on that date is found on the former set of curves, and from the point thus determined a horizontal line is drawn across the star map. A vertical line is then drawn from the corresponding point on the right-ascension curve, and where these two lines intersect on the star map is the position occupied by the planet. A calendar of oppositions, quadratures, and conjunctions is also shown on the chart.

CHICAGO MEETING OF THE AMERICAN ASSOCIATION.

THE fifty-eighth meeting of the American Association for the Advancement of Science and of its affiliated scientific societies was held at Chicago from December 30, 1907, to January 4, 1908, under the presidency of Prof. E. L. Nichols, professor of chemistry at Cornell University. The attendance was estimated at about 1400, the accurate registration of the affiliated societies having not been handed in at the time of writing. The programme was one of unusual interest, and a number of important measures were adopted.

The opening meeting of the association was held on the morning of Monday, December 30. Addresses of welcome were made by Dean G. E. Vincent, of the University of Chicago, in the enforced absence of the president, Dr. H. P. Judson, and by Mr. G. E. Adams, vice-chairman of the local committee for the meeting. The retiring president, Dr. W. H. Welch, of Johns Hopkins University, introduced the president of the meeting, Prof. Nichols, who replied to the addresses of welcome. The address of the retiring president, Dr. W. H. Welch, was given on December 30 before a large audience, and consisted of a masterly treatment of the subject of the interdependence of medicine and other sciences of nature (see NATURE, January 23). At the conclusion of the address a reception was given to the members of the association and affiliated societies.

The vice-presidential addresses, that is, addresses of presidents of sections, were distributed through the week at afternoon sessions. That before Section A (mathematics and astronomy) was delivered by the retiring vice-president, Edward Kasner, of Columbia University. Its title was "Geometry and Mechanics." The address of the retiring vice-president of Section B (physics) was given by Prof.

W. C. Sabine, of Harvard University, under the title of "The Origin of the Musical Scale." The address before Section C (chemistry) was given by Mr. Clifford Richardson, of the New York Testing Laboratories, on "A Plea for the Broader Education of the Chemical Engineer." There was no address before Section D (mechanical science and engineering). The address of the retiring vice-president of Section E (geology) was delivered by Dr. A. C. Lane, State Geologist of Michigan, at the summer meeting of the section held at Lake George. The address of the retiring vice-president of Section F, Dr. E. G. Conklin, of the University of Pennsylvania, was entitled "The Mechanism of Heredity." The retiring vice-president of Section G (botany), Dr. D. T. MacDougal, of the Carnegie Institution, Washington, D.C., discoursed on "Heredity and Environic Forces." The retiring vice-president of Section H (anthropology and psychology), Prof. A. L. Kroeber, of San Francisco, spoke on "The Anthropology of California." The address before Section K (physiology and experimental medicine) was given by retiring vice-president Simon Flexner, of the Rockefeller Institute for Medical Research, New York, on the subject "Recent Advances and Present Tendencies in Pathology." An address was given before the newly established Section L (education) by the Hon. Elmer Brown, United States Commissioner of Education, on "The Future of the Section of Education."

The character of the papers read before the different sections and the affiliated societies was of a very high order. A prominent feature of the meeting was the holding of joint sessions and symposiums on subjects of allied interest. The section on mathematics and astronomy, that on mechanical science and engineering, and the Chicago branch of the American Mathematical Society, for example, held an important joint session to consider the teaching of mathematics to engineering students, in which the present status in the United States was discussed by Prof. Edgar J. Townsend, of the University of Illinois, and in other countries by Prof. Alexander Ziwet, of the University of Michigan.

Section K held an important symposium on January 1 on the subject of immunity, in which the following papers were presented after introductory remarks by the vice-president of the section, Dr. Ludwig Hektoen, of the University of Chicago:—anaphylaxis and its relation to immunity, by Dr. M. J. Rosenau and Dr. John F. Anderson, of the United States Public Health and Marine-Hospital Service (paper read by Dr. Anderson); hyper-susceptibility and immunity, by Dr. Victor C. Vaughan, of the University of Michigan; the hæmolysins of animal toxins, by Dr. Preston Kyes; artificial immunity to glucosides, by Dr. W. W. Ford; the differentiation of homologous proteids by serum reactions, by Dr. S. P. Beebe; immunity in spirochætal infections, by Dr. F. D. Novey; immunity in Rocky Mountain spotted fever, by Dr. H. T. Ricketts and Dr. L. Gomez; virulence of pneumococci in relation to phagocytosis, by Dr. E. C. Rosenow; the mechanism of streptococcus immunity, by Dr. G. F. Ruediger; immunity in tuberculosis, by Dr. M. P. Ravenel; chemical aspects of immunity, by Dr. H. Gideon Wells.

The American Society of Naturalists, in the afternoon of January 1, held an important discussion on the topic of cooperation in biological research, in which Prof. F. P. Lillie, of the University of Chicago, Dr. W. Trelease, of the Missouri Botanical Garden, Dr. H. H. Donaldson, of the Wistar Institute, Dr. Simon Flexner, of the Rockefeller Institute, Prof. W. H. Howell, of Johns Hopkins University, and Prof. J. R. Angell, of the University of Chicago, took part.

Under the auspices of Section I an important symposium was held on the subject of federal regulation of public health. This session was held jointly with the National Legislative Conference of the American Medical Association and other interested organisations. Addresses were given by Dr. W. H. Welch, Hon. George L. Shiras, Dr. Charles A. Reed (president of the National Legislative Council of the American Medical Association), and Dr. F. F. Westbrook, of the University of Minnesota. There was also a lengthy prepared discussion by representatives of the various organisations concerned.

Section G and the Botanical Society of America held a symposium on the species question, in which the taxonomic aspect was discussed by Prof. C. E. Bessey and Dr. N. L. Britton, the physiologic aspect by Dr. J. C. Arthur and Dr. D. T. MacDougal, and the ecologic aspect by Prof. F. E. Clements and Prof. H. C. Cowles.

The American Chemical Society, as usual, held a very important meeting with a lengthy programme in joint session with section C of the American Association for the Advancement of Science.

As the result of a letter from the President of the United States, Mr. Roosevelt, to the president of the association, Dr. Nichols, concerning the necessity for active measures to conserve the natural resources of the United States, resolutions were adopted announcing the importance of such an effort, and appointing a standing committee of the association to consider plans and to forward the general movement. Resolutions were also adopted favouring an increase in the facilities given by Congress to the United States Bureau of Education. Further resolutions were passed urging the establishment of a research laboratory in tropical medicine in the Isthmian Canal zone; favouring the efforts to preserve from extinction the great sea animals of the waters adjoining the United States; and urging upon Congress the establishment of an Appalachian Forest Reserve, reiterating a recommendation urged at the last meeting of the association.

At the meeting of the general committee on the night of January 2 it was decided that the next regular meeting of the association be held in Baltimore during convocation week, 1908–9, and that a summer meeting be held in the week beginning June 29 at Dartmouth College, Hanover, N.H. A resolution was also adopted recommending that arrangements be made, if possible, for a meeting in the summer of 1910 in the Hawaiian Islands.

Officers for the present year were elected as follows:—president, Prof. T. C. Chamberlin, of the University of Chicago; vice-presidents, A, no election; B, Prof. K. E. Guthe, State University of Iowa; C, Prof. L. Kahlenburg, University of Wisconsin; D, Prof. G. F. Swain, Massachusetts Institute of Technology; E, Prof. Bailey Willis, U.S. Geological Survey; F, Prof. C. J. Herrick, University of Chicago; G, Prof. H. M. Richards, Columbia University; H, Prof. R. S. Woodworth, Columbia University; I, no election; K, Prof. W. H. Howell, Johns Hopkins University; L, Prof. G. Stanley Hall, Clark University; general secretary, Prof. F. W. McNair, president Michigan School of Mines; secretary of the council, Prof. D. C. Miller, Case School of Applied Science; treasurer, Prof. R. S. Woodward, Carnegie Institution, Washington, D.C. (as before); permanent secretary, Dr. L. O. Howard, Smithsonian Institution, Washington, D.C. (as before).

STRESSES IN MASONRY DAMS.

THE stresses in masonry dams, to which much attention has recently been devoted in our correspondence columns, formed the subject of three papers read before the Institution of Civil Engineers on January 21. In the first, Sir John W. Ottley, K.C.I.E., and Dr. A. W. Brightmore described some experiments, occupying about fourteen months, made with plasticine models of a dam of typical triangular section under perfect conditions. The height of the model was 30 inches, and the length of the dam 12 inches. From the results of the experiments the following conclusions were drawn:—(1) If a masonry dam be designed on the assumption that the stresses on the base are uniformly varying, and that these stresses are parallel to the resulting force acting on the base, the actual normal and shearing stresses, on both horizontal and vertical planes, would (in the absence of stresses due to such factors as changes in temperature, unequal settlement, &c.) be less than those provided for. There can be no tension on any plane at points near the outer toe. There will be tension on planes other than the horizontal plane near the inner toe, the maximum intensity of such tension being generally equal to the average intensity of shearing stress on the base, and the inclination of its plane of action being about 45°.

In the second paper Mr. J. S. Wilson and Mr. W. Gore gave the results of an experimental investigation by means of india-rubber models. The following are some of the conclusions given:—(1) Tensile stresses may exist at the up-stream toe of a dam, notwithstanding the fact that the line of resistance lies well within the middle third. The tension may be reduced by (*a*) making the up-stream face vertical, or by otherwise increasing the weight of the dam toward that face; this would have the effect of increasing the stresses in the dam when the reservoir is empty; (*b*) by a general increase in the dimensions of the dam; (*c*) by placing an earth embankment against the down-stream face. (2) The direct stresses at the down-stream toe are compressive in every direction, but reduce to zero in the direction normal to the face. (3) The maximum compressive stresses in a dam above its foundations are in a direction approximately parallel with the down-stream face, and generally some distance therefrom. In magnitude they are slightly greater than

$$\frac{P_T}{\cos^2\phi},$$

where P_T is the maximum normal pressure on a horizontal plane as determined by the trapezium law, and ϕ is the angle between the resultant and the vertical. (4) The shearing stresses are considerable at or near the up-stream toe. They are a maximum a short distance from the down-stream face, in a plane approximately at 45° to the face. The maximum shearing stresses are in magnitude equal to

$$\frac{P_T}{2\cos^2\phi}.$$

(5) The stresses in the foundations are of less consequence than in the dam above the base, because of the lateral support and the more extended distribution. (6) The stresses are considerable at the toes of a dam if they form sharp angles with the foundations. These stresses may be reduced by replacing the angles with curves of large radii. The curve at the up-stream toe may take the form of a rounded quoin, cut in large stones, so as to avoid joints, in the masonry, normal to the direction of the greatest tensile stress.

In the third paper Mr. E. P. Hill described a method of determining stresses based on the assumption that the vertical pressure on the base varies uniformly from one side to the other.

AUSTRIAN SCIENCE.

THE monthly parts of the *Sitzungsberichte* of the Vienna Academy of Sciences which appeared last year show that there is no falling off in the research work carried out at the Austrian universities in the fields of mathematics and natural philosophy. Prof. Lecher, of Prague, has verified Ohm's law by showing that there is no difference in the resistance of a silver or platinum wire when a small or a large electric current passes through it, provided its temperature is the same in both cases. Assuming that the current is carried by one type of free electron, he deduces a velocity of propagation of electricity in ordinary cases of the order of a few centimetres per second.

Prof. F. Exner and Dr. E. Haschek have been engaged in a search for the cause of the slight variability of wave-length of many of the spectral lines with the method of excitation. They are disposed to attribute it to the lines for which it has been observed being complex, with satellites of variable intensity or number which appear to be present more frequently on the red than on the blue side of the line. In an instrument of only moderate resolving power, the apparent effect of any cause tending to increase the intensity of such satellites with respect to the original line will be a displacement of the line towards the red end of the spectrum.

Dr. N. Stücker has investigated the sensitiveness of a great number of persons to small differences of pitch in different parts of the musical scale. He finds that in general the region of maximum sensitiveness is in the octaves c^1 and c^2, where about 1/20th of a tone can be detected. A few musical people were able to detect a difference of 1/200th of a tone in this region. The higher limits of audibility varied from about 40,000 in general to more than 60,000 in the case of musicians.

The meteorological side of the activity of the academy is well represented by Dr. F. M. Exner's outlines of a theory of variation of atmospheric pressure. The principal result of this investigation is that the pressure variations may be represented by the motion of a relatively permanent system of isobars over the surface of the earth from west to east with a velocity varying slightly with the season.

An important series of papers by Prof. Rudolph Wegscheider and Dr. Heinrich Walter, published in the *Sitzungsberichte* (vol. cxvi., pp. 443, 455, and 533), throws a great deal of light on the phenomena occurring when soda is causticised by means of lime. On the one hand, the conditions of equilibrium for the reversible change $Ca(OH)_2 + Na_2CO_3 \rightleftharpoons CaCO_3 + 2NaOH$ have been ascertained at different temperatures; that the change is a reversible one is shown by the fact that the same condition of equilibrium is established at a definite temperature whether the lime acts on sodium carbonate or caustic soda on calcium carbonate. The change in the direction from left to right seems to be more complete at 80° than at 106°–110°, and to occur more readily in dilute than in concentrated solutions; the way in which it is influenced by concentration is considered at some length from the standpoint of the theory of mass action. The loss of sodium carbonate which may occur in the more concentrated solutions owing to the formation of the mixed carbonate, $CaCO_3,Na_2CO_3$, is also fully dealt with, the conditions under which gaylussite, $CaNa_2(CO_3)_2,5H_2O$, and pirsonnite, $CaNa_2(CO_3)_2,2H_2O$, are capable of existence in contact with solutions of sodium carbonate and caustic soda being defined for different temperatures. It is noteworthy that the decomposition of both of the double salts by water is retarded owing to the formation of a protective sheath of insoluble calcium carbonate on the surface of the particles, so that if the mixed salt is once precipitated owing to the concentration becoming too great, loss of sodium carbonate may occur even though the insoluble material be well washed. The whole investigation has a special interest as illustrating the applicability of recently developed views in pure chemistry to the elucidation of technical problems.

During several years past the study of the general laws of esterification, especially of the influence exercised by structural peculiarities on the phenomena, has formed a special feature of the research work carried out under the direction of Prof. Wegscheider in the first chemical laboratory of Vienna University. The results obtained have, in particular, thrown considerable light on the nature of the so-called "steric hindrance." In continuation of these researches a series of papers by Anton Kailan appears in the *Sitzungsberichte* of the academy dealing with the esterification of the dinitrobenzoic acids, of mono- and di-hydroxybenzoic acids, and of pyridinemonocarboxylic acids by alcoholic hydrogen chloride. Prof. Wegscheider and E. Frankel discuss in considerable detail the reasons for abnormalities which sometimes are found to characterise the action of alkyl haloids on metallic salts of organic acids. The peculiar influence exercised by the presence of a small proportion of water on the rate of formation of ethyl chloride from alcohol and hydrogen chloride is the subject of a paper by A. Kailan, in which it is shown that the velocity constants of the action are proportional to the concentration of the hydrogen chloride only in absolute alcohol. In alcohol containing water, even in 99·9 per cent. alcohol, an increase in the concentration of the hydrogen chloride is found to be accompanied by a considerably greater increase in the velocity constant.

To vol. cxvi. of the *Sitzungsberichte* (*mathematisch-naturwissenschaftliche Klasse*) of the academy Mr. F. Siebenrock contributes a monographic revision of the American tortoises of the family Cinosternidæ, in which several changes in the generally accepted classification are proposed. In the British Museum Catalogue of Chelonians the family is taken to include only the single genus Cinosternum, while Claudius and Staurotypus are included with Dermatemys in the family Dermatemydidæ. This the author regards as an unnatural arrangement, and he proposes to transfer Claudius and Staurotypus to the Cinosternidæ, in which they form the subfamily Staurotypinæ. Mr. Siebenrock goes, however, even further than this, and suggests that the Cinosternidæ should be brigaded with the Chelydridæ in one sectional group—the Chelydroidea; while the families Dermatemydidæ and Platysternidæ are regarded as more nearly related to the Testudinidæ, with which they should form the group Testudinoidea. For the structural details on which the author justifies this radical change in taxonomy, reference must be made to the paper itself.

Morphologists will find much to interest them in an article in the same volume by Mr. Max Holl, of Graz, on the anatomy of the hind portion of the cerebral lobes in man and apes. The author appears to have been led to undertake the investigation by finding one human brain which differed most remarkably in regard to the arrangement and complexity of the postero-lateral sulci from all others which had come under his observation. His studies have, however, shown that there is a great amount of variation in this respect in human brains, and he has in consequence been led to recognise two principal types. To the more primitive of these he gives the name pithecoid and to the other that of anthropoid, type. Between the two there exists, however, an almost complete gradation. By far the greatest degree of individual variation in the form of the postero-lateral region of the brains of Primates occurs in the case of the tropical American spider-monkeys of the genus Ateles.

Attention may likewise be directed to a paper by Dr. Karl Byloff in the same volume on the structure and life-history of the blood-parasites *Trypanosoma lewisi* and *T. brucei*. New methods of staining microscopic preparations have enabled the author to bring to light certain previously unknown features in connection with these organisms. The various developmental stages assumed by trypanosomes in mammalian blood are the result of division of adult forms. High magnifying power has revealed the presence of pseudopodia-like projections at the "hind extremity" of both species of trypanosomes, but whether these are constant morphological features or merely temporary developments has yet to be demonstrated.

THE CENTENARY OF DAVY'S DISCOVERY OF THE METALS OF THE ALKALIS.[1]

A HUNDRED years ago last October, there happened one of those events to which the term epoch-making may, without cavil or question, be fittingly applied.

As it was an occurrence with which the name and fame of the Royal Institution are inseparably bound up, the managers have thought it only proper that its centenary should not pass unnoticed here, and it is by their wish, therefore, that I appear on this the first possible opportunity after the actual date of its hundredth anniversary to give you some account of it, and to state, so far as I am able and within the limits of an hour, the fruitful consequences that have flowed from it.

Let me, in the first place, attempt to recall the circumstances which led up to that cardinal discovery of which to-night we celebrate the centenary. These are connected partly with the institution itself and partly with the state of science in the early years of the nineteenth century.

In the year 1807 this institution was entering upon the eighth year of its existence. As you doubtless know, the Royal Institution grew out of a proposal to deal with the question of the unemployed, namely, by forming in London by private subscription an establishment for feeding the poor and giving them useful employment, and also for furnishing food at a cheap rate to others who may stand in need of such assistance, connected with an institution for introducing and bringing forward into general use new inventions and improvements, particularly such as relate to the management of heat and the saving of fuel, and to various other mechanical contrivances by which domestic comfort and economy may be promoted. Such was the original prospectus, but, like many other prospectuses, it failed to equal the promise its projectors held out.

[1] A lecture delivered at the Royal Institution of Great Britain, on Friday, January 17, by Prof. T. E. Thorpe, C.B., F.R.S.

Eventually the promoters decided, on the initiation of Count Rumford, that the Associated Institution would, as they expressed it, be "too conspicuous and too interesting and important to be made an *appendix* to any other existing establishment," and therefore it ought to stand alone on its own proper basis.

Accordingly, the problem of the unemployed still remains with us, whilst the new institution took the form of converting Mr. Mellish's house in Albemarle Street into a place where, by regular courses of philosophical lectures and experiments, the applications of the new discoveries in science to the improvement of the arts and manufactures might be taught, so as to facilitate the means of procuring the comforts and conveniences of life.

The Royal Institution had a troubled infancy. Like the poor it was originally designed to succour, it suffered much in the outset from lack of nourishment. To add to its miseries, the little starveling was caricatured by Gillray, lampooned by Peter Pindar, and ridiculed by Lord Brougham, and it was literally in the throes of dissolution when new life was breathed into it by the opportune arrival, in 1801, of a small spare youth of twenty-two from Bristol, whom the managers had engaged at a salary of 100 guineas a year. The youth was Humphry Davy, who had acted as assistant to Dr. Beddoes, of the Pneumatic Institution, and who had already made some slight stir in scientific circles by his discovery of a characteristic property of nitrous oxide. In announcing his arrival to the managers, Count Rumford reported that he had purchased a cheap second-hand carpet for Mr. Davy's room, together with such other articles as appeared to him necessary to make the room habitable, and among the rest a new sofa-bed, which, in order that it may serve as a model for imitation, had been made complete in all its parts. Six weeks after his arrival Davy was called upon to lecture, and a descriptive paragrapher of the period thus chronicles his success in the *Philosophical Magazine* for 1801:—

"It must give pleasure to our readers to learn that this new and useful institution, the object of which is the application of Science to the common purposes of life, may be now considered as settled on a firm basis. . . .

"We have also to notice a course of lectures, just commenced at the institution, on a new branch of philosophy—we mean the Galvanic Phenomena. On this interesting branch, Mr. Davy (late of Bristol) gave the first lecture on the 25th of April. He began with the history of Galvanism, detailed the successive discoveries, and described the different methods of accumulating galvanic influence. . . . He showed the effect of galvanism on the legs of frogs, and exhibited some interesting experiments on the galvanic effects on the solution of metals in acids. Sir Joseph Banks, Count Rumford, and other distinguished philosophers were present. The audience were highly gratified, and testified their satisfaction by general applause. Mr. Davy, who appears to be very young, acquitted himself admirably well; from the sparkling intelligence of his eye, his animated manner, and the *tout ensemble*, we have no doubt of his attaining a distinguished eminence."

And what was of more immediate consequence, this confident assurance was shared also by the managers, for at a subsequent meeting they unanimously resolved "that Mr. Humphry Davy, director of the chemical laboratory, having given satisfactory proofs of his talents as a lecturer, should be appointed, and in future denominated, lecturer in chemistry at the Royal Institution, instead of continuing to occupy the place of assistant lecturer, which he has hitherto filled."

That such shrewd experienced men of the world as Sir Joseph Banks and Rumford, who were the moving spirits in the management of the institution and genuinely solicitous for its welfare, should thus entrust its fortunes, then at their lowest ebb, to the power and ability of a young and comparatively unknown man, barely out of his teens, seems, even in an age which was familiar with the spectacle of "a proud boy" as a Prime Minister, like the desperate throw of a gambler.

But Banks and Rumford had, doubtless, good reason for the faith that was in them. For a happy combination of circumstances had served to bring the Cornish youth within the range of many who could be of service to him in that search for the fame for which he hungered. His connection with the Beddoes brought him the friendship of the Edgeworths, and it is amusing to trace how the good-humoured patronage of the gifted Maria quickly passed into amazement and ended in awe as her acquaintance with him ripened. Living in Bristol, he was at once brought into that remarkable literary coterie which distinguished that city at the close of the eighteenth century. Southey spoke of him as a miraculous young man, whose talents he could only wonder at. Cottle, the publisher, on one occasion said to Coleridge, "You have doubtless seen a great many of what are called the cleverest men—how do you estimate Davy in comparison with these?" Mr. Coleridge's reply was strong and expressive. "Why, Davy can eat them all! There is an energy, an elasticity, in his mind which enables him to seize on and analyse all questions, pushing them to their legitimate consequences. Every subject in Davy's mind has the principle of vitality. Living thoughts spring up like turf under his feet."

Davy's experimental work on "the pleasure-giving air" had made him known to the Watts and the Wedgwoods. Priestley, then in exile, and Hope, of Edinburgh, were greatly impressed with the philosophical acumen of the author of phosoxygen, and he had a powerful friend in his own countyman Davies Gilbert, who succeeded him in the presidential chair of the Royal Society. We need be in no doubt, therefore, as to the influences which conspired to bring Davy into what he termed "the great hotbed of human power called London."

The mention of Davy's first course of lectures in this institution brings me at once to the proper subject of this discourse.

The first year of the last century is memorable for the invention of the voltaic battery and for its immediate application by Nicholson and Carlisle in this country to the electrolytic decomposition of water.

Davy himself has said:— "The voltaic battery was an alarm bell to experimenters in every part of Europe; and it served no less for demonstrating new properties in electricity, and for establishing the laws of this science, than as an instrument of discovery in other branches of knowledge; exhibiting relations between subjects before apparently without connection, and serving as a bond of unity between chemical and physical philosophy."

We owe it to Sir Joseph Banks that Volta's great discovery was first made known to English men of science, and the study of the phenomena of galvanic electricity was at once entered upon by a score of experimenters in this country. Among them was Davy. Even before he left Bristol he was hard at work on the subject, sending the results of his observations to Nicholson's Journal in a series of short papers. He resumed his inquiries immediately on his arrival in London, and was doubtless well prepared, therefore, for his opening course of lectures.

In 1801 he sent his first communication to the Royal Society on "An Account of some Galvanic Combinations formed by the Arrangement of Single Metallic Plates and Fluids, Analogous to the New Galvanic Apparatus of Mr. Volta." Although the work was continually interrupted by requests made to him by the managers to carry out their own ideas of facilitating the means of procuring the comforts and conveniences of life, he never lost sight of the subject of voltaic electricity, and in spite of innumerable distractions due to the precarious position of the institution, he gradually accumulated the material out of which grew his first Bakerian lecture, "On some Chemical Agencies of Electricity," read before the Royal Society on November 20, 1806. I have ventured elsewhere to express my opinion of this paper. In my judgment it constitutes, in reality, Davy's greatest claim as a philosopher to our admiration and gratitude, for in it he, for the first time, succeeded in unravelling the fundamental laws of electrochemistry, and thereby imported a new order of conceptions, altogether unlooked for and undreamt of, into science.

I am only at the moment concerned with this memoir in its relation to the discovery of which to-night we celebrate the centenary. The isolation of the metals of the alkalis was unquestionably an achievement of the highest brilliancy, and as such appeals strongly to the popular imagination. But it was only the necessary and consequential link in a chain of discovery which, had Davy neglected to make it, would have been immediately forged by another.

The publication of Davy's first Bakerian lecture produced a great sensation, both at home and abroad. Berzelius, years afterwards, spoke of it as one of the most remarkable memoirs that had ever enriched the theory of chemistry. Very significant, too, of the impression it made on the world of science was the action of the French Institute. Bonaparte, then First Consul, had announced his intention of founding a medal "for the best experiment which should be made in the course of each year on the galvanic fluid," and a committee of the institute, consisting of Laplace, Halle, Coulomb, Hauy, and Biot, was appointed to consider the best means of giving effect to the wishes of the First Consul. To the young man, with the little brown head, like a boy (as Lady Brownrigg described him), now twenty-eight years of age, was awarded the medal. All the institute got from the founder of the medal was what Maria Edgeworth termed "a rating all round in imperial Billingsgate." There was no *entente cordiale* in those days; indeed, the feeling of animosity was intense. Of course, there were persons who said that patriotism should forbid the acceptance of the award. Davy's own view was more sensible and politic:—"Some people," he said to his friend Poole, "say I ought not to accept this prize; and there have been foolish paragraphs in the papers to that effect; but if the two countries or Governments are at war, the men of science are not. That would, indeed, be a civil war of the worst description; we should rather, through the instrumentality of men of science, soften the asperities of national hostility."

Thanks to the kindness of Dr. Humphry Davy Rolleston, the grandson of Dr. John Davy, the brother of Sir Humphry, who has also been so good as to lend me this admirable bust of the great chemist by Chantrey, and this charming portrait by Jackson, I am able to show you this evening this historically interesting medal.

What Davy looked like at this period of his life may be seen from the picture I now project upon the screen. It is a reproduction of the large portrait which hangs in the vestibule, and which the institution owes to the thoughtful kindness of the late Mr. Graham Young.

As the applications of voltaic electricity seemed in 1806 to have no immediate bearing on the comforts and conveniences of life, Davy, during the greater part of the following year, was required to direct his attention to other matters. But in the late summer of 1807 he was able to resume his work with the voltaic battery, and he commenced to study its action on the alkalis.

That the alkalis—potash and soda—would turn out to be compound substances was not an unfamiliar idea at the time, and it is significant that almost immediately after Nicholson and Carlisle had resolved water into its elements by the action of voltaic electricity, Henry, of Manchester, the friend and collaborator of Dalton, should have made the attempt to apply the same agency to the separation of the presumed metallic principle of potash. The conception that what the older chemists called "earths" might be made to yield metals was at least as old as the time of Boyle, and probably dates back from the earliest days of alchemy. The relation of the earths to the metals was part of the doctrine of Becher and Stahl; it was no less a part of the antiphlogistic doctrine of Lavoisier, although the points of view were diametrically opposed. Neumann attempted to obtain a metal from lime, Bergman considered that baryta was, like lime, a metallic calx, and Baron that alumina contained a metal. From their many analogies to these substances it was not unreasonable, therefore, to surmise that potash and soda might also contain metallic principles.

I have elsewhere pointed out that there is some evidence that whilst at Bristol Davy had already attacked the problem of the resolution of the alkalis by means of voltaic electricity. What precise idea he had in again attacking it, or what expectation he had of a definite result, is difficult to determine. In one of his lectures on electrochemical science, delivered some time subsequently, he said he had a suspicion at the time that potash might turn out to be "phosphorus or sulphur united to nitrogen," conceiving that, as the volatile alkali was composed of the light inflammable hydrogen united to nitrogen, so the fixed and denser alkalis might be composed of the denser inflammable bodies—phosphorus and sulphur—also united to nitrogen.

Davy once said that "analogy was the fruitful parent of error," and few more striking instances of perverted analogy are to be met with in science than this. In another of his lectures he said of the alchemists that "even their *failures* developed some unsought-for object partaking of the marvellous"; and if such had been his reasoning, the statement is no less true of himself.

So far as can be ascertained, it was on October 19, 1807, that he obtained his first decisive result. This is thus described in Davy's own handwriting in the Laboratory Journal, which has been preserved for us by the pious care of Faraday, and which is one of the most precious of the historical possessions of the Royal Institution:—"When potash was introduced into a tube having a platina wire attached to it, so [fig.], and fused into the tube so as to be a conductor—*i.e.* so as to contain just water enough, though solid—and inserted over mercury, when the platina was made negative, no gas was formed and the mercury became oxydated, and a small quantity of the alkaligen was produced round the platina wire, as was evident from its quick inflammation by the action of water. When the mercury was made the negative, gas was developed in great quantities from the positive wire, and none from the negative mercury, and this gas proved to be pure oxygen—a capital experiment, proving the decomposition of potash." On the 19th of the following month he delivered what is generally regarded as the most memorable of all his Bakerian lectures. It is entitled "On some New Phenomena of Chemical Changes produced by Electricity, Particularly the Decomposition of the Fixed Alkalies; and the Exhibition of the New Substances which Constitute their Bases; and on the General Nature of Alkaline Bodies."

Few discoveries of like magnitude have been made and perfected in so short a time, and few memoirs have been more momentous in result than that which, put together in a few hours, gave the results of that discovery to the world.

The whole work was done under conditions of great mental excitement. His cousin, Edmund Davy, who at the time acted as his assistant, relates that when he saw the minute globules of the quicksilver-like metal burst through the crust of potash and take fire, his joy knew no bounds; he actually danced about the room in ecstasy, and it was some time before he was sufficiently composed to continue his experiments.

The rapidity with which he accumulated results after this first feeling of delirious delight had passed was extraordinary, and he had obtained most of the leading facts concerning the physics and chemistry of the new substances before the middle of November.

He began his lecture with a felicitous reference to the concluding remarks of the one of the previous year, namely, "That the new methods of investigation promised to lead to a more intimate knowledge than had hitherto been obtained concerning the true elements of bodies. This conjecture, then sanctioned only by strong analogies, I am now happy to be able to support by some conclusive facts."

In the first attempts he made to decompose the fixed alkalis he acted upon concentrated aqueous solutions of potash and soda with the highest electrical power he could then command at the Royal Institution, viz. from voltaic batteries containing twenty-three plates of copper and zinc of 12 inches square, 100 plates of 6 inches, and 150 of 4 inches, charged with solutions of alum and nitric acid; but although there was high intensity of action, nothing but hydrogen and oxygen was disengaged. He next tried potash in igneous fusion, and here the results were more encouraging; there were obvious and striking signs of decomposition: combustible matter was produced, accompanied with flame and a most intense light. He had observed that although potash, when dry, is a non-conductor, it readily conducts when it becomes damp by exposure to air, and in this state "fuses and decomposes by strong electrical powers."

Let me state in his own words, for the words are classical, what followed:—

"A small piece of pure potash, which had been exposed for a few seconds to the atmosphere, so as to give conductive power to the surface, was placed upon an insulated disc of platina, connected with the negative side of the battery of the power of 250 of 6 and 4 [that is 100 plates of 6 inches square and 150 plates of 4 inches square] in a state of intense activity; and a platina wire communicating with the positive side was brought in contact with the upper surface of the alkali. . . . Under these circumstances a vivid action was soon observed to take place. The potash began to fuse at both its points of electrization. There was a violent effervescence at the upper surface; at the lower, or negative surface, there was no liberation of elastic fluid; but small globules, having a high metallic lustre, and being precisely similar in visible characters to quicksilver, appeared, some of which burnt with explosion and bright flame, as soon as they were formed, and others remained, and were merely turnished, and finally covered by a white film which formed on their surfaces."

He goes on to say:—

"Soda, when acted upon in the same manner as potash, exhibited an analogous result; but the decomposition demanded greater intensity of action in the batteries, or the alkali was required to be in much thinner and smaller pieces.

"The substance produced from potash remained fluid at the temperature of the atmosphere at the time of its production; that from soda, which was fluid in the degree of heat of the alkali during its formation, became solid on cooling, and appeared having the lustre of silver."

It would seem from this description of its properties that the potassium Davy first obtained was alloyed with sodium owing to the fact that the potash contained soda. Potassium is solid up to 143° F., whereas, as Davy was the first to show, an alloy of potassium and sodium is fluid at ordinary temperatures.

On account of their alterability in contact with air, Davy had considerable difficulty in preserving and confining the new substances so as to examine their properties. As he says, like the alkahests imagined by the alchemists, they acted more or less upon almost every body to which they were exposed. Eventually, he found they might be preserved in mineral naphtha.

The "basis" of potash was described by him as a soft malleable solid with the lustre of polished silver.

"At about the freezing point of water it becomes harder and brittle, and when broken in fragments, exhibits a crystallised texture which in the microscope seems composed of beautiful facets of a perfect whiteness and high metallic splendour. It may be converted into vapour below a red heat, and may be distilled unchanged, and is a perfect conductor of heat and electricity. Its most marked difference from the common run of metals is its extraordinary low specific gravity." At the time of its discovery it was the lightest solid known.

The "basis" of soda was found to have somewhat similar properties. It was slightly heavier than the "basis" of potash, and fused at a higher temperature.

Davy next examined the behaviour of the new substances towards a large number of reagents, but as his observations are now the common property of the textbooks, it is unnecessary here to dwell upon them.

He then enters upon some general observations on the relations of the "bases" of potash and soda to other bodies:—

"Should the bases of potash and soda be called metals? The greater number of philosophical persons," he says, "to whom this question has been put, have answered in the affirmative. They agree with metals in opacity, lustre, malleability, conducting powers as to heat and electricity, and in their qualities of chemical combination.

"Their low specific gravity does not appear a sufficient reason for making them a new class; for amongst the metals themselves there are remarkable differences in this respect. . . . In the philosophical division of the classes of bodies, the analogy between the greater number of properties must always be the foundation of arrangement.

"On this idea, in naming the bases of potash and soda, it will be proper to adopt the termination which by common consent has been applied to other newly discovered metals, and which, though originally Latin, is now naturalised in our language.

"Potasium (*sic*) and sodium are the names by which I have ventured to call the new substances; and whatever changes of theory, with regard to the composition of bodies, may hereafter take place, these terms can scarcely express an error; for they may be considered as implying simply the metals produced from potash and soda. I have consulted with many of the most eminent scientific persons in this country upon the methods of derivation, and the one I have adopted has been the one most generally approved. It is perhaps more significant than elegant. But it was not possible to found names upon specific properties not common to both; and though a name for the basis of soda might have been borrowed from the Greek, yet an analogous one could not have been applied to that of potash, for the ancients do not seem to have distinguished between the two alkalies."

Such, then, are the more significant features of one of the greatest discoveries ever made by a British chemist, as these are set forth in one of the most remarkable papers in the Philosophical Transactions of the Royal Society.

The publication of Davy's discovery created an extraordinary sensation throughout the civilised world, a sensation not less profound, and certainly more general from its very nature, than that which attended his lecture of the previous year. But at the very moment of his triumph it seemed that the noise of the universal acclaim with which it was received was not to reach him. I have already made reference to the condition of mental excitement under which the discovery was made and prosecuted. Almost immediately after the delivery of his lecture he collapsed, struck down by an illness which nearly proved fatal, and for weeks his life hung on a thread. He had been in a low, feverish condition for some time previously, and a great dread had fallen upon him that he should die before he had completed his discoveries. It was in this condition of body and mind that he had applied himself to the task of putting together an account of his results. Four days after this was given to the world he took to his bed, and he remained there for nine weeks. Such a blow following hard on the heels of such a triumph aroused the liveliest sympathy. The doors of the Royal Institution were beset by anxious inquirers, and written reports of his condition at various periods of the day had to be posted in the hall. The strength of the feeling may be gleaned, too, from the sentences with which the Rev. Dr. Dibdin, who had been hurriedly engaged to take his place in the theatre, began the lecture introductory to the session of 1808:—

"The managers of this institution have requested me to impart to you that intelligence, which no one who is alive to the best feelings of human nature can hear without the mixed emotion of sorrow and delight.

"Mr. Davy, whose frequent and powerful addresses from this place, supported by his ingenious experiments, have been so long and so well known to you, has, for the last five weeks, been struggling between life and death. The effects of these experiments recently made in illustration of his late splendid discovery, added to consequent bodily weakness, brought on a fever so violent as to threaten the extinction of life. Over him it might emphatically be said in the language of our immortal Milton, that

"... Death his dart
Shook, but delayed to strike."

"If it had pleased Providence to deprive the world of all further benefit from his original talents and intense application, there has certainly been sufficient already effected by him to entitle him to be classed among the brightest scientific luminaries of his country."

After having, "at the particular request of the managers," given an outline of Davy's investigations, Dr. Dibdin proceeded to say:—

"These may justly be placed among the most brilliant and valuable discoveries which have ever been made in chemistry, for a great chasm in the chemical system has been filled up; a blaze of light has been diffused over that part which before was utterly dark; and new views have been opened, so numerous and interesting, that the more any man who is versed in chemistry reflects on them, the more he finds to admire and heighten his expectation of future important results.

"Mr. Davy's name, in consequence of these discoveries, will be always recorded in the annals of science amongst those of the most illustrious philosophers of his time. His country, with reason, will be proud of him, and it is no small honour to the Royal Institution that these great discoveries have been made within its walls—in that laboratory, and by those instruments which, from the zeal of promoting useful knowledge, have, with so much propriety, been placed at the disposal and for the use of its most excellent professor of chemistry."

And now, in the few minutes that remain to me, let me indicate what has been the outcome of this great and fundamental discovery. How far has the expectation of future important results been realised? Have sodium and potassium at all justified the hope that they would facilitate the means of procuring the comforts and conveniences of life?

I have not the time, even if I had the intention, to attempt to follow the many changes in the metallurgy of the metals of the alkalis of the past century. Let me at once proceed to show how the matter stands at the end of a hundred years.

The general properties and chemical activities of potassium and sodium are so very similar that, as a matter of commercial production, that metal which can be most economically obtained is necessarily the one most largely manufactured, and of the two that metal is sodium. To-day, sodium is made by thousands of tons, and by a process which in principle is identical with that by which it was first made by Davy, *i.e.* by the electrolysis of fused caustic soda. It is very significant that after a series of revolutions in its manufacture, sodium, having been produced from time to time on a manufacturing scale by a variety of metallurgical methods involving purely thermal processes of reduction and distillation, entirely dissociated from electricity, we should have now got back to the very principle of the process which first brought the metal to light. And that this has been industrially possible is entirely owing to another of Davy's discoveries—possibly indeed the greatest of them all—Michael Faraday. As we all gratefully acknowledge, it is to the genius and labours of Faraday—Davy's successor in this place—that the astonishing development of the application of electrical energy which characterises this age has taken its rise.

The modern method of production of sodium is based, therefore, as regards principles, upon the conjoint labours of Davy and Faraday.

These principles took their present form of application at the hands of a remarkably talented American—Mr. Hamilton Y. Castner—whose too early death, in the full vigour of his intellectual powers, was an incalculable loss to metallurgical chemistry. It is by Castner's process that all the sodium of to-day is manufactured.

In the Castner process melted caustic soda, produced by the electrolysis of a solution of common salt by a method also devised by Castner, is brought into an iron vessel shaped like a large cauldron, mounted in brickwork, and provided with an extension adapted to receive the negative electrode. Suspended directly above the kathode is an iron vessel attached to a lid; to its lower edge is secured iron wire gauze, which, when the receptacle is in position, completely surrounds the kathode. The positive electrode is connected with the lid of the vessel, which is provided with openings for the escape of the gases resulting from the electrolysis, and is suitably insulated.

As the electrolysis proceeds, the alkali metal, being much lighter than the molten caustic, rises from the negative electrode and passes into the receiver, the gases escaping around the edges of the cover. The molten metal collects on the surface of the caustic, and is removed by means of a large perforated spoon, the perforations enabling the melted caustic to flow out, while the metal remains in the spoon. As the several vessels are thus skimmed in succession, the fused sodium is collected into an iron vessel, whence it is poured into moulds, in which it congeals, forming blocks of the size and shape of an ordinary building brick. These, after being trimmed to remove adherent oxide, are immersed in paraffin oil, and are then packed into large iron drums holding about 6 cwt. or 7 cwt., capable of being closed air-tight, and protected in transit by an outer casing of wood.

The due regulation of the volume and intensity of the current is a matter of the greatest importance in order to obtain the most economical yield of the metal. No very high temperature is needed; indeed, the temperature of the fused caustic soda should not be much higher than that of its melting point. By suitably regulating the current, the soda, in fact, may be maintained at the proper temperature and in the proper degree of fluidity without extraneous heat. Fresh melted caustic soda is added to the vessel from time to time to replace the metal removed, and in this manner the process is made continuous.

The Castner process is now worked in England at Wallsend-on-Tyne, and at Weston Point, in Cheshire; at Rheinfelden, in Germany; at Clavaux, in France; also in Switzerland, and at Niagara, in America. The present yearly output amounts to about 5000 tons, but the plant already laid down is capable of producing at least twice this quantity.

The greater quantity of the sodium made in England is sent to Glasgow, where it is converted into sodium cyanide by the Cassel Cyanide Company for use in the extraction of gold. As gold is, I suppose, generally considered the principal material factor in procuring the comforts and conveniences of life, Davy's great discovery may be thus said to have secured the primary object which the projectors of the Royal Institution had in view. Other important uses of sodium are in the manufacture of peroxide for bleaching purposes, of artificial indigo, and of a number of other synthetic dye-stuffs and of drugs like antipyrin.

It need hardly be said that this extraordinary development of the manufacture has not been without its influence on the price of sodium. A quarter of a century ago it was a comparatively rare metal, and a stick of it was regarded as a chemical curiosity, to be handled with circumspection and care. Even as late as 1890 its selling price was as high as 8*s*. per lb. To-day it is 8*d*. Sodium now takes rank, therefore, with zinc, tin, copper, or aluminium as a common, ordinary metal of commerce.

I am indebted to the directors of the Castner-Kellner Company, and in particular to my friends Sir Henry Roscoe and Mr. Beilby, for affording me the opportunity, in connection with this lecture, of actually witnessing the modern process of manufacturing sodium as it is carried out at Wallsend, and I am further indebted to Mr. Beilby for the loan of the lantern-slides and specimens with which I have sought to illustrate that process.

And in concluding may I be permitted to recall here the feelings to which that visit to Wallsend gave rise? There, grouped together on the very spot where ended the old wall—the visible symbol of the power and might of a civilisation long since passed away—were some of the characteristic signs of another civilisation ampler and more beneficent. Before me, stretching down to the river, was the factory where a score of workers, clad in helmets and gauntlets, and swathed like so many Knights Templar, their visages lit up by the yellow soda flames, and their ears half-deafened with the sound of exploding hydrogen—a veritable inferno—were repeating on a Gargantuan scale the little experiment first made a century ago in the cellars of this building, turning out, day and night, tons of the plastic metal in place of the little pin-heads which then burst upon the astonished and delighted gaze of Davy. Behind me was the magnificent power-house—one of the most magnificent of its kind in the world—furnishing not only the electrical energy which transformed the soda into sodium, but diffusing this energy for a multitude of other purposes over an entire district—a noble temple to the genius and prescience of Faraday. Surely one might here say, if you desire to see the monuments of these men, look around! And to my right, and close at hand, was the huge building slip just vacated by the *Mauretania*, herself a symbol of the supremacy of an empire, far mightier, more world-wide, and more potent for good than that which massed its legions behind the old wall.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The electors to the Allen scholarship give notice that they are prepared to receive applications from candidates. Any graduate of the University is eligible for the scholarship provided that his age on the first day of the Lent term 1908 does not exceed twenty-eight years. This year the scholarship is open to candidates who propose to undertake research in any branch of study which comes within the department of any of the following special boards:—medicine, mathematics, physics and chemistry, biology and geology. The scholarship is tenable for one year, during which period it will be the duty of the student to devote himself to research in Cambridge or elsewhere. The emolument of the student is 250*l*., or such smaller sum as the fund, after payment of all expenses, shall be capable of providing. Every candidate must send particulars of his qualifications, &c., to the Vice-Chancellor, Gonville and Caius College Lodge, on or before February 15.

MANCHESTER.—The following brief summary of some recently published statistics serves to illustrate the development in the work of the University during the past eight years. The table not only indicates that a considerable increase has taken place in the numbers of students and staff, but also shows that the progress has been particularly marked in the fields of advanced study and research. The growing success of the honours schools in both science and arts is particularly worthy of notice:—

	End of 1899	End of 1907
Professors	30	43
Total teaching staff	98	203
Students taking full day courses	900	1400
Science honours students	97	180
Arts honours students	34	106
Graduate and research students in residence	—	141
Research fellows and students pursuing original work	—	55

BY the will of the late Mr. Basil McCrea, the Magee Presbyterian College, Londonderry, receives several substantial benefactions. Among these gifts occur 14,000*l*. for building and equipping a new lecture hall; a sum to endow two professorships, to be known respectively as the "Henry Wallace" and the "William Archer Butler" professorships, each professor to receive an annual stipend of 300*l*.; a sum to found and endow two lectureships in the science department of the college, each lecturer to receive an annual stipend of 150*l*., and to be known as the "McCrea lecturers"; such annual sum as may be necessary to make up the stipends of each of the professorships in the literary and science departments to 300*l*. per annum; 500*l*. each year to found and endow a "McCrea science scholarship" and a "McCrea literary scholarship," each of the value of 100*l*., to be competed for every third year, and any surplus to be used for "McCrea prizes" in the science and literary departments.

AT a recent meeting of the governors of the Glasgow and West of Scotland Technical College it was intimated that the Glasgow City Educational Endowments Board had made a further grant of 1000*l*. to the building fund of the college, and that the trustees of the Bellahouston Bequest Fund had promised a donation of 5000*l*. on condition that the governors raised a further sum of 45,000*l*. Including these grants, the building fund now amounts to 301,000*l*. The governors of the college have just resolved to raise the standard of the preliminary examination for admission to the course for the college diploma to that of the Leaving Certificate of the Scotch Education Department. The holders of this certificate are exempted from the preliminary examination of the Scottish universities. This raising of the standard of the entrance examination by the governors of the great technical college at Glasgow represents a new departure of high significance in technical education. Now that the courses will be based upon a preparatory training equal to that demanded by any British university, it will be possible to make substantial advance in the quality of the work undertaken.

A SCHEME to prepare girls better to undertake the duties of the home was described in a letter to the *Times* of January 24. The communication was signed by Prof. William Osler, F.R.S., Sir Henry Roscoe, F.R.S., and Prof. A. Smithells, F.R.S., with others. Instruction of the kind required is impossible without teachers capable of giving it, and the first step must be, the letter points out, to provide education of an advanced type for those who will hereafter conduct the work in its more elementary stages. It is therefore proposed to provide in London a course of post-graduate instruction in household economics. The course will be given at the women's department of King's College, and will begin next October. A college board, consisting mainly of the professors of the subjects germane to the course, with Prof. Smithells acting as honorary adviser, will control the educational side of the work. It is hoped that it will be found possible to include courses of training for the management of large educational and other institutions, for the duties of factory inspection, and for social work aimed at raising the standard of home life. Donations are asked for in order to raise 3000*l*., the sum necessary for the effective organisation of the scheme, and may be sent to Miss Soltau, King's College (Women's Department), 13 Kensington Square, W.

THE best results are obtained in those technical schools where the students are encouraged to follow a suitable course of training extending over a number of years, and where the instruction provided is suited exactly to the industrial requirements of the district. The latest report of the Board of Education states in this connection:—"Well-considered programmes of instruction within schools and careful adjustment of the relation of school to school in populous areas have become more common. In an increased number of schools we find teachers at pains to urge continuity of study and to order their teaching so as to help towards this end. Opportunities for advanced work are provided more widely than before, and accordingly we find the period of study extending and the number of students of mature years increasing." To mark still more obviously the importance of continuity of study, the Board has given prominence to an arrangement by which the Board and the school authorities join in responsibility for the issue of "technical course certificates" affording suitable records of completed curricula. These certificates are to be given only in connection with courses each approved as providing such a technical education as will have a definite value in relation to the occupation to which it has regard. Each certificate as awarded by the local education authority or the managers of a school and endorsed by the Board will record continued attendance and satisfactory attainments in the several sections of the specified course of instruction. The system thus initiated appears to be capable of considerable development. It may become a valuable feature in the organisation of technical courses—standardising their aims and encouraging the students to persistent attendance and continuity of study. The statistics in connection with the examination of students in evening schools, too, the report points out, reflect both the improvement in the provision of more advanced classes and the increased regularity of the attendance of the students.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 7, 1907.—"The Electrical Discharge in Monatomic Gases." By F. **Soddy** and T. D. **Mackenzie**. Communicated by Prof. J. Larmor, Sec.R.S.

Helium and argon purified by volatilising calcium (Soddy, Proc. Roy. Soc., 1907, lxxviii., A, 429) from traces of common gases show a disinclination to conduct the discharge, and the question arises whether the monatomic gases in a perfectly pure state will conduct at all. The well-known phenomenon of "running out" or exhaustion of spectrum tubes filled with these gases with prolonged use might be due to absorption of the impurities only by the electrodes leaving the pure monatomic gases in a non-conducting state. This question has been exhaustively investigated, and the conclusion is drawn that the monatomic gases conduct in the same manner as common gases, but are relatively electrically, as well as chemically, inert. That is to say, the various stages of the discharge from the X-ray vacuum to the ribbon discharge when considerable quantities of gas are present are produced in the case of helium, for example, at pressures from five to ten times the pressure required to produce the same stage of the discharge in a gas like hydrogen or nitrogen.

The "running out" of spectrum tubes filled with monatomic gases under the discharge is due to absorption of the monatomic gas principally in the film of aluminium volatilised from the electrodes. In one series of experiments six tubes were filled with helium purified by calcium at the initial pressures 1·1 mm., 2·3 mm., 4·9 mm., 8·6 mm., 16·8 mm., and 31·2 mm. The first three became non-conducting—the discharge passing an alternative spark gap of an inch of air, and the tube fluorescing strongly—with less than an hour's running, and the fourth after sixty hours, the residual pressure of pure helium in each case being about 0·7 mm. This was determined by breaking the tube under mercury, and confirmed by the use of a specially designed form of McLeod gauge. In the first case the mercury rapidly liberated the greater part of the occluded gas by dissolving the film of volatilised aluminium. The occluded gases are also slowly evolved spontaneously in the cold, and practically completely when the tube is heated to its softening point for some time.

X-rays are given out in pure helium at pressures below 0·2 mm. in an X-ray tube 8 cm. diameter, while in hydrogen X-rays are not given out until the pressure is reduced below 0·1 mm. It is probable that the real pressure in an X-ray tube is in no case below 0·01 mm., and the general impression that the pressure is of the order of 0·001 mm. is due to a variety of misapprehensions regarding high vacua. The behaviour of argon, neon, mercury vapour, nitrogen, and carbon dioxide has also been investigated.

The behaviour of helium at low pressures, at which it conducts the discharge with abnormal difficulty, is strictly analogous to its behaviour at high pressures, when it conducts with abnormal facility (Ramsay and Collie, Proc. Roy. Soc., 1896, lix., p. 257). The curves connecting discharge potential and pressure were taken in the same tube for helium and hydrogen. Helium at 60 mm. showed the same discharge potential (7750 volts) as hydrogen at 12 mm. At a pressure of 30 mm. the potential in helium was 3400 volts, and in hydrogen 16,000 volts. Throughout the whole region, both of high and low pressure, one hydrogen molecule is electrically equivalent, so far as its effect on the character of the discharge is concerned, to several helium molecules.

The remarkable observation was made that some new spectrum tubes, as obtained from the maker, generated helium during preparation and the removal of the occluded gases. The only escape from the conclusion that helium was formed under the special conditions to which the tubes had been subjected was that the helium was derived from the aluminium electrodes. Experiments were made with old aluminium electrodes which had been exposed for months to the air after removal from old spectrum tubes in which they had been used with the rare gases. By the help of the calcium method it was proved that helium, neon, and argon can be obtained in this way in quantities sufficient to give a clear spectrum from old aluminium electrodes which have been used with these gases.

All the spectrum tubes used showed strongly Campbell Swinton's effect (Proc. Roy. Soc., 1907, A, vol. lxxix., p. 134) of developing minute bubbles when fused, usually in the areas exposed to the bombardment of particles travelling normally from the surface of the electrodes; but the argon tubes showed the effect to an extraordinary extent, the glass appearing to boil when fused. Experiments are described in which these glasses have been subjected to a temperature of 1300° C. in a vacuum furnace, and all but the inert gases absorbed by calcium. Only the minutest trace of rare gas is ever obtained in this way, and this is quite insufficient to produce the effect. In the case of the glass of a helium tube which showed Campbell Swinton's effect strongly, it was proved that after a preliminary heating in a vacuum, at a temperature below that necessary to produce bubbles, to drive off surface gas, not the faintest trace of helium was obtained. The view is put forward that the effect is due to a secondary decomposition of the glass under local heating during the bombardment, and that it is not due to the discharge gases being driven into the glass.

Royal Microscopical Society, December 18, 1907.—Mr. Conrad Beck, vice-president, in the chair.—Specimens of luminous bacteria: J. E. **Barnard**. On the room being darkened, the light given off by the bacteria was at once apparent, and the contents of the flask when shaken became very luminous. The light produced was nearly monochromatic, lying between the lines F and G of the spectrum. The whole energy of these bacteria seemed to be utilised in producing light, no heat whatever being detected.—Specimens of natural twin-crystals of selenite: E. **Large**. Specimens were also exhibited under special reflecting polariscopes; under some of these were also shown artistic subjects made from selenite, one representing a vase of flowers, and another flowers and fruits, with animals, such as parrots, chameleons, &c., which changed colour when a film of mica below the design was rotated. Mr. Large also exhibited a small double-image prism made from a fragment of Iceland spar and mounted on the nose of an objective, by means of which two images of a suitable object placed on the stage with a selenite plate were obtained in complementary colours.—Gregory and Wright's microscope: E. M. **Nelson**. This microscope was described and illustrated in an old and rare book published by Gregory and Wright in 1786, and was called a "new universal microscope, which has all the uses of the single, compound, opaque and aquatic microscopes." The illustration shows it to be very similar to one presented to the society in 1899 by Dr. Dallinger, which was then thought to have been made by Benj. Martin, but it now seems likely that it was made by Gregory and Wright, who were probably Martin's successors.—A correction for a spectroscope: E. M. **Nelson**. The paper described a device by which the object-glass of the telescope may be automatically rotated so as always to receive the rays from any part of the spectrum without obliquity.—Some African rotifers: J. **Murray**. The paper described about twelve species of Bdelloid rotifers from Old Calabar, Uganda, and Madagascar, among which were one new species and two new varieties.

January 15.—Mr. E. J. Spitta in the chair.—A new method of showing living bacteria by dark-ground illumination: C. **Beck**. The apparatus consisted of a modified parabolic illuminator, a Nernst lamp, and monochromatic blue light filter.—Some microscopes of new design made by Messrs. Leitz: J. W. **Ogilvy**. The instruments were fitted with Leitz's fine adjustment, the arrangement consisting of a worm wheel and heart-shaped cam, which gives an alternate rise and fall of 3 mm. to the body of the microscope. Mr. Ogilvy said an important feature in the arrangement was that, in the event of the objective being brought into contact with the cover glass when focussing, it simply rested upon the slide, no further downward motion being imparted to the body even if the observer continued to turn the milled head. The coarse adjustment was also provided with a safety arrangement.—The microscope as an aid to the study of biology in entomology, with particular reference to the food of insects: W. **Wesché**.

EDINBURGH.

Royal Society, January 6.—Prof. Crum Brown, F.R.S., vice-president, in the chair.—The chairman read a preliminary obituary notice of the late president, Lord Kelvin (see p. 253).—The fossil Osmundaceæ, part ii.: D. T. **Gwynne-Vaughan** and R. **Kidston**, F.R.S. The present part begins with a full account of the synonymy of scorral fern stems of osmundaceous affinity from the Permian of Russia. The internal structure of two of these, *Zalesskya gracilis* and *Z. diploxylon* (the latter a new species), is described in detail. They form a primitive genus of the Osmundaceæ, and are especially characterised by the possession of a broad and perfectly continuous ring of xylem, from which the leaf-traces depart in protostelic manner. The xylem is non-parenchymatous, and most of the tracheæ bear multiseriate pits. The protoxylems of the leaf-traces are shortly decurrent into the stele of the stem as mesarch strands dying out rapidly below. Two distinctly different regions are to be observed in the xylem, a peripheral zone of normal tracheæ and a central mass of short and wide elements with reticulate markings. In the living plant of *Z. diploxylon* the latter tissue occupied the whole of the centre of the stele, which therefore possessed a solid central mass of xylem. It follows that the central ground-tissue of the recent Osmundaceæ must be regarded as a true pith derived from the modified central xylem of such a stele. The phlœm consists of metaphlœm only, there being no protophlœm or porous layers.

PARIS.

Academy of Sciences, January 20.—M. Henri Becquerel in the chair.—The principal earthquake centres in France, and on the system of seismic stations that should be established: G. **Bigourdan**. Taking into account the stations already existing or now being established, further stations are suggested at Nice, Marseilles, Rennes, and Lille.—Concerning a tooth discovered by MM. Maurice de Rothschild and H. Neuville: Albert **Gaudry**. It is concluded that this tusk, found near Addis-Abeba, belongs to a large unknown African mammal, now existing or recently extinct.—Morphological variations, obtained artificially, of the tubercle bacillus of man and mammals: S. **Arloing**. An account, accompanied by reproductions of photographs, of the modifications produced in human and bovine tubercle bacilli by prolonged cultivation at either a high temperature (45°) or high pressure (2·5 atmospheres).—A differential system of the second degree: L. **Schlesinger**.—The periodic solutions of certain functional equations: Ernest **Esclangon**.—Methodical attempts at a cellular aëroplane: H. **Farman**. A detailed account of the steps by which the author constructed his aëroplane and learnt its use.—The efficiency of screws for propulsion in the air: Louis **Breguet**.—The study of radio-active lead: B. **Szilard**. Radium D, E, and F have been separated from radio-lead. The present paper is concerned with the best methods of effecting this separation.—An exceptional case of Zeeman's phenomenon: A. **Dufour**. It is shown that there exists at least one source of light, a flame in which calcium fluoride is volatilised, giving a spectrum attributed to a compound and not to an element, which, placed in a magnetic field, gives out circular vibrations the sense of which agrees with the hypothesis of the existence of positive electrons.—The calorimetric method applied to the study of slow reactions: Jacques **Duclaux**. A closed Dewar tube is used as the calorimetric vessel, the whole being placed in the water of a thermostat. As showing the accuracy obtainable, an example of the application of the method to the hydrolysis of ethyl acetate by potash is given.—The synthesis of ammonia: M. **Wolterek**.—The catalytic power of silica and alumina: J. B. **Senderens**. The catalytic effect produced by silica or alumina depends upon the state of division and also upon the temperature to which these substances have been raised. Thus precipitated silica, dried by a gentle ignition, at 280° acts upon alcohol giving 99·5 per cent. of ethylene. The same silica, calcined for one hour at a red heat, gives ethylene and 5·3 per cent. of hydrogen. After six hours' ignition, the decomposition takes place only at 390°, and the amount of hydrogen increases to 17 per cent. Alumina behaves in a similar manner.—Some compounds of terbium and dysprosium: G. **Urbain** and G. **Jantsch**. Salts of these elements having been recently isolated in a pure state by the authors, they have studied the properties of some of their compounds with the view of devising less tedious methods of separation. The present note contains an account of terbium peroxide, Tb_4O_7; nitrate, $Tb(NO_3)_3,6H_2O$; sulphate, $Tb_2(SO_4)_3,8H_2O$; and chloride, $TbCl_3,6H_2O$. Dysprosium does not form a peroxide, but the properties of the nitrate, $Dy(NO_3)_3,5H_2O$; sulphate, $Dy_2(SO_4)_3,8H_2O$; and chloride, $DyCl_3,6H_2O$, are described.—The heats of solution of the alkali metals and the heats of formation of their protoxides: E. **Rengade**. On account of the violence of the action of water upon these metals, especially cæsium and rubidium, the reaction was allowed to take place in a modified Berthelot bomb. The results are very concordant, and lower than those previously obtained by other methods.—The estimation of sulphide of carbon in benzenes: Isidore **Bay**. The carbon bisulphide is precipitated by phenylhydrazine, the precipitate washed with pure benzene, and dried *in vacuo*.—The transformation of the α-oxyacids into aldehydes by boiling their mercuric salts in aqueous solution; application to the preparation of *l*-arabinose by means of mercuric gluconate: Marcel **Guerbet**.—Some cases of the simultaneous production of the 1:6- and 2:7-dimethylanthracenes: James **Lavaux**.—Syntheses by means of ethyl and methyl adipates: L. **Bouveault** and R. **Locquin**.—The action of nascent hypoiodous acid (iodine and sodium carbonate) on some acids of the general formula $R.CH:CH.CH_2.CO_2H$, R being C_6H_5 more or less substituted: J. **Bougault**.—Some mineral salts which can act as peroxydases: J. **Wolff**.—A new type of polychætal annelid: Ch. **Gravier**.—The oculo-reaction in its relation to previous treatment with tuberculin: H. **Vallée**.—A bacilliform piroplasmosis observed in cattle in the neighbourhood of Algiers: H. **Soulié** and G. **Roig**.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part iv. for 1907, contains the following memoirs communicated to the society:—

January 12.—Seismic waves. (1) Theory of the propagation of seismic waves; (2) seismic time-curves: E. **Wiechert** and K. **Zoeppritz**.

July 6.—The uniformisation of algebraic curves: P. **Koebe**.

July 20.—Researches from the Göttingen University chemical laboratory, xviii. (1) The synthesis from nopinone of a hydrocarbon related to β-pinene; (2) the synthesis of homologous compounds of the dipentene series; (3) syntheses in the terpinene series; (4) the synthesis of anethol from anise-aldehyde, and of isosafrol from piperonal; (5) the occurrence of sabinene in Ceylon oil of cardamoms and majorana oil; (6) isomeric camphenes and a new camphene-camphor acid; (7) condensation products of cyclic ketones with aromatic aldehydes: O. **Wallach**.

August 6.—A contribution to our knowledge of the light-sense in chickens: D. **Katz** and G. **Révész**.

The official communications (part ii., 1906), just published, include a report by E. **Klein** on the progress of the issue of Gauss's works.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 30.

ROYAL SOCIETY, at 4.30.—On the Observation of Sun and Stars made in some British Stone Circles. Third Note: The Aberdeenshire Circles: Sir Norman Lockyer, K.C.B., F.R.S.—On the Non-periodic or Residual Motion of Water moving in Stationary Waves: Mrs. Ayrton.—The Refractive Index and Dispersion of Light in Argon and Helium: W. Burton.—On the Generation of a Luminous Glow in an Exhausted Receiver moving near an Electrostatic Field, and the Action of a Magnetic Field on the Glow so produced: Rev. F. J. Jervis-Smith, F.R.S.

FRIDAY, JANUARY 31.

ROYAL INSTITUTION, at 9.—Recent Researches on Radio-activity: Prof. E. Rutherford, F.R.S.

MONDAY, FEBRUARY 3.

VICTORIA INSTITUTE, at 4.30.—The Southern Alps of New Zealand and their Glaciers: C. D. Fox.

ARISTOTELIAN SOCIETY, at 8.—The Religious Emotion; Some Results of Inductive Enquiry: Dr. A. Caldecott.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Nitro-glycerine and its Manufacture: Lieut.-Col. Sir Frederick Nathan and W. Rintoul.

TUESDAY, FEBRUARY 4.

ROYAL INSTITUTION, at 3.—Roman Britain: (*b*) Its Interior Civilisation: Prof. F. J. Haverfield.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further discussion*: Experimental Investigations of the Stresses in Masonry Dams subjected to Water Pressure: Sir J. W. Ottley, K.C.I.E., and Dr. A. W. Brightmore.—Stresses in Dams; an Experimental Investigation by Means of India-rubber Models: J. S. Wilson and W. Gore.—Stresses in Masonry Dams: E. P. Hill.

ZOOLOGICAL SOCIETY, at 8.30.—Cinematograph Demonstration of Results of Natural Colour Photography with Zoological Subjects: F. Martin Duncan.—The Duke of Bedford's Zoological Exploration in Eastern Asia. VII. List of Mammals from the Tsu-shima Islands: O. Thomas.—On the Presence of Gonadial Grooves in *Aurelia aurita*: T. Goodey.—The Duke of Bedford's Zoological Exploration in Eastern Asia. VIII. A Collection of Freshwater Fishes from Corea: C. Tate Regan.

WEDNESDAY, FEBRUARY 5.

GEOLOGICAL SOCIETY, at 8.—On Antigorite and the Val Antigorio, with Notes on other Serpentines containing that Mineral: Prof. T. G. Bonney, F.R.S.—The St. David's Head "Rock Series" (Pembrokeshire): J. V. Elsden.

ENTOMOLOGICAL SOCIETY, at 8.—On Diaposematism, with Reference to some Limitations of the Müllerian Hypothesis of Mimicry: Guy A. K. Marshall.

SOCIETY OF ARTS, at 8.—War Balloons: A. E. Gaudron.

THURSDAY, FEBRUARY 6.

ROYAL SOCIETY, at 4.30.—*Probable Papers*:—On the Weight of Precipitum obtainable in Precipitin Interactions with Small Weights of Homologous Protein: Prof. D. A. Welsh and H. G. Chapman.—Nitrification in Acid Soils: A. D. Hall, N. H. J. Miller, and C. T. Gimingham.—A Criticism of the Opsonic Theory based upon Studies carried out by Means of Melanin: S. G. Shattock and L. S. Dudgeon.—A Contribution to the Study of the Mechanism of Respiration, with Especial Reference to the Action of the Vertebral Column and Diaphragm: J. F. Halls Dally.

ROYAL INSTITUTION, at 3.—The Story of the Spanish Armada: Major Martin Hume.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Protective Devices for High Tension Transmission Circuits: J. S. Peck.

LINNEAN SOCIETY, at 8.—Fruits and Seeds from the Pre-Glacial Beds of Britain and the Netherlands: Clement Reid, F.R.S.—On a Method of Disintegrating Peat and other Deposits containing Fossil Seeds: Mrs. Reid.—On a Botanical Expedition to Fokien: S. T. Dunn.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Some Devices for the Absorption of Shock on Wheeled Vehicles: F. G. Woollard.

CHEMICAL SOCIETY, at 8.30.—The Metallic Picrates: O. Silberrad and H. A. Phillips.—Organic Derivatives of Silicon. Part V., Benzylethylsilicone, Dibenzylsilicone and other Benzyl- and Benzylethyl-derivatives of Silicane: R. Robison and F. S. Kipping.—Some Physico-chemical Properties of Mixtures of Pyridine and Water: H. Hartley, N. G. Thomas, and M. P. Applebey.—The Constitution of Umbellulone, Part III.: F. Tutin.—The Residual Affinity of the Coumarins and Thiocoumarins as shown by their Additive Compounds: A. Clayton.—The Influence of Foreign Substances on Certain Transition Temperatures, and the Determination of Molecular Weights: H. M. Dawson and C. G. Jackson.—The Bromination of *p*-Hydroxydiphenylamine: Miss A. E. Smith and K. J. P. Orton.—Colour and Constitution of *az*-Methine Compounds, Part I.: F. G. Pope.—The Decomposition of Ammonium Bichromate by Heat. Preliminary Notice: W. M. Hooton.

FRIDAY, FEBRUARY 7.

ROYAL INSTITUTION, at 9.—Napoleon and the Louvre: Humphry Ward.

SOCIETY OF ARTS, at 8.—The Hygiene of the Pottery Trade: W. Burton.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Electric Hardening and Annealing Furnaces: P. T. Steinthal.

GEOLOGISTS' ASSOCIATION, at 8.—Presidential Address: The Centenary of the Geological Society: R. S. Herries.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—Aërial Navigation: H. Chatley.

CONTENTS.