THURSDAY, JULY 20, 1911.

A DETECTIVE'S VADE MECUM.

Science and the Criminal. By C. Ainsworth Mitchell. Pp. xiv+240. (London: Sir Isaac Pitman and Sons, Ltd., 1911.) Price 6*s.* net.

IN the introduction to this fascinating book is suggested a special State department of criminal investigation. Police routine work, walking beats, directing traffic, quelling drunken street rows, is not, the author thinks, an effective school of deductive reasoning or scientific investigation. He would allow his investigators to enter the State service by another door; he would train them in applied science, and he would enable them to meet the clever criminal, as Sherlock Holmes loved to do, on the same intellectual plane. It would be unreasonable, however, to expect even from investigators so trained the same unerring instincts that surprise and delight us in the popular detective of fiction. The detective story is, we must remember, written backwards, and the author, having carefully laid his clues along the track of the crime, it is an easy matter for the detective, who is in the secret, to pick them up as he goes along.

Yet it is not impossible that the same faculty which enables one to devise ingenious detective stories would help in the actual detection of crime. Edgar Allan Poe, the first and greatest of detective story-writers, could not merely devise but detect. The wonderful inductive reasoning in the story of the murder of Marie Roger, in which, as in the popular puzzle game, each clue, even to the most tiny, is fitted into its place to complete the picture, was founded on the facts of a real murder, which was perplexing the police at the time, and the storyteller succeeded in unravelling the mystery when the detectives had failed. In Sir A. Conan Doyle the new department of criminal investigation might find a distinguished first president; than Mr. Mitchell's volume there could be no better handbook for its schools.

The book admirably indicates how, with ever-increasing advantage and success, the weapons forged by scientific research and discovery can be availed of in society's interminable war against the criminal. Of those agencies, electricity is one of the most effective, if not for detecting, for capturing the criminal. The man in the street is not quick at grasping the possibilities of a novel invention. At first it is popularly regarded as a new toy, a matter of amazement and amusement, but of no moment in the practical affairs of men; so it was in our own day with the telephone, the phonograph, and the biograph, with the miracles of the X-rays, radium, and wireless telegraphy. A great invention must prove itself and so live. Still, we find it hard to believe that the utility of the telegraph was less in doubt, and that it was as a criminal catcher it first established its reputation with the public.

"It is strange to reflect," writes Mr. Mitchell, "that it was not until it had been employed in the capture of a criminal that it was recognised in how many directions the electric telegraph might be of service to mankind."

Prior to that time the invention had been little better than a failure, from a commercial point of view, for though the railway companies had some time before this realised the advantages of the new system the Government had refused to have anything to say to it. It was thus little short of a revelation to the public when in 1845 the news was made known that a suspected murderer had been arrested through the agency of the telegraph.

But the telegraph has learned a lot about detective work since that time. It has even dabbled in photography, and is now able not merely to describe but to depict the fugitive criminal. The last word (so far at any rate) on this subject appears to be the telectograph invented by Mr. Thorne Baker, which, we learn from Mr. Mitchell, "may also be used with wireless installations for the transmission of simple pictures or diagrams, and by whose means it would be easy for a ship at sea to send or receive portraits." A picture of King Edward VII., transmitted in this fashion, and reproduced from the *Daily Mirror*, is one of the most striking of the many illustrations of the book.

In every department of crime science seems to have lent a hand to make easy the work of the detective and to harass the criminal, who, with his own finger-tips, is now compelled to print off an infallible means of identification. The book is full of fairy tales of science, more startling than the wonders of the "Arabian Nights." The retort and microscope of the analyst are the special bugbears of adepts in the higher and more scientific walks of crime.

In the old days the murderer caught red-handed could safely deny the bloodstain was human, and the microscope was unable to contradict him. It is not so now. By a method recently discovered the analyst examining the minutest stain of blood, dry, and scarcely discernible to the naked eye on the garment of a suspect, can tell to a certainty the species of animal in the veins of which it originally flowed. There is but one exception to the rule; the blood of the anthropoid ape gives the same reaction as human blood. One might fancy the spirit of Darwin rejoicing in this singular confirmation of his theories.

Mr. Mitchell possesses in a rare degree the gift of interpreting between the man of science and the public. The complicated process by which the blood of different animals is differentiated in the test-tube is described in clear and popular language easily understood even by the least scientific. The ultimate result is summed up in a few sentences, which make the matter plain to the humblest intelligence.

"A simple method of applying the serum test has recently been discovered. A small quantity of human serum is placed into a series of tubes, and into each of these is next introduced one drop of the fresh blood of different animals diluted with salt solution, or of the dried blood dissolved in that liquid. The tubes are now allowed to stand from thirty to forty-five minutes, and then examined. If, in the case of the blood of unknown origin there is a faint red precipitate (of coagulated blood), leaving the upper liquid clear, the blood is of human origin. On the other hand, the blood of other species of animals will have dissolved in the human serum, colouring it red. If the tubes are charged in the first place with the serum of the horse, ox, or other animal, the corresponding blood is coagulated, while that of any other animal dissolves."

Perhaps it is as well to explain to uninitiated readers that the "serum" is the liquid or watery substance of the blood.

The more cautious murderer, who resorts to the subtle agency of poison, has even more reason to dread the analyst, with his test-tube and microscope, than his brother in crime, who adopts the cruder methods of bone-breaking and blood-letting.

There has been a deal of romantic nonsense written about Cæsar Borgia and his more famous sister and their subtle and deadly poisons, "of which the secret is now fortunately lost to mankind." The modern poisoner has fluid, powder and perfume far more subtle and dangerous at his disposal, but amongst them are none that can elude the scrutiny of modern science. It is generally thought that arsenic was a constituent part of the mysterious Borgia poisons. Mr. Mitchell tells us, "with the more refined methods of analyses now available the tests are capable of detecting arsenic even in the minute proportion of one part in sixty million"—a minuteness which the imagination can scarcelv conceive.

Under the pitiless eye of the microscope the most skilful and delicate handiwork of the forger is of no avail. We have in the book a hundred interesting illustrations of how his efforts are brought to nought. Does he trace the forgery over pencil writing, the microscope shows the pencil marks along the edges. Does he erase and write over, the most delicate lines are broad smudges, under the microscope the most skilful erasures are rough as unplaned wood. When the writer begins and leaves off, every joining, every doubt, every hesitation is plainly revealed, as if the eye at the microscope was watching the penman.

But it is not in scientific explanation and demonstration alone that this book excels; it is not to the scientific student alone that it appeals. By that vast and miscellaneous public vaguely classified under the head of "the general reader," it will be thankfully received and eagerly devoured. Mr. Mitchell illustrates his scientific disquisitions by vivid illustrations and judicious extracts from the most famous and exciting trials of ancient and modern times. We have many quaint pictures of the peculiar administration of justice in the good old days, when Lord Chief Justice Hale exerted himself to secure the conviction of Anne Turner, because he was afraid "lest by an acquittal countenance should be given to a disbelief in witchcraft, which he considered tantamount to a disbelief in Christianity."

We read, too, that in the trial of Anne Turner for the murder of Thomas Overbury (1615) evidence was given that she was in possession of parchments, some of which contained the names of the Blessed Trinity, others, on which were written +B+C+D+E, and another with a figure in which was inscribed the word Corpus, and to which was fastened a little piece of the skin of a man. In some of these parchments were the names of devils, who were conjured to torment the Lord Somerset and Sir A. Mainwaring if their loves should not continue, the one to the countess and the other to Mrs. Turner.

On evidence like this poor Mrs. Turner was convicted and sentenced to death. The form of the sentence was perhaps the strangest thing of all. The learned Lord Chief Justice Hale gravely informed the trembling woman that

"she had been guilty of the seven deadly sins, and that as she was the inventor of that horrid garb, the yellow tiffany ruffs and cuffs, he hoped she would be the last by whom they would be worn. To this end he ordered that she should be hanged in that garb. This was duly done, while, as a further condemnation of the fashion to which the judge had taken exception, the hangman wore yellow bands and cuffs."

We are not surprised to learn that the fashion died with its author, but we can scarcely imagine a Lord Chief Justice of our own day solemnly deciding that a lady should be hanged in a hobble or a harem skirt by a hangman similarly attired.

We have new trials as well as old in the book. The exciting question of the guilt or innocence of Mrs. Maybrick, on which Lord Chief Justice Russell entertained such strong convictions, is elaborately and intelligently discussed. We have a brief but very vivid *résumé* of the trial of Robert Wood, whose careless and callous behaviour in the dock excited such a strange fervour of sympathy and admiration, and of whom Mr. Hall Caine wrote after watching the case throughout, "Robert Wood, innocent of the murder of Emily Dimmock, is yet the most remarkable man alive." There is no space to enumerate the hundred and odd other trials not less interesting or remarkable which are summarised in the book.

There is a singular fascination in the detective story in fiction or real life. Any editor can tell how a sensational trial inflates the circulation of his newspaper. The magazines and the publishers and the public alike are clamouring for detective stories. Of all the characters in modern fiction, Sherlock Holmes is the best-known and most admired. A man who writes one passable detective story must write nothing else, for the public will accept nothing else from his pen.

In the book under review there is the material for a hundred detective stories. Every half a dozen pages contains the suggestion of a plot which needs only a little imagination and elaboration for its completion.

It is impossible within the limits of a review to do justice to the wealth of material in the book or to the attractive form in which it is presented to the public. Hypnotism, handwriting, dog training, food adulteration and its detection, and a score of other interesting topics are elaborately discussed, and illustrated by extracts from appropriate trials. The author exhausts his subject without in the least degree exhausting the interest and delight of his reader. His book possesses the two essential qualities of a good book: it is readable and it is worth reading. It serves up scientific facts and theories in a most palatable form, and we have high authority for the dictum, "Omne tulit punctum qui miscuit utile dulci." The illustrations, of which there is a vast variety, are scarcely less interesting than the letterpress. Once published the book becomes an essential *vade mecum* of the detective and the writer of detective stories. To the detective it supplies innumerable facts and suggestions which cannot fail to be useful in the practical work of his profession. To the writer it is a veritable mine of valuable material. The general public, who read mainly for amusement, but do not object to a little instruction unostentatiously slipped in as they go along, will find the book as fascinating as a new volume of Sherlock Holmes's adventures, and a great deal more instructive.

THE GENESIS OF CIVILISATION.

(1) *Marriage, Totemism, and Religion. An Answer to Critics.* By the Rt. Hon. Lord Avebury. Pp. xi+243. (London: Longmans, Green, and Co., 1911.) Price 4*s.* 6*d.* net.

(2) *The Golden Bough: a Study in Magic and Religion.* By Prof. J. G. Frazer. Third edition. Part ii., Taboo and the Perils of the Soul. Pp. xv+446. (London: Macmillan and Co., Ltd., 1911.) Price 10*s.* net.

(1) LORD AVEBURY opens his "answer to critics" with the following just remark:—

"In spite of the profound study which has been devoted by many learned and able philosophers to the origin and evolution of civilisation, there are still great differences of opinion on the subject."

His book, "The Origin of Civilisation and the Primitive Condition of Man," published forty-one years ago, was, as Mr. Lang rightly described it, "a pioneer work of great value and importance." But the best of theories would be expected to grow or change with the accumulation of new evidence and a closer analysis of the old, and both these conditions have been satisfied in the interval.

Among the author's original theories, that which showed most insight was the demonstration of the antagonism between idolatry and fetichism, in later terms, between religion and magic. Later research, however, has not so decidedly corroborated his views on the origins of marriage, exogamy, and totemism. A good deal of misconception that has existed, owing to the use of the same terms with different meanings, is now being removed, as in the case of "religion" itself. The one term for which there is no use is "superstition." But the modern distinction between "magic" and "religion," which Lord Avebury laid down long ago, while distinguishing between man's control of nature and "supernature's" control of man, between coercion and prayer, and so forth, rather ignores that vital component of both tendencies, which is known as animism, the belief in "spirit." The antagonism, on which Tylor has laid such stress, between animistic and non-animistic thinking, and the origin of animism itself, are certainly of profound importance in the evolution of culture.

In the case of marriage, however, there is as yet little agreement as to the meaning of the term in reference to origins. Lord Avebury himself, "for want of a better term," spoke of the "primitive" condition as "communal marriage," both words connoting legalism. "Promiscuity" erred in the opposite direction; its modern substitute is "group-marriage." Lord Avebury's view that exogamy and individual "marriage" arose from "marriage by capture" was largely based on customs which were cases not of capture but of elopement, a very different thing. He does not seem yet to have realised the difference; for instance, he brings forward the Kurnai custom, reported as capture by Fison and Howitt. But their actual words prove it to have been elopement. Speaking of "marriageability" between exogamous sections of a tribe, I once ventured to say that no "rights" were exercised in virtue of it. I meant rights as against the actual husband. In reply to this Lord Avebury (p. 20) quotes a case of "capture" where the captor has a right to the captive. He concludes, "Mr. Crawley is mistaken in questioning the right of the conqueror to his captive," a statement I did not make. But, further, the case he quotes is merely a case of elopement!

The defloration of the bride among the Central Australians by other men than the bridegroom was explained by Spencer and Gillen as a rudimentary (*sic*) right of marriage deriving from a previous promiscuity, by Lord Avebury as an "expiation" (to the tribe) for individual marriage, a vestigial right of communal marriage. Here, as in the analogous custom of "symbolic capture," the whole question is the psychological question of the nature of "survivals." Can, for instance, such a custom as that of a mock capture of the *bridegroom* (a not uncommon custom) be explained as a survival, in "play" or ceremony, from a previous real and serious practice of kidnapping? All cases of symbolic capture can be explained as quasi-magical or symbolic expressions of the idea of connubial possession. Similarly with the other custom. We may explain it as a quasi-magical or symbolic expression of the idea of consummation. Spencer and Gillen themselves note that the participators wear magical decorations. Similar acts of physical preparation with or without a magical irradiation are found everywhere; they are often performed by the parents of the bride. A case is just to hand (*Journal of the Royal Anthropological Institute*, xl (1910), 298) from the tribes near Lake Nyasa, where a man (it may be any man) is "called in to oblige." I have enlarged on this point because it is crucial in the question of marriage-origins, and largely made use of by the supporters of the hypothesis of primitive promiscuity. On the face of it the custom has nothing to do with group-marriage of to-day, and all analogy is against its being a survival from the "horde"-rights of the past. Lord Avebury approves the conclusion of Spencer and Gillen that "individual marriage does not exist either in name or in practice in the Urabunna tribe." But they themselves admit that every woman is the special *nupa* of one man, that those men who have the right of "access" (not the same thing as marriage) must obtain his consent, and that this is asked only in such circumstances as the "husband's" absence ("Native Tribes of Central Australia," p. 63).

No one denies that the earliest marital relations were in a fluid state, or that even with individual marriage the husband may have had to fight for the continued possession of the wife. Of the two extremes of animal analogies, the baboon and the gorilla type, Lord Avebury favours the former. In the evolution of social organisation it is quite probable that, given the latter type as the normal, the pendulum might at times swing to the former. In the ages before custom a tendency to individual marriage would have to struggle for existence, just as the tendency to individual property had to struggle. Customs like "avoidance" seem to be expressions of a fear of "trespass." The rise of the idea of fatherhood is closely connected with the property-instinct, and the evolution of marriage, generally, will receive its most probable demonstration when adequate account is taken of the psychological and historical relations between the ideas of ownership and marital possession.

The book suffers from the lack of an index. There are some misprints, *e.g.* M'Lennan for McLennan, Ling Roth for W. E. Roth, Reinack for Reinach.

(2) The second part of "The Golden Bough" is an enlargement of the original chapter on "Taboo and the Perils of the Soul." It fulfils the promise of the first part in the way of multiplication combined with continuity. In view of the fact that the two chief subjects of the volume bring us so very near to the origins of spiritual religion on one hand, and of the immense, complex, and changing body of human morality and law on the other, one regrets that neither subject is treated as a whole. Prof. Frazer points out that such a treatise would far exceed the limits he has prescribed for himself in "The Golden Bough." Nor can we fairly ask him for more than is necessary to place in the clearest light the central figure, the supreme subject, of the book, the idea of the god-man. When first propounded, twenty-one years ago, this idea, as a world-force, savoured of the improbable, but to-day we know it as an axiomatic principle of social evolution. The idea of a man who is "a pledge and guarantee of the continuance and orderly succession of those physical phenomena upon which mankind depends for subsistence" is, in its many forms, one of the most powerful factors in human history. It is a mistake to confine its operation to royal priests and divine kings; it is embodied in all who are vicars of nature, aristocrats of science and of commerce, no less than aristocrats of politics and religion. At one end we have the savage medicine-man, in his way a depositary of knowledge and a controller of supplies; at the other we have the inventor and the capitalist. But its most spectacular form is in religion, and of all great national religions, with few exceptions, it is the living nucleus. To have proved this so convincingly is the chief social service of "The Golden Bough."

Among new sidelights are the study of confession, showing the remarkable sensitiveness of the individual brain to the social judgment; the Eskimo theory of taboo (that brilliant discovery of Dr. F. Boas), a really fascinating chapter in human ethical thought, which we will not spoil by a *précis*.

In his preface and conclusion the author has some suggestive observations on the continuity of human nature and the fluidity of moral ideas.

"When all is said and done, our resemblances to the savage are still far more numerous than our differences from him; and what we have in common with him and deliberately retain as true and useful we owe to our savage forefathers, who slowly acquired by experience and transmitted to us by inheritance those seemingly fundamental ideas which we are apt to regard as original and intuitive."

"The old view that the principles of right and wrong are immutable and eternal is no longer tenable." The ethical theory and the moral practice of an enlightened future will owe much to the pages of "The Golden Bough," veritable leaves of a tree of knowledge. A. E. CRAWLEY.

CAMBRIDGESHIRE AND THE ISLE.

Highways and Byways in Cambridge and Ely. By the Rev. E. Conybeare. Illustrated. Pp. xviii+439. (London: Macmillan and Co., Ltd., 1910.) Price 6*s*.

THE Rev. Edward Conybeare has written a fascinating book about Cambridge and the Isle of Ely. He has taken as his theme a county and an isle the natural features of which to many seem dull, flat and unprofitable. Yet all England is beautiful and all England is interesting, and owing to the skill of his pen and to his wide knowledge, Mr. Conybeare has succeeded in telling us something interesting even of the meanest of Cambridge country villages. The fascination of the fens to those who like far-off horizons and gorgeous sunsets does not escape him.

To any member of the University of Cambridge Mr. Conybeare on his bicycle is as familiar a figure as the White Knight. It is on this bicycle that he has visited and inspected innumerable churches, remote villages, out of the way farmhouses, ruins, and antiquities. He has a most intimate acquaintance with the roads, lanes, and bypaths of this part of East Anglia, and his book adds a new joy to life to those inhabitants of these districts who are interested in the history of their forefathers.

Mr. Conybeare deals fully with the early history of the country, the Devil's Dyke, Fleam Dyke, tumuli and other prehistoric works, but he is equally at home with what, in comparison with these mounds, is modern history, and as this appeals rather more immediately to us, we venture to give as an example of his style two quotations, one of which is to the infamous Dowsing:—

"In 1863, Hardwick Church, which is so conspicuous an object from the roof of King's College Chapel, was purified by Dowsing, who notes with disgust that for dealing with 'ten superstitious pictures and a cross' he was here paid only 3*s*. 2*d*. instead of the 6*s*. 8*d*., which was his regular fee. The great iconoclast had the same grievance in the adjoining village of Toft, where he got 'only 6*s*. 8*d*.' for a specially heavy 'purification' of the church, involving the destruction of 'twenty-seven superstitious pictures in the windows, ten others in stone, three inscriptions, *Pray for the souls,* divers *Orate pro animabuses* (*sic*) in the windows, and a bell *Ora pro anima Sancta Katharina.*' The 'pictures in stone' were doubtless the alabaster images of the reredos, fragments of which are still preserved in the church, exquisite in modelling and colour."

Thus was the beauty of rural England destroyed by a fanatic and at a carefully calculated price.

The second quotation deals with national history and tells us that:—

"Near Hardwick is Childerley Hall, now a farmhouse, and hither King Charles the First was brought by his captors, when carried off by Cornet Joyce from Holmby House, in Northamptonshire. He was not altogether an unwilling captive, for both he and the Army hoped to arrive at some mutual accommodation which would make both independent of that Parliamentary control of which both were heartily wearied. He was treated accordingly with the utmost respect, and during his stay at Childerley Hall (from Saturday, June 5, to Tuesday, June 8), the students of Cambridge 'flocked apace' to pay their homage to him. 'He is exceedingly cheerful,' writes a contemporary scribe, 'shows himself to all, and commands that no scholler be debarred from kissing his hand, for which honour they return humble thanks and *Vivat Rex;* and there the Sophs are in their gowns and caps as if no further than Barnwell.' Nay, even the great chiefs of the army, the men who at Marston and Naseby had faced and conquered him, Fairfax, Ireton, and Whalley, and Cromwell himself, came hither to join in this hand-kissing."

The book is by no means free from small, but to a resident stimulating, errors (like the minute gas-bubbles in soda-water), but in spite of these it will do much to popularise a countryside which has been too long neglected.

THE SUGAR CANE AND CANE SUGAR.

Cane Sugar: a Text-book on the Agriculture of the Sugar Cane, the Manufacture of Cane Sugar, and the Analysis of Sugar House Products; together with a Chapter on the Fermentation of Molasses. By Noël Deerr. Pp. xv+592. (Altrincham, Manchester: N. Rodger, 1911.) Price 20*s.* net.

IN this work the author has brought together very nearly all the information, both scientific and practical, which an enthusiastic planter, manager, or chemist would be likely to require in dealing with the production of cane sugar.

The first ten chapters—about one-third of the whole space—are devoted to description of the cane and its methods of culture. They include a section on the pests and diseases to which the plant is subject, with notes on the various devices which have been found most useful in combating them. In case anyone should question whether it was advisable for the author, a chemist, to devote a considerable amount of space to the botany, agriculture, and pathology of the sugar cane, as well as to its chemistry, an explanation is offered which enlists our sympathy at once. "I found it impossible," the author says, "to live on plantations without taking a keen interest in . . . all phases of the production of cane sugar."

We may hope that there are many others afflicted with the same kind of inquisitiveness. If so, Mr. Deerr's suggestion that his work may serve to fill a gap in English technical literature will no doubt be justified. On plants and insects he may not write with the authority of the professional botanist or entomologist; but that is not the whole story. To point out the road, one need not have helped to make it. A useful purpose is served in stimulating the reader's interest, and putting him in the way of getting further information when his curiosity is aroused. From this point of view the outlines given of the botany of the sugar cane, and especially the summary of the insect and fungoid pests that infest it, are by no means lost labour.

The factory operations connected with the production of sugar and molasses from the harvested cane are dealt with in the next ten chapters, and the remainder of the volume is chiefly concerned with the chemical control of the manufacture and with questions of sugar analysis. There is also a chapter on fermentation and distillation, with special reference to the requirements of the sugar house in respect of the production of rum.

Several years ago V. H. and L. Y. Veley ascribed the phenomenon of "faulty" rum to a micro-organism which they isolated and studied, but their conclusions were subsequently challenged by Scard and Harrison. The author has found in weak rum a fungus which, he says, is "similar" to that described by the Veleys. He does not, however, think it can be called the cause of faulty rum, inasmuch as it did not develop when placed in strong alcohol (75 per cent.). It was not killed, but no change could be traced in sound, clear rum when this was inoculated with a drop of the weak spirit containing the fungus. Apart from the question of micro-organisms as a cause, the turbidity shown by faulty rum on dilution is attributed to the presence of certain kinds of caramel, higher fatty acids, and terpenes.

The book represents a great amount of reading. It is not the author's first work on the subject, and his experience as chemist, manager, and sugar technologist is a guarantee that his own statements are likely to be practical and trustworthy, whilst for the views of authorities quoted copious references are given. Tested here and there on points within the present writer's knowledge, the information has proved to be accurate. The illustrations, which are numerous, include some excellent photographs and coloured plates.

C. S.

LABORATORY METHODS IN ZOOLOGY.

Zoologisches Praktikum. By Prof. A. Schuberg. Band i., Einführung in die Technik des zoologischen Laboratoriums. Pp. xii+478. (Leipzig: W. Engelmann, 1910.) Price 11 marks.

DR. SCHUBERG has set out to write a laboratory manual of methods for dealing with different groups of animals, but found that there was a good deal of general descriptive matter as to methods, apparatus, and reagents to be dealt with before the systematic treatment of the groups could be reached. It is this general part that occupies the whole of the present volume. A good deal of it resembles an instrument dealer's catalogue, and almost every piece of apparatus used for zoological technique is described and figured. Then the choice of instruments and their use and abuse are considered, with many experienced remarks. The routine of zoological procedure, fixing, staining, mounting, the use of the microscope, and so on, are dealt with. There are many useful references to books or papers that advocate special methods.

The volume is intended for "Hochschulen" and universities, but there are one or two points in which its usefulness might have been increased. There are, for example, no instructions as to how to collect and observe animals. A few remarks on nets and boxes do not constitute instruction, and general directions would be a most useful addition, if they were devoted to skinning and preserving; how to work different kinds of ground, sea, lake, moor, &c.; how to obtain material for observing life-histories. Another point omitted is the insertion of directions for collecting in other countries, especially in the tropics, where difficulties of unusual order have to be overcome. Again, the author does not appear to describe how any of the apparatus may be made. It is, of course, nearly always possible to buy what you require ready-made, but there are many advantages in knowing how to make the simpler pieces of apparatus, since not only the manipulation is learnt, but the physics of the working are mastered in a way that no ready-made machine permits. For physiological work particularly such training is simply invaluable.

The only other point that has occurred to us is the incomplete nature of the instruction on certain modes of procedure, a drawback common to so many "practical" text-books. Thus in reconstructing embryos or animals from sections, the author does not state exactly what to do or what precautions to take to ensure a satisfactory result. Perhaps, however, the subject will recur in his later volume. In fact, any judgment on this section of the work is premature until the second part has appeared, as we trust it soon will. We must say, however, that only the beginner will learn much from the present instalment. The methods are, so far as we have been able to test them, well known and ably advocated already. But to anyone who is fitting up a laboratory or starting out upon a course of practical study, the work may be heartily recommended.

CONSTRUCTION IN EARTHQUAKE COUNTRIES.

Le Case Nelle Regioni Sismiche e la Scienza delle Costruzioni. By A. Montel. Pp. iv+116. (Torino: S. Lattes and Co., 1910.)

THIS book, dealing with construction in earthquake-shaken countries, opens with a few words on the nature of earthquake motion, particularly acceleration. Then follows two scales of seismic intensity. After this a little is said about the nature of foundations, as, for example, whether they are upon soft or hard ground, on a slope, or on a plain. The materials used for construction are given considerable consideration, particularly the advantages that may be obtained by the use of ferro-concrete. The pictures, like those showing the framework of buildings, and various formulæ are old acquaintances, whilst the text which accompanies them in many places closely follows a translation from English into Italian. Its author, Mr. Montel, particularly refers to two books from which he has obtained his information; one is No. 4 of the publications of the Earthquake Investigation Committee of Japan, written almost entirely by Dr. F. Omori, and the other is "La Science Séismologique," by Comte de Montessus de Ballore. The other contributors to some eighty volumes issued by the Earthquake Investigation Committee have been omitted, and no reference made to the Transactions of the Seismological Society of Japan, in which we find accounts of almost everything that has been elaborated by Dr. Omori, and written about by Count Montessus and Mr. Montel.

Some thirty years ago, when Europeans were invited to Japan, their attention was naturally directed to earthquakes. These they measured, and earthquake motion was for the first time reduced to mechanical units. The result was that engineers and constructors learned for the first time something about the forces with which they had to contend. The visitors even went a little further, and tested their suggested formulæ by placing columns of masonry and other articles on a truck which could be moved back and forth at an increasing rate. The quickness or suddenness of motion required to produce the shattering or overturning of these objects was recorded, and theory brought into closer relationship with practice. For many years past new forms of buildings have been rising in Japan, and these are found to withstand earthquake movement better than their predecessors. The formula of C. D. West, formerly professor of engineering in the University of Tokyo, which is the foundation of all other formulæ, relating to the more important principles guiding constructors occupies a prominent position in Mr. Montel's work, but the name of C. D. West is not mentioned. About this we need not be surprised, because it is only found with difficulty in those works from which he quotes. But practical seismology has grown and it must not be supposed that the guests who visited Japan some thirty years ago did everything. Their work also had foundations.

So far as we know, Robt. Mallet was practically the first man who treated earthquake movement scientifically, and attempted to reduce it to practical units. Notwithstanding his work, engineers continued to regard an earthquake as something strong, and to resist its effects structures should be strong and heavy. Although M. Montel has not done all the justice he might have done by more extensive references, still he has produced a useful book, and if the principles it sets forth are adopted in the earthquake-shaken parts of Italy, they should do much to ameliorate the lot of inhabitants of those regions.

J. MILNE.

OUR BOOK SHELF.

Notes on the Use of the Portable Reversible Transit Instrument and the Method of Calculation of the Observations. By Captain C. E. Monro. Pp. 60. (London: J. D. Potter, 1911.) Price 3s.

THIS excellent little handbook is written to serve as a practical guide for the use of beginners with the transit instrument. After a very slight amount of personal instruction, the learner will find a sufficient aid in this book, which gives ample directions for securing the best possible determinations of time. The notes are written in a thoroughly practical manner; the whole procedure to be adopted in setting up the instrument and in making and reducing the observations is explicitly set forth.

Captain Monro is well qualified by experience for compiling such a handbook, having taken the principal part in the important longitude determination Greenwich-Ascension-Cape in 1907; but beyond his own observations, he has drawn largely on the accumulated experience of Greenwich observers during the series of fundamental longitude determinations made by the Royal Observatory. These notes may, in fact, be regarded as embodying in the main the practice actually employed at Greenwich. In one respect, however, a deficiency is apparent, namely, with regard to the observations which depend on the use of the Right Ascension micrometer. This is presumably owing to the author having gained his experience near the equator, where slow-moving polar stars are almost unobservable; in consequence, he himself would have little occasion for using the micrometer screw. To this we attribute the fact that there is no explanation of how to determine the value of the screw, a very important instrumental constant in time determinations under ordinary conditions. Further, the example given of the reduction of a slow-moving polar involves an extravagant amount of arithmetic, and an excessive number of decimal places are employed. It may also be remarked that the wire intervals are better determined from special observations of two or three polar stars than by the laborious process of reducing some hundreds of equatorial transits.

Apart from this the book contains all that is necessary for the most refined work with the type of instrument described. The appendix, containing specimens of computing forms for the reduction of the observations, is a useful feature. Another appendix contains an elementary account of the theory of the corrections for azimuth and level. A. S. E.

Elements of Zoology; to accompany the Field and Laboratory Study of Animals. By Dr. Charles B. Davenport and Gertrude C. Davenport. Revised edition. Pp. x+508. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 5s. 6d. net.

THIS attractive work was issued ten years ago by Dr. and Mrs. Davenport, and it has now passed into a revised edition. In the interval the author has taken charge of the Carnegie Institute for Experimental Evolution and of the Brooklyn Institute Laboratory at Long Island, and he is consequently well qualified to introduce changes in the work that reflect to some extent the advance of zoological knowledge so far as it affects an elementary text-book. The chief feature of the work is the abundance and excellence of the illustrations. Scarcely less striking than the figures are the suggestive and interesting remarks on the habits and behaviour of the examples selected. There is little plan or sequence in the chapters. Each of them consists of an isolated study of some particular topic associated with a given form of animal life. By some curious oversight only one-half of the selected forms are figured, though illustrations of related forms occur in abundance, and there are, in addition, photographs of the localities in which the chosen animals may be found. The work is so attractive and will be so useful to teachers who wish to organise nature-study courses that we are loth to point out the few blemishes that we have noticed. Darwin, however, would object to be quoted as saying (p. 171), or rather writing "mold" for mould, and "plow" for plough. The Ranidæ occur over Africa, and are not limited, as suggested on p. 348, to the northern hemisphere and East Indies. The spotted salamander figured on p 335 is called "A urode," a name which is certain to cause trouble and misunderstanding, as are many other curious vernacular names, such as "sow-bug" for Oniscus, "basket-fish" for branched Ophiuroids, "tumble-bugs" for the large dung-beetles, the "underwing" for Catocala, "spring azure" for blue Lycænas, and many others. Probably in the States these difficulties will not occur. We can heartily recommend this book.

Modern Industrial Chemistry, from the German of H. Blucher. Translated by J. P. Millington. Pp. xvi+779. (London: Gresham Publishing Co., 1911.) Price 30s. net.

THIS work is an attempt to survey the field of chemical technology and to bring the results within the compass of about 800 pages of well-leaded type. It is, lexicographically arranged, fairly well illustrated by "process" cuts, and plentifully interspersed with advertisements, or with references to the many advertisements between which the book itself is sandwiched. As might be anticipated from its origin, it deals mainly with German technology, and is especially rich in references to German patent literature. Another feature in which it differs from the ordinary run of such works is the prominence it gives to the nostrums and drugs with which modern chemical manufacturers, more especially in Germany, have flooded the markets of the world. Many of these are only of the most ephemeral interest, and certain of them are no longer in use, either because they have been found to be baneful, or because they have been superseded by others more convenient in use. As their names are to be found in modern pharmacological literature, and are presumably of interest to medical men, a catalogue of them, arranged alphabetically, may possibly be of some service. It must be admitted, however, that the information vouchsafed in the case of many of them is very meagre and not always authentic. Indeed, many of the titles in the book seem to be introduced for no other purpose than to direct attention to a trade advertisement.

The book may be of use in the counting-house of a manufacturer, but would be of very limited value to the specialist or the student of chemical technology.

Practical Plant Physiology. By Prof. F. Keeble, assisted by M. C. Rayner. Pp. xvi+250. (London: G. Bell and Sons, Ltd., 1911.) Price 3s. 6d.

BOTANICAL physiology is one of the most instructive branches of science, because it provides an excellent test of a student's capabilities and is particularly suitable for inculcating the spirit of original research. Both these objects are kept in view by the author of this practical text-book, where they supply the main undercurrent flowing below the more obvious stream of information conveyed in the text. The course outlined is also thorough and complete, as the student is led systematic ally by argument and experiment through the sequence of problems connected with plant nutrition.

Indeed, it will be speedily ascertained by those who start the course that the experiments indicated require considerably more time than is ordinarily devoted to this branch of botany; however, in this case there is no great objection to superfluity, as it is a simple matter to leave out those experiments considered to be less important. In the circumstances the author was well advised to touch only lightly upon the sensitivity of plants, which is discussed in the last chapter.

The general method of exposition is original, and a certain number of experiments, such as that devised by Dr. F. Blackman for illustrating the dependance of germination upon oxygen supply are additions to the courses generally followed in botanical laboratories. There is overmuch insistence on the correlation of guessing, reasoning, and trying, and perhaps a superabundance of chemical and physical tests. But these are minor matters of opinion, whereas there can be no question that the book is original, vigorous, and stimulating.

The Statesman's Year-Book. Statistical and Historical Annual of the States of the World for the Year 1911. Edited by Dr. J. Scott Keltie. Pp. lxxii + 1412. (London: Macmillan and Co., Ltd., 1911.) Price 10*s*. 6*d*. net.

THIS is the forty-eighth annual issue of a work of reference which has become indispensable to administrators, statesmen, and students of economics and geography. The volume has been thoroughly revised and brought up to date—a preliminary section of additions and corrections including the results of the 1911 census of the United Kingdom. A series of new maps is provided, and these include maps of the new projected railway routes to India; railways, navigable waters, and steamship routes; the new Liberian Boundary, 1909; the northern territory of Australia; and of the Panama Canal from the latest reports of the Isthmian Canal Commission.

Several sections of the book have been greatly improved—those dealing with Turkey, Spain, and China may be mentioned. Altogether this issue of the "Year-Book" will preserve the high reputation the work has secured, and the editor may well be congratulated upon his efforts to maintain the accuracy and usefulness of the volume.

Catalogue of the Serial Publications in the Library of the Manchester Literary and Philosophical Society. Compiled, under the direction of the honorary librarian, C. L. Barnes, by A. P. Hunt. Pp. vi + 177. (Manchester: Published by the Society, 1911.) Price 2*s*. 6*d*.

THE object of this catalogue is to make known the wealth of periodical scientific literature in the library of the Manchester Literary and Philosophical Society. The total number of current publications at present received by the society is 810, and they come from all parts of the world and cover every branch of science. The catalogue is excellently arranged, and is provided with an exhaustive index. It should be of great service to members of the society and to others engaged in scientific research.

The Lore of the Honey-Bee. By Tickner Edwardes. Pp. xx + 196. (London: Methuen and Co., Ltd., 1911.) Price 1*s*. net.

THE first edition of Mr. Edwardes's book on the bee was reviewed in the issue of NATURE for November 5, 1908 (vol. lxxix., p. 6). This fourth edition is a cheap re-issue of what has already proved a popular work; and, at its present price, such an interesting history of the folk-lore of the bee and account of its activities should become known to a wider circle of readers.

LETTERS TO THE EDITOR.

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

The Deformation of Rocks under Tidal Load.

I HAVE read with interest Prof. Milne's letter under the above title in NATURE of July 13, and congratulate him on the promising character of the results. As he himself remarks, the subject theoretically is not a new one. Its geophysical interest lies largely in the possibility of deriving information from the observed phenomena as to the elastic character of the earth's crust. Several difficulties, however, stand in the way of this information. The earliest mathematical treatment of the problem, so far as I am aware, is that by Sir G. H. Darwin, to which Prof. Milne refers. The problem which he actually solved relates to the effect of load on the surface of an elastic solid material which is *homogeneous, isotropic,* and *incompressible*. In ignorance of this solution, I obtained another[1] in 1896—a simple deduction from the important solution by Prof. Boussinesq for material bounded by an infinite plane—which is somewhat more general, in so far as it does not assume incompressibility in the material, but otherwise is subject to the same limitations. In practice, the most important of these limitations are probably the assumptions of homogeneity and isotropy. Very possibly, an expert mathematician familiar with recent developments of the mathematical theory of elasticity might have no serious difficulty in removing these restrictions in part or in whole. For instance, if a solution were obtained for the case where there is a relatively thin superficial layer differing in elastic quality from the remainder, it would immediately throw light on what is to be expected from differences in the surface strata.

The solution derived from Boussinesq's for the homogeneous solid is simple, the formula for the vertical component w of the elastic displacement at a point in the plane of the loaded surface being[2]

$$w=\{(1-\eta)/2\pi n\}\int\int(p/r)d\sigma,$$

where p is the normal pressure over the element $d\sigma$ of surface, situated at a distance r from the point where w is being measured, n denotes the rigidity, and η Poisson's ratio for the material, dw/dx gives the slope measured in the direction of the axis of x, supposed horizontal. We see at once that however complex the distribution of load may be, the slope varies directly as $1-\eta$, and inversely as n. For a given value of n it is 50 per cent. greater when Poisson's ratio is $\frac{1}{4}$—as it approximately is in steel—than when the material is incompressible.

There is, however, another aspect of the case that has to be taken into account. The influence of the tide does not consist solely of the pressure effect. At high-tide we have a large additional quantity of gravitating material, the attraction of which modifies the direction of gravity at the land station. If we compare the readings of a delicate spirit level at mid-tide and at high-water, there is an apparent change of level $\psi_1+\psi_2$, made up of ψ_1 due to the actual slope of the surface carrying the level, and ψ_2 due to the alteration in the direction of local gravity. Under the conditions postulated in my solution of the problem

$$\psi_1/\psi_2=2(1-\eta)g\rho a/3n,$$

where g is gravity, a the earth's radius, and ρ its mean density. The ratio varies enormously for values of η and n that exist in known materials. Thus we have, measuring n in grammes weight per sq. cm.,

$$\eta=0{\cdot}25,\quad n=80\times10^7,\quad \psi_1/\psi_2=\ 2 \text{ approximately},$$
$$\quad =0{\cdot}5,\quad n=11\times10^7,\quad \qquad =11 \quad ,,$$

The first thing to be considered is what does the instrument used actually record? Is it ψ_1 or $\psi_1+\psi_2$? In the latter event, unless ψ_2 is relatively negligible, we must

[1] See *Phil. Mag.*, March, 1897, p. 173.
[2] Proc. Physical Society, vol. xv., p. 36, and *Phil. Mag.*, *l.c.*, p. 177.

calculate it before we can arrive at the true bending effect. If the material is homogeneous and elastic, the vertical plane of steepest slope at any place contains the direction of the resultant gravitational force. But while the gravitational effect must be as instantaneous as gravity itself, the bending effect will show a lag unless the material is perfectly elastic, so far, at least, as tidal load is concerned. It is manifestly a case in which measurement of the apparent slope in two perpendicular planes is likely to add materially to knowledge. An estimate which I made in 1896 for the effect of tides in the Thames at Kew Observatory,[1] assigning the low value of 11×10^7 grammes weight per sq. cm. to the rigidity, and assuming the material incompressible, made the difference of the slope between extreme high- and low-water only of the order $0''\cdot05$, and so too small to be measured satisfactorily by the Milne seismograph at the observatory. CHARLES CHREE.

July 15.

Hamilton and Tait.

IT may at first sight seem a little ungracious to take exception to a statement in the extremely gratifying review of the "Life and Scientific Work of P. G. Tait," which "A. G." contributed to NATURE of July 13. But the point is one which brings out in a remarkable degree the great modesty of Tait in regard to his own achievements. Your reviewer says that Tait "was introduced by Andrews to Rowan Hamilton, at that time in the full tide of his quaternion work, and busy with the preparation of the 'Elements' for publication."

Now it is, I think, clearly established in the "Life," by means of quotations from Hamilton himself, that when the correspondence with Tait began Hamilton had stopped working at quaternions, that the correspondence drew Hamilton back to the study of his calculus, and that, as I put it in the "Life," p. 132, it was Tait "who fired Hamilton with the ambition to write his second great 'Treatise on Quaternions.'" This is proved by Hamilton's own words, quoted on p. 131 of the "Life." Since possibly many readers may not be interested in the quaternion side of Tait's activities, I take the liberty of reproducing this quotation here. Writing on January 21, 1859, Hamilton remarked :—

"As to myself I cheerfully confess that I consider myself to have, in several respects, derived advantage, as well as pleasure, from the correspondence. It was useful to me, for example, to have had my attention *recalled* to the whole *subject* of the *quaternions*, which I had been almost trying to *forget*; partly under the impression that nobody cared, or would soon care, about them. The result seems likely to be that I shall *go on* to write some such 'Manual,' not necessarily a very *short* one—as that alluded to in a recent paragraph."

It seems clear that without the Tait correspondence, Hamilton would never have undertaken the second treatise. This was one of the discoveries which I was privileged to make when the correspondence was committed to my care. To me it was a very surprising discovery. I had often conversed with Tait about his relations with Hamilton—and he was critical as well as appreciative in these reminiscences—but I never heard him say anything as to the part he played in the first beginnings of the "Elements." In his own writings, such as the prefaces to the successive editions of his treatise, or the biographical notices he wrote of the great Dublin mathematician, Tait had ample opportunities of telling the story of his intimate connection with Hamilton's second treatise. But not the least hint was ever given. It may be that Tait felt his hands tied because of the absence of any reference in the "Elements" to the correspondence. But we must remember that Hamilton did not live to complete his work or to write more than the merest fragment of a preface. Now that we know the truth from Hamilton's own letters, the whole episode is a fine example of Tait's modesty, and even self-effacement, in regard to his influence in shaping scientific development. The story throws such a beautiful light upon the character of Tait that I am sure your reviewer will thank me pointing out the one slight inaccuracy in an otherwise perfect review. C. G. KNOTT.

Edinburgh University, July 17.

The Fruiting of the Tamarisk.

THIS exceptional season is having strange effects on many of our native plants and animals, and naturalists would do well to note these before it is too late.

For many years I have tried without success to find *Tamarix anglica* in fruit in Britain. The absence of fruit, and the rarity of the tamarisk except where obviously planted, seemed to support the idea that it was of fairly modern introduction.

A few years ago, however, fragments of rope, found in Roman Pevensey and sent to Kew, were pronounced to be formed in part from the inner bark of tamarisk. This seemed to favour the inclusion of the tamarisk in the British flora, though rope found in a Roman seaport may quite well have been manufactured abroad.

This season the negative evidence yielded by the absence of seed has also broken down; and if a plant seeds once in its lifetime, it may hold its own and establish its right to a place in our flora—as the Cornish elm has done.

I planted last spring some young tamarisks on a steep bank of loose sand in my garden at Milford. During the long drought they received no water; they are now seeding freely, and the winged seeds are being dispersed by the wind. If the plant reproduces itself from these seeds, sown under natural conditions, the cycle will be complete; but the garden is a quarter of a mile from the sea, and the test may be too severe a one.

Tamarisk is essentially a desert and sea-coast plant, and it would be worth while to examine any tamarisks growing on sand-dunes, to see whether they also are seeding, and to see whether seedlings come up. Possibly the tamarisk may be a survivor from times when desert or "loess" conditions extended over western Europe. We have found the fossil remains of many of the desert animals, but plants decay in porcus deposits of dust, and desert plants are seldom washed into ordinary alluvial deposits. CLEMENT REID.

Milford-on-Sea, Hampshire.

Sunshine and Fleas.

ARISTOTLE (H.A. viii. 605*b*) makes the following curious and perplexing statement :—*πάντα δὲ τὰ ἔντομα ἀποθνήσκει ἐλαιούμενα· τάχιστα δ', ἄν τις τὴν κεφαλὴν ἀλείψας ἐν τῷ ἡλίῳ θῇ.* That is to say : "All insects die if they be smeared over with oil; and they die all the more rapidly if you smear their head with the oil and lay them out in the sun." So Pliny, Albertus Magnus, and recent commentators read and interpret the passage. But in the former half of the sentence, for *ἐλαιούμενα*, several MSS. read *ἡλιούμενα*: *i.e.* not "if they be smeared with oil," but simply "if they be exposed to the sun"; while in the latter half there is an obvious ambiguity, which inclines me to think that *τὰ ἔντομα* is used *sensu restricto,* and that *τὴν κεφαλὴν* refers, not to the insect's head, but to the experimenter's.

I take it, in short, that the heat of the sun was the main agent recommended for the destruction of the insects, and it is interesting to find this agency again coming into practical use for a very similar purpose. One of the latest of the Indian Medical Department's "Scientific Memoirs," by Capt. J. Cunningham, is entitled "On the Destruction of Fleas by Exposure to the Sun." The writer recommends the wholesale disinfection of clothing and baggage, for the special purpose of destroying plague-carrying fleas, by the simple process of laying out the garments or bedding on a sandy floor, exposed to the full rays of the sun. The author has made many careful and elaborate experiments, and has succeeded in showing that in less than an hour's time, under an Indian sun, the fleas are all dead.

D'ARCY W. THOMPSON.

The Oban Pennatulida Again.

MARINE biologists may be interested to hear that the bed, near Oban, of the largest British pennatulid *Funiculina quadrangularis,* and the smaller *Virgularia mirabilis* described by Mr. W. P. Marshall and the late Prof. Milnes Marshall in 1881 or 1882 (I have no books of reference with me) is still apparently in very flourishing condition. In a couple of hauls of the small Agassiz trawl, from this yacht yesterday, between the islands of Kerrera and Lismore, at depths of eighteen to twenty fathoms, I got about a dozen fine specimens of Funiculina, the largest of which measured nearly four feet in length. The bed must be of considerable extent, as the hauls were not on the same spot, and both brought up equally good specimens of these magnificent pennatulids. Most of the large specimens of Funiculina, by the way, were not caught in the trawl-net, but were balanced across the front of the frame, at each end, in such a precarious position as to make one wonder how many others had been lost in hauling in. The bottom deposit was evidently fine mud. W. A. HERDMAN.

S.Y. *Runa*,
Sound of Iona, July 11.

On the Non-simultaneity of Suddenly Beginning Magnetic Storms.

IN his paper "On the Supposed Propagation of 'Equatorial' Magnetic Disturbances with Velocities of the Order of a Hundred Miles per Second," read before the Physical Society of London, November 11, 1910, and published in the Proceedings of that society, vol. xxiii, pp. 49–57, Dr. Chree, in reviewing my paper published in the *Journal of Terrestrial Magnetism* (vol. 15, pp. 93–105), expressed some doubts as to my views on the subject of the non-simultaneity of suddenly beginning magnetic storms.

It seems to me that there should not be any doubt as to my position on this point when I stated in my above-mentioned paper (*loc. cit.* p. 103) that the evidence there presented confirmed what Dr. Bauer had stated, namely, that magnetic storms do not begin at the same instant all over the world, and added a little further on that a new view-point in the discussion and analysis of magnetic storms is thus introduced, meaning that a new view-point must now be had on account of this non-simultaneity of the occurrence of the beginning of the storms which, I believe, the data shows to exist.

I agree with Dr. Bauer in his conclusion that the abruptly beginning magnetic storms are not simultaneous all over the world, and this conclusion, it seems to me, is supported, not only by the data in my paper, but by that in his paper which appeared prior, and in that which has appeared subsequent, to mine. R. L. FARIS.

U.S. Coast and Geodetic Survey,
Washington, D. C.

The Number of Possible Elements and Mendeléeff's "Cubic" Periodic System.

ACCORDING to Rutherford's theory of "single scattering" ("On the Scattering of α and β Particles by Matter and the Structure of the Atom," *Phil. Mag.*, May, 1911), and to Barkla's "Note on the Energy of Scattered X-Radiation" (*ibid.*), the numbers of electrons per atom is half the atomic weight; thus, for U, about 120. Now, a reconstruction of Mendeléeff's "cubic" periodic system, as suggested in his famous paper "Die Beziehungen zwischen den Eigenschaften der Elemente und ihren Atomgewichten" (*Ostw. Klass.*, No. 68, pp. 32, 36, 37, and 74), gives a constant mean difference between consecutive atomic weights =2, and thus, from H to U, 120 as the number of possible elements (van den Broek, "Das Mendelejeff'sche 'Kubische' Periodische System der Elemente und die Einordnung der Radioelemente in dieses System," *Physik. Zeitschr.* 12, p. 490). Hence, if this cubic periodic system should prove to be correct, then the number of possible elements is equal to the number of possible permanent charges of each sign per atom, or to each possible permanent charge (of both signs) per atom belongs a possible element. A. VAN DEN BROEK.

Noordwijk-Zee, June 23.

Phases of Evolution and Heredity.

I SHOULD like your reviewer of the above book in NATURE for May 25 to consider the following points:—

1. In a tall-dwarf crossing where the results are read in plants, the ultimate ratios considered as due to a probability combination of the egg-cells and pollen grains the influence of which necessarily ends within a generation, explain why we do not get the ratio in the plants coming out in F^1.

2. To my query, "How is the recessive element expressed in F^1? It has not disappeared as it reappears in F^2 unaltered. It is not expressed in the 'soma' of the plant: where is it?" your reviewer answers "In the germ-cells."

If, however, the determinants of the recessives are expressed in the germ-cells, *i.e.*, in the propagative part of the plant, so must those for the impure dominant and dominant plants. These plants segregate in a 1:2:1 ratio, and therefore the determinants for the contrasted unit-characters must be in that ratio in the propagative part of the oospores. Does the reviewer not admit the accuracy of my view after all? D. BERRY HART.

5 Randolph Cliff, Edinburgh.

I FIND it very difficult to follow Dr. Berry Hart. If he means, by the question which concludes his letter, to ask whether I accept his theory as truly representing, once and for all, the causes which determine the Mendelian ratio 1:2:1, my answer is an unqualified negative; not because I think I know what the true theory is, but because I do not think the time is yet ripe to formulate it. Dr. Hart's theory is evidently different from the accepted Mendelian theory; and it may be nearer the truth. Whether it is or not, further experiment alone can show. THE REVIEWER.

Available Laboratory Attendants.

THE London County Council has for some time been referring to us a certain number of boys who have been trained as laboratory attendants in their higher grade and secondary schools, and whose services they are unable to retain after they have attained seventeen years of age. We are anxious to find suitable vacancies either in chemical works or laboratories for these boys, who are of a distinctly superior type and some of whom have profited by their experience to pass the Board of Education examinations in inorganic chemistry.

Some of these boys who were placed by us, thanks to a letter published by you last year, are doing well and giving satisfaction to their respective employers.

Should any of your readers, now or at any future time, have a vacancy for such a lad, I should be glad to hear from him.

G. E. REISS, *Hon. Sec.*

Apprenticeship and Skilled Employment Association,
36 Denison House, 296, Vauxhall Bridge Road,
London, S.W. July 6.

Mersenne's Numbers.

I DESIRE to announce the discovery which I have made that $(2^{181}-1)$ is divisible by 43441. This leaves only 16 of the numbers $(2_q - 1)$ originally reported composite by Mersenne, still unverified. I have submitted my determination to Lt.-Col. Allan Cunningham, R.E., who has kindly verified it.

It is interesting to know that while $(2^{181}-1)$ is divisible by 43441, the quotient when divided by this number (43441) leaves a remainder 21839. This latter result has been verified by two divisions.

HERBERT J. WOODALL.

Market Place, Stockport, June 12.

The Fox and the Fleas.

SOME readers of NATURE may be interested in seeing the following passage from one of Liebig's letters to Wöhler, dated Giessen, June 24, 1849, as showing that the story has long been familiar, at least in Germany:—

"Das freiheitsmörderische Gesindel ist nun, wie beim Fuchs die Flöhe in dem Bündel Heu, in einer Schlinge gefangen . . .," &c. WILLIAM A. TILDEN.

The Oaks, Northwood, Middlesex, July 10.

Cabbage White Butterfly.

WOULD some entomologist state if he knows of any reference to the fact that the larvæ of the Large Cabbage White seek to arrange themselves in pairs—male and female—when they pupate?

Can the sexes be distinguished externally in the larval and in the pupal stages? E. W. READ.

Sutherland Technical School, Golspie.

NOTES ON THE HISTORY OF THE SCIENCE MUSEUM.[1]

II.

IN the former notes I referred to the early history of the Patent Museum.

By 1874, in consequence of the acts of the Commissioners of the 1851 Exhibition, land for the proper display, on the one hand, of objects chiefly illustrating art and its application to industry, and, on the other, of objects illustrating natural history, had been provided, and buildings for these purposes, as well as a School of Science, had been commenced. But for the Patent or Science Museum, no building had been erected on the five acres assigned to it by Lord Palmerston on the land bought in 1863.

In this year the question of museums was considered by the Duke of Devonshire's Commission, and the collections at South Kensington were inquired into. The question of the Patent Museum was specially considered, and it was pointed out that objects illustrating patents should find their true place among those dealing with the advance and applications of the physical and mechanical sciences.

As a result of this inquiry, the Duke of Devonshire's Commissioners recommended to the Government the establishment of what they were the first to call a Science Museum, in which was to be included not only patented objects, but those necessary to illustrate the advances of both pure and applied science. I give the following extract from their fourth Report:—

"81. While it is a matter of congratulation that the British Museum contains one of the finest and largest collections in existence illustrative of Biological Science, it is to be regretted that there is at present no National Collection of the Instruments used in the investigation of Mechanical, Chemical or Physical Laws, although such collections are of great importance to persons interested in the Experimental Sciences."

"82. We consider that the recent progress in these Sciences and the daily increasing demand for knowledge concerning them make it desirable that the National Collections should be extended in this direction, so as to meet a great scientific requirement which cannot be provided for in any other way."

"83. The defect in our collections to which we have referred is indeed already keenly felt by teachers of Science. If a teacher of any branch of Experimental Science wishes to inspect any physical instrument not in his possession, as a teacher of Literature would a book, or a teacher of Biology would a specimen, there is no place in the country where he can do it."

"93. We accordingly recommend the formation of a Collection of Physical and Mechanical Instruments; and we submit for consideration whether it may not be expedient that this Collection, the Collection of the Patent Museum, and that of the Scientific and Educational Department of the South Kensington Museum, should be united and placed under the authority of a Minister of State."

Here then we find the definition of a "Science Museum" as resulting from all the inquiries made by the Duke of Devonshire's Commission. Their statement regarding its organisation under a Minister of State was evidently inserted, because in another Report they pointed out the importance of the whole National Museum system being under a Minister of State, instead of being in two water-tight compartments, one of them controlled by a body of Trustees without Government responsibility.

This is too large a question to be entered upon in these notes, but it may be pointed out that if this recommendation had been acted upon the recent discussions would never have arisen.

A step was at once taken by the Government to facilitate the carrying out of these recommendations, and a loan collection of scientific apparatus was brought together in 1876, as an object-lesson of what such a Science Museum might be in relation to the "Patent Museum," arranged for by Lord Palmerston in 1863, which would form part of the new museum. Still no steps were taken to commence the building.

The building of the new Natural History Museum, however, was proceeding; it was finished in 1880. It has been shown that the land allotted for natural history purposes by Lord Palmerston was five acres. The completed museum building covered nearly four acres, and was erected in the centre of a space of about eleven and a half acres, fenced off from the remainder of the sixteen and a half acres purchased in 1863, in such a manner as to make it difficult to apply the eight acres not built over to any other service, or even to expand largely the museum itself without injury to its architectural features. As to how this state of things, so different from that to be gathered from Lord Palmerston's speech, came about I have no information.

The recommendations of the Duke of Devonshire's Commission touching a Science Museum had much influence in leading the Commissioners of the 1851 Exhibition to adopt proposals for the future appropriation of their estate.

Even while the loan collection of scientific apparatus in 1876 was indicating the national importance of such a museum as the Duke of Devonshire's Commission had suggested, the 1851 Commissioners began their proposals to bring it into being by offering to endow a Science Museum with money and land.

I quote from the sixth Report (p. 41) the action taken in 1876:—

"Influenced by these considerations, and by the regrets expressed by the Royal Commission on Scientific Instruction, in their Report already quoted, we concluded that there could be no more appropriate employment of a portion of our resources than to expend them on a building on our own Estate, for the advancement of scientific study and research, and, in connection with the South Kensington Museum, to receive the important contributions of instruments which we understood would be made to the nation at the close of the Loan Exhibition already alluded to.

"We, therefore, proposed to Her Majesty's Government that 100,000*l*. of the amount we might realise, or might be enabled to raise on ground-rents, should be devoted to the furtherance of the recommendations of the Royal Commission on Scientific Instruction by erecting, on a site opposite the Government Science Schools, a building suitable for a Museum of Scientific Instruments, or for a Library of Scientific Works, and for laboratories of scientific research and instruction. And we made this offer on condition that the Government would undertake to maintain the building, when erected, in the manner proposed. The site referred to is partly our property and partly the property of the Government, and we suggested that, in exchange for a conveyance of the part belonging to us, the Government should return to us two small portions of the site of the Exhibition of 1862, which project into our main square."

The proposal then was very similar to the present one, utilising the land to the north of the Natural History Museum building.

Events, however, indicated that the Commission's land to the north of the plot first proposed would be a more convenient site for the Science Museum, and a second letter was addressed to the Govern-

[1] Continued from p. 16.

ment in 1878, in which the Commission again offered to convey land and to provide 100,000*l.* for a Science Museum to be built on a plan to be approved by the Government.

The view of the Commission is thus expressed in their sixth Report (p. 44):—

"*The proposed new building would complete the group of buildings already erected by the Commission, and these . . . would alone satisfactorily realise the first conception of the illustrious Prince who conceived the idea of purchasing the estate.* Should the Government eventually acquire also the ante-garden for the extension of the Science building now proposed, or for other public buildings, and thus connect our direct work with the Natural History and the South Kensington Museums, *the success of the plans of the Prince Consort would be complete.* The national collections of Mediæval and Recent Art would have their home on the portion of the Estate purchased with the funds derived from the Exhibition of 1851 which lies on the east of Exhibition Road; the Science collections on the portion of the Estate which lies on the west of that road."

This offer was declined by the Government in 1879 on the ground of the depression of trade, and that the establishment of such a museum was not sufficiently urgent!

After this the Commissioners took no further action with regard to the Government until 1888. In the meantime, however, they had granted land for the erection of the City and Guilds Institute and the Imperial Institute.

In a letter of 1888 the land to the south of the Imperial Institute Road, reaching to the land conveyed to the Government in 1864, was offered under the old conditions, namely, "that the land shall be permanently used for purposes connected with Science and the Arts." This plot consisted of 4½ acres, valued at 200,000*l.* It was offered to the Government for 70,000*l.*, and the contained southern gallery (already leased to the Government) for 30,000*l.* This offer was accepted.

In the year 1907, in spite of the Commissioners' repeated efforts, we had no Science Museum, and the Commissioners had no more land to offer.

All that remained in 1906 was given to the governing body of the Imperial College of Science and Technology, the new institution which is to bring together all the colleges already built, and to be built, on land presented, or sold at reduced value, by the Commission for scientific purposes.

The existing buildings are the College of Science, the site of which was given gratis; the City Guilds' College, the site of which is rented at one shilling per annum; and the new Chemical and Physical Laboratories of the Imperial College, on a site sold by the Commission at less than half its value.

It may be said that, adding the value of these old plots to that of the three given in 1906, the Commission has really endowed the new institution to the extent of some 400,000*l.*

But if a Science Museum was desirable before such a bringing together and extension of science teaching and research as the new institution affords, it is vastly more important now, when advanced research in the applications of science to the national industries is to be fostered along new lines. The opinions of those most competent to judge of the national importance of a Science Museum thirty years ago can be gathered from an appendix to the Commissioners' sixth Report (p. 130), in which is printed the memorial addressed to the Lord President of the Council in 1876.

Such a museum is vastly more important now, but its location at South Kensington, in close contiguity to the Imperial College, has become imperative.

In 1907, mindful of what the Commission of the 1851 Exhibition had attempted to do during the whole time of its existence up to that time in furtherance of the completion of the National Museum organisation, I considered it my duty to call the attention of the Commissioners to the fact that practically the whole of the land belonging to them had been allocated, and that, so far, no proper provision had been made for a Museum doing for the Physical, Chemical, and Mechanical Sciences what the British Museum Library does for books, the Galleries for Antiquities, the National Gallery does for pictures, and the Natural History Museum does for the Biological Sciences.

In a memorandum to the Commissioners urging the early erection of such a museum I wrote:—

"How, then, can its early erection be brought about? I submit by holding out a special inducement to the Government to utilise in this direction some part of the land sold to the Government in 1888 still waste between the old and new buildings of the College of Science and adjacent thereto.

"The importance of the eastern part of this site for the purpose I have indicated has long been recognised. In 1891 it was ignorantly offered by the Government to Mr. Tate for an art gallery, but when the facts had been inquired into, the offer was withdrawn by the then Chancellor of the Exchequer, Mr. Goschen. Both in a memorial presented to Lord Salisbury and by a deputation to the Lord President of the Council and the Chancellor of the Exchequer it was pointed out that were the corner site in question not occupied by the science collections the teaching in the Royal College of Science would be cut in two when the new laboratories were erected (they have been erected since). On this ground the Government withdrew the offer to Mr. Tate, and reserved the site for future science buildings.[1]

"The frontage of this plot, which indeed is the last important and considerable *frontage* remaining, is in Exhibition Road, stretching from the Natural History Museum grounds to the Imperial Institute Road. It lies exactly between the old and new Royal College of Science buildings.

"I may add that the frontage available in Exhibition Road is over 360 feet; that is, 60 feet longer than the west frontage of the Victoria and Albert Museum, and only 17 feet shorter than the frontage of the new buildings of the British Museum. . . .

"Were this building erected, all the ground once possessed by the Commissioners along Cromwell Road and to the south end of Exhibition Road would have been utilised for the purposes of Science and Art, Art on the east side, and Science on the west side of Exhibition Road, as was originally planned.

"Were the southern galleries—the old Exhibition refreshment rooms—taken down, and the dangerous spirit museum removed to a safer site, such as the Natural History Museum Gardens, some distance west of the main building, there would be a space of more than four acres between the Natural History Museum and the Chemical and Physical Laboratories, and stretching from Exhibition Road to Queen's Gate, not only with the frontage to which I have referred, but another in Queen's Gate. Here, indeed, it would be possible, as a variant of the plan I have suggested, to erect a Science Museum similar to the one offered by the Commissioners to the Government in 1878, and indicated on their plan. Much of this land is not at present permanently occupied, and the Solar Physics Observatory is under notice to quit, a new site at Caterham having already been fixed upon.

"It seems desirable that this long-standing question of a Science Museum should be again discussed, and

[1] Accounts of what took place will be found in NATURE, February, 1891, and March, 1892, vols. xliii. and xlv.

without delay, because if any buildings are erected on the spaces referred to, any such Science Museum as the Commissioners have had in contemplation during the last thirty years, for which they have freely given their land and offered money, will be impossible of realisation, to say nothing of future extension.

"I have reason to think that if the Commissioners would again take up the question, remind the Government of their continuous action and appeal to the Government to consider the matter, such an appeal would be received sympathetically. If such an appeal could be accompanied by the renewal of the offer, already twice made, to provide a money contribution towards the building, the matter would, of course, become still more hopeful.

"The last Annual Report shows that the Commissioners have in hand funds available for such a purpose, and, speaking as a Commissioner, I can conceive no more worthy expenditure, as it will give full effect to the great purposes the Commissioners have had in view during the whole time they have been engaged in carrying out the late Prince Consort's wise advice as to the best use of their property in the nation's interest."

In 1910 the Commissioners took action in the matter. In the "Further Correspondence" already referred to [Cd. 5673] is given a letter (June 25, 1910) from the Secretary:—

"The Board of Management of the Royal Commission for the Exhibition of 1851 have recently had before them a proposal to establish at South Kensington a permanent building for the accommodation of the National Science Collections. . . .

"Believing that the application to such an object of a portion of their surplus funds would be consistent with the declared policy of the Commissioners, they have resolved to recommend to the Commissioners a repetition of their former offer of 100,000*l.* towards the expense of providing a Museum, subject to their being satisfied that his Majesty's Government are prepared to make provision, so as to secure the erection of an adequate building."

On August 25, 1910, the Treasury accepted this offer. While this correspondence was going on the Office of Works was writing to the Trustees of the British Museum with regard to the Northern Boundary, a subject dealt with in the previous notes.

We now learn from *The Times* report of Mr. Runciman's speech on the Education vote (July 13, 1911) that at last some compromise has been arrived at.

"Since the first announcement was made about the site of the Science Museum I have entered into negotiations with the Trustees of the British Museum, and we have now arrived at an agreement which will give us the land we require for the Science Museum and will not interfere with the development of the Natural History Museum, so that we shall have in South Kensington a group of museums which will be the envy of foreign nations." NORMAN LOCKYER.

THE ROYAL COMMISSION ON TUBERCULOSIS.

THE Reports of Royal Commissions are as a rule based almost entirely on summaries of oral evidence submitted by authorities, expert or otherwise, on the subjects with which these Commissioners have been called together to deal. Such Commissions can be expected to give little more than a *résumé* of what is already known.

In the Final Report of the Royal Commission on Tuberculosis (Cd. 5761; price 6*d.*) it is soon made manifest that here something more than personal opinions of even the most eminent authorities have been brought together. The very genesis of the Commission made this necessary. The greatest living authority on the subject of tuberculosis, Robert Koch, had for long taught that tuberculosis was a disease common to animals and man, a disease induced by a specific micro-organism, the tubercle bacillus. Of this micro-organism there might be varieties in which the virulence or disease-producing activity might be higher in one and lower in another, but they were still essentially and specifically the same wherever they were found in the tuberculous lesions, whether of man or of animals.

At the International Congress held in London in July, 1891, Koch had turned round (perhaps not suddenly, though the announcement of the *volte face* had come with startling suddenness) and had announced that the tuberculous disease of cattle was not the same thing as tuberculosis of the human subject, and that the tubercle bacillus found in the tuberculosis of cattle was non-virulent for man.

The experimental work on which this statement was based was considered by many of the scientific men who heard the pronouncement to be totally inadequate to bear the wide generalisations founded upon it.

Lord Lister, the late Prof. Nocard, Prof. Bang, Sir John McFadyean, Dr. Sims Woodhead, and others were in agreement that the statement, if true, would revolutionise our whole attitude to the tuberculosis problem, and that before it could be accepted independent and corroborative evidence must be obtained.

Sanitarians in the United States appreciated the importance of this to the full, and the morning after Koch's address was given a telegram was received in London from Washington stating that the tenor of the address had been noted, and that arrangements, financial and otherwise, had been made to carry out experiments to test the trustworthiness of Koch's thesis.

Although a resolution asking the British Government to appoint a Royal Commission had been carried at the meeting of the Executive Committee, the business of the closing meeting of the Congress had been practically concluded, and no resolution asking for this Commission had been brought forward, and none could be found. One or two members of the Executive Committee, however, had carried the terms of the Resolution in their memories, they were hurriedly committed to paper, and the matter was placed before the meeting. Lord (at that time Sir James) Blyth had made a most generous offer to place a farm or farms at the disposal of any Committee or Royal Commission appointed, and it was evident that any such Commission set to work to inquire into the question would be able to carry on its investigations under most satisfactory conditions.

In these circumstances the Right Honourable Walter Long, M.P., then President of the Local Government Board, advised her Majesty Queen Victoria to appoint a Royal Commission with instructions to inquire and report with reference to tuberculosis:—

1. Whether the disease in animals and man is one and the same.
2. Whether animals and man can be reciprocally infected with it.
3. Under what conditions, if at all, the transmission of the disease from animals to man takes place, and what are the circumstances favourable and unfavourable to such transmission.

The Commission appear to have laid down a very definite plan, from which there has been no deviation. It was asked to inquire and report on the above questions. No inquiry except an actual experimental investigation seemed to give promise of any trustworthy results, and the scheme of work did not include the taking of oral evidence.

The answers to the questions, though very guarded in many directions, are, where the Commissioners have made up their minds, clean cut and definite. No pretence is made to answer any questions but those contained in the reference, and anyone going to this Report for general information on the subject of tuberculosis generally will come away greatly disappointed, but on the questions the Commission was asked to answer the expert will find ample material for thought.

Is the disease in animals and man one and the same? Before this question could be answered the Commissioners had apparently to satisfy themselves that the tubercle bacilli found in animals (especially bovine) and man (*a*) were the same, morphologically, culturally, and pathogenetically; or (*b*) they differed in one or other or all of these aspects, and, if they differed, whether any modification of these aspects ever occurred under either natural or artificially produced conditions.

The conclusion at which the Commissioners arrive is that it is practically impossible to differentiate the bacillus found in the bovine animal suffering from tuberculosis from that found in certain cases of tuberculosis in the human subject. The bacilli are alike in every respect—morphology, cultural characters, and virulence. In the human subject, however, especially in cases of pulmonary tuberculosis, a type of tubercle bacillus occurs which, though resembling morphologically that found in bovines suffering from tuberculosis, differs considerably in cultural characters—*e.g.*, rate of growth on artificial media and in virulence. Both types produce rapidly progressive tuberculosis in the human subject and certain other animals, but only one, the bovine type, is specially active when introduced into the bovine animal. It is obvious, then, that wherever a tubercle bacillus is found, it may set up tuberculosis in the human subject, whatever it may be able to do in the cow. Moreover, the disease, when set up in the human subject, always runs much the same course, whether the exciting agent in its production is the one form of the bacillus or the other.

The answer to the second term of reference—"Whether animals and man can be reciprocally infected with it"—follows as a kind of corollary. There is ample evidence put forward to prove that many cases of fatal tuberculosis in the human animal (usually in children) have been set up by the bacillus proved to have been the cause of the disease in bovines. On the other hand, the type found naturally only in the human subject appears to set up in the bovine merely a non-progressive tuberculosis. It was found, however, that adult human beings are sometimes infected by the tubercle bacillus of bovine type, even the lungs becoming involved, whilst it is evident from recorded experiments that cattle have not by any means complete insusceptibility to the attacks of the tubercle bacillus of human type. These facts are of primary importance when, as is evident from the work recorded, there are such gradations in all the differentiating characters in many of the strains of bacilli separated from ordinary cases of tuberculosis in the human subject—a gradation that becomes even more marked and important in the groups of bacilli isolated (*a*) from the lesions in cases of lupus and (*b*) from the tuberculous in the horse.

Granting that the foregoing may be accepted, it follows that the third term of reference concerning the conditions under which transmission of the disease from animals to man takes place can only be answered through a study of the susceptibility (*a*) of the animal and (*b*) of man. The susceptible individual, whether brute or human, will be most affected, and by the widest range of tubercle bacilli as regards gradations of virulence. Each individual affected will constitute a centre of infection, and the greater the number of these susceptible individuals exposed even to "weak infections," the greater the chance of further transmission of the disease. It would appear that residence of a tubercle bacillus in any animal or series of animals for a considerable length of time may increase the virulence of that bacillus for the special species in which it is "cultivated." This certainly occurs in connection with other micro-organisms—*e.g.*, the pyogenic streptococci and certain forms of micro-organisms giving rise to septicæmic processes—still no direct evidence is adduced by the Commissioners that this takes place in connection with the tubercle bacilli, though in the course of their work they came across an enormous variety of grades of virulence in the tubercle bacilli from various sources in man and the lower animals. The bovine type of bacillus occurs with such frequency in children, especially in sites connected with the alimentary canal, that it seems impossible to ignore the causal relationship between tubercle bacilli found so frequently in the milk given by tuberculous cows and the tubercle in the child; whilst, on the other hand, the tubercle bacilli usually associated with pulmonary tuberculosis in the adult human subject being of the human type, have probably passed through a number of men and women, one transmitting it to the other in direct succession.

During the few days that have elapsed since the appearance of the Report some criticism has been directed against it on the ground that all the moot questions concerning tuberculosis have not been answered. This is surely unreasonable, as it cannot be too clearly recognised that the reference to the Commissioners was exceedingly closely defined. They had no authority or power to go beyond this reference. Indeed, the time—ten years—required for the elucidation of the special questions referred to them gives a definite indication of the propriety of the limitations imposed upon and accepted by the Commission.

Many and most important questions bearing on the cause and cure of tuberculosis have still to be answered. This can be done only by well-trained men working on an organised plan, co-operating whole-heartedly for a considerable period, and well supplied with financial means, facilities, accommodation, and equipment. That some organised scheme of work will be devised can now scarcely be doubted, and it is to be hoped that it will be adequately supported by Government. Such legislation has long been under consideration, and it may be that it has been held back until the appearance of this Report. Now, *bis dat qui cito dat*.

Although the Commissioners make no direct recommendation as to legislation, anyone who reads their Report can have little doubt as to their opinion on this matter, and we feel satisfied that those in high places will realise that in bringing forward such legislation as may be necessary to ensure a pure milk supply, their hands are greatly strengthened by the findings here recorded.

The Commissioners were evidently splendidly served by the Secretary and by their staff of scientific assistants, as they insist very strongly on the value of the services rendered by these gentlemen in the carrying out of the scheme of work planned at the outset.

In conclusion, it may be pointed out that one name not hitherto mentioned in connection with the formation of this Commission is that of Sir Herbert Maxwell, who, during the Congress and until the completion of the arrangements for the Commission, planned carefully and worked indefatigably to get together a thoroughly representative Commission.

THE GYROSTATIC COMPASS.[1]

MESSRS. ELLIOT BROTHERS, the English makers of the Anschütz gyro compass, are to be congratulated on the publication of an admirable account of the principle, construction, and practical use of this, the newest and most marvellous of all applications of the gyrostatic principle to a useful purpose. This book is chiefly translated from the German publication by Anschütz and Co., but the more mathematical part, due originally to Herr M. Schuler, has been modified by Mr. Harold Crabtree and Mr. Alfred Lodge so as to be more in accord with English mathematical usage. Commander Chetwynd and Commander Marston have also assisted in making those parts which deal with practice as useful as possible. With such skilled collaboration and with so admirable an original to work upon, it is not surprising that the result is so charming and instructive.

A gyrostat may be supported so that it has three (angular) degrees of freedom, or so that it has only two, one angular motion being constrained. With three degrees of freedom and really perfect balance the axis of rotation would maintain itself indefinitely in space and so the axis of rotation, if it were set parallel to the earth's axis, for instance, at any time and place would, rotation being maintained, retain that parallelism indefinitely, and show both latitude and the ship's course. The trouble is partly the difficulty of obtaining sufficient gyrostatic stability, but chiefly the impossibility of obtaining a really perfect balance, and so, however small the turning couple due to want of balance may be, precession will be set up and a cumulative error will grow and make the indications useless. If, however, the axis of a gyrostat is subjected to an elastic constraint tending to keep it level, but allowing it to tilt in spite of the constraint, and if, further, the gyrostat is supported so that no couple acts upon it in azimuth as resulting from the support, then with sufficient gyrostatic capacity the whole combination cannot rest in any position except that in which the axis is pointing north and south very nearly, and the direction of rotation is in the same direction as that of the earth. For if the axis should be in any other direction the rotation of the earth will, through the elastic constraint, tend to elevate one end of the axis and depress the other, and under this constraint the axis will precess towards the north and south direction. When, however, this direction is reached, the axis will be neither exactly level nor at rest, and the motion would, like a pendulum, continue as far to the other side if some system of damping were not introduced.

In the Anschütz gyro compass the gyro wheel is supported by a hollow steel ring immersed in mercury and with the centre of flotation a little above the centre of gravity, thus giving the necessary elastic constraint to the axis. The whole floating system (Fig. 1) is located by the compound piece, S, T, the two parts of which serve as two electric poles communicating with a three-phase motor within the gyro wheel A in the casing B. The compass card, R, is carried by the casing B. The third electric pole is supplied by the mercury, Q, and floating hollow ring, S, of steel. The whole case for the mercury, K, is carried on gymbal rings, like an ordinary compass. The gyro wheel, A, is run at a speed of 333 turns a second, and is subject to a bursting stress of 10 tons per square inch. Its axle, like that of a de Laval turbine, is sufficiently flexible to enable the wheel to establish its own dynamical axis, and it is supported on ball bearings of the highest perfection.

Beautiful as the invention is, closely as the material and construction approach perfection, perhaps no detail affords such a pleasing surprise as the system by which the damping of the motion, to which reference has been made, is effected. Side holes are provided in the casing, A, for the admission of air, and at the bottom there is a tangential opening through which a blast of hot air escapes. As something like

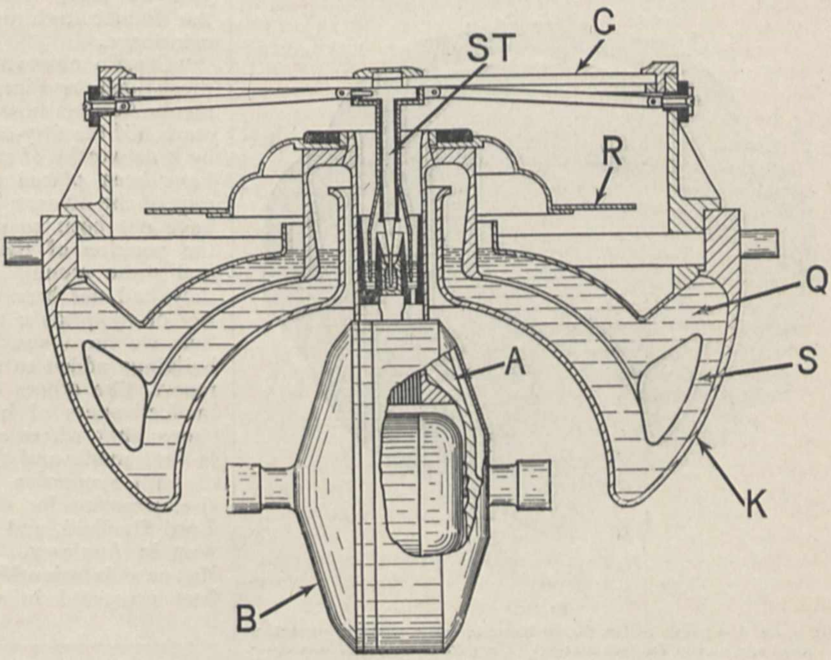

FIG. 1.—Vertical section through the centre of the gyro compass as constructed for use on board ship.

half a horsepower is being absorbed within the casing, this air circulation affords the necessary cooling. The orifice, *a*, *b* (Fig. 2), for the escape of air is partly covered by a shutter, *u*, carried by a pendulum, so that when the gyro axle is horizontal the escape of air is symmetrical on either side of the shutter, but when it is inclined the escape of air is greater on that side on which the axle is elevated. The reaction due to the increased escape of air on one side tends to turn the casing round opposing the precession, and so bringing the axle towards the horizontal position. It therefore comes about that each excursion of the axle is only about one-fifth of the previous one in the opposite direction, and in about three hours from starting with axle level and 45° east or west, it has settled down steadily to its position of rest almost exactly due north and south.

Almost exactly, but not exactly; not that there is any vagueness as to the point of rest, but because there are certain corrections, a latitude correction, with which the little weight, *t*, has to do, and which

[1] "The Anschütz Gyro Compass. History, Description, Theory, Practical Use." Pp. ii+109. (London: Elliott Brothers, 1910.)

can be made thereby zero for any particular latitude in one hemisphere only. There is a second correction due to the ship's motion in latitude, small and independent of the particular instrument, and there is a third correction, a ballistic correction due to change in the ship's motion in latitude. Space does not admit of these being followed out, but they are fully explained.

The directive force of the gyrostatic compass is about fifteen times as great as that of an ordinary magnetic compass undisturbed by surrounding iron. In addition, therefore, to its being undisturbed by the magnetism of the ship or the movements of heavy magnetic pieces, such as guns, a master gyrostatic compass may be set up in a protected and quiet spot low down in the ship, and there control a number of dials placed in convenient positions for steering or for taking azimuth observations. These local dials are provided with central dials geared up thirty-six times, so that a complete turn corresponds to ten degrees. With such a compass to steer by and steering

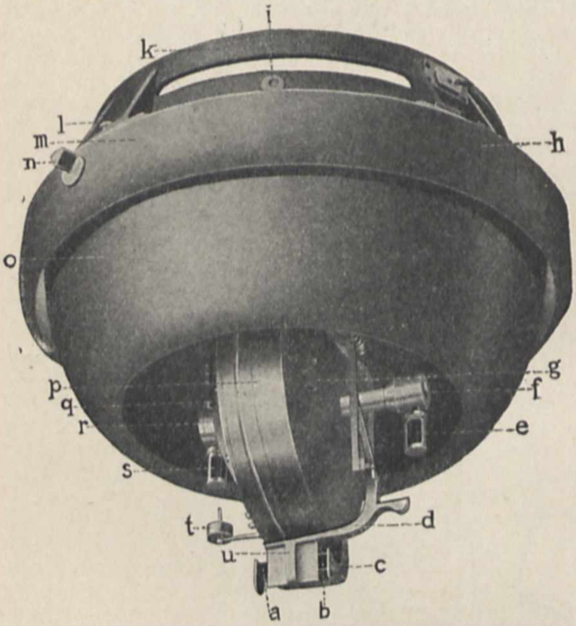

FIG. 2.—*a*, *b*, variable outlets for air blast; *c*, outlet pipe; *d*, pendulum arm; *e*, *s*, oil cup for gyro bearings; *f*, *r*, gyro bearings; *g*, inlet opening for air; *q*, terminal of gyro motor; *p*, gyro case; *o*, mercury bowl.

gear of greater precision than usual, the new compass should effect a saving in the actual distance run and in the horsepower at present wasted on the rudder, and it is an interesting question how long it will take for the reduction in the coal bill to pay for the compass.

It is not possible owing to limitations of space to follow the numerous details relating to the theory, construction, and use of this beautiful instrument, but anyone with a sense of fine mechanics will appreciate this excellent exposition, even though he may never have the chance of running the compass himself.

C. V. BOYS.

THE PRESERVATION OF ANCIENT MONUMENTS.

THE report of the Inspector of Ancient Monuments for the year ending March 31, 1911, is the first by the new inspector, Mr. C. R. Peers. There are 104 monuments under the care of the Commissioners of Works, forty-eight in England and Wales and fifty-seven in Scotland. During the last year fifteen monuments have been placed under the protection of the Ancient Monuments Acts, ten in England and Wales and five in Scotland. Eight of the newly-protected monuments are situate in Anglesey, all prehistoric monuments, three of which have recently been astronomically surveyed by Sir Norman Lockyer and others. Of the two prehistoric Orkney monuments now under protection, the Chambered Mound of Maeshowe has received the attention of the same authority.

Useful linear measures are given of the monuments noticed in the report, and in one case, as a sort of nest-egg, we have the information that the bearing of the dolmen at Trefigneth "comes within one degree of the line of the winter solstice." Never a word is found referring to the available astronomical surveys, while it may safely be asserted that the formal protection of the Anglesey and Maeshowe monuments is largely due to the local interest awakened in the astronomical inquiry. In connection with the statement that "no adequate record has up to the present time been kept of the treatment of each monument year by year," surely the annual reports issued by the Pembrokeshire archæologists should have been mentioned.

"Certain observations of a general character" are most timely and important. "The first Ancient Monuments Act has now been in operation for twenty-nine years. Of the fifty-one prehistoric monuments scheduled by it as worthy of preservation by the State, twenty-six have been placed under its provisions, by the consent of the owners, while the rest, for various reasons, have not been so placed. In regard to these latter, the position of the State is entirely unsatisfactory, and these monuments are in a worse case than if they had not been noticed in the Act." The second Act of 1900 has a wider scope, with the grand result that we have now three castles and three monastic buildings added to the State waifs and strays! This report, like others of its kind, reveals the deplorable ineffectiveness of high-sounding measures. It also shows that where a scientific survey of a monument is first made and the results duly published, owners of such properties are among the first to recognise the necessity for effective protection. Lord Boston, Lord Sheffield, and Major Fox-Pitt have nobly led the way in Anglesey. The first and foremost factor in the case is scientific inspection, and monuments are best preserved in accurate measures.

JOHN GRIFFITH.

THE PORTSMOUTH MEETING OF THE BRITISH ASSOCIATION.

IN about six weeks' time, on August 30, the citizens of Portsmouth will have the privilege of welcoming the members of the British Association for their annual meeting. In many respects this meeting will be a contrast to that at Sheffield last year. Portsmouth cannot offer the attractions of large engineering works or manufactories, but at the same time it holds a unique position as the first naval port of the United Kingdom, and one of the most ancient of its boroughs. The borough of Portsmouth fifty or sixty years ago included only a small portion of the island of Portsea, on which the town is situated. There were walls and gates (which were closed every day at sunset) and a military governor. The walls are gone, but some of the old parts of the town are still well worth a visit. Three years ago the borough boundary was enlarged, now including the whole of the Island of Portsea.

Opportunity will be offered to members of the British Association to inspect the old corporation plate dating from Queen Elizabeth onward, and the old charters of the town, covering the last 500 years, can also be seen in the Town Hall, and are of great interest. The population of the borough has increased during the last decade by upwards of 40,000, the number of inhabitants, as shown by the census just completed, being about 232,000.

Not being a university or large industrial centre, Portsmouth cannot perhaps boast of as many large halls as other cities in which the association has met, but the accommodation will be found quite adequate. The general reception room will be in the Connaught Drill Hall, which is the headquarters of the 3rd Hants Volunteers. Here will be obtained all the literature relating to the meeting, tickets for excursions, postal facilities, &c. Most of the sections will be housed in the Municipal Technical College, a fine building, erected about four years ago at a cost of more than 70,000*l*., and situated close to the Town Hall. This latter building itself will probably accommodate one or two of the sections, and is a magnificent edifice resembling the Town Hall, Leeds. As mentioned above, there are no large works, but several of the excursions will deal with objects of naval interest, such as visits to battleships, the dockyard, Whale Island (the gunnery school), or the *Vernon* (the torpedo and wireless telegraph instruction ship). Other excursions will include visits to Arundel Castle and various parts of the South Downs, and to the Isle of Wight. The Mayor proposes to give a garden-party to all members of the association, as well as a banquet to all the officers.

A good local guide-book is now well in hand, by the aid of which visitors will be able to find their way to the numerous objects of interest without difficulty, and also acquire much interesting information with regard to the borough and environs generally. If the number of visitors is large, the question of accommodation may present some difficulty. The best available accommodation in lodging-houses will probably soon be exhausted, as even at the end of August there are still a considerable number of visitors in the town. There are plenty of hotels, but in view of the above facts it will be well to apply early to the local secretaries for particulars of housing accommodation, as if the housing question is left until a few days before the meeting the choice may be very limited. There is no doubt, however, that the town and outlying districts will be able to accommodate as many as attend the meeting.

Portsmouth has during the last few weeks taken a prominent part in the Coronation Naval Review, and this has to a slight extent interfered with the meetings of the various committees which are dealing with the British Association gathering. Arrangements will, however, now go ahead fast under the guidance of the local secretaries, and in a few weeks we hope to publish further details respecting the meeting, which promises at present to be well up to the standard of any of its predecessors, both as regards work and pleasure.

It will be seen from the subjoined provisional programmes received from recorders of sections, that the scientific proceedings of the meeting promise to be of interest and importance.

PROVISIONAL PROGRAMMES OF SECTIONS.

SECTION A (MATHEMATICAL AND PHYSICAL SCIENCE).—The presidential address, by Prof. H. H. Turner, will be delivered at 10 a.m. on Thursday, September 1. Three discussions have been arranged: one on the principle of relativity, to be opened by Mr. E. Cunningham; one on stellar distribution and movements, to be opened by Mr. A. S. Eddington; the third (in conjunction with Section G) on mechanical flight, with Mr. A. E. Berriman as opener. The following papers have been promised:—Prof. Petterson, on great boundary waves; parallactic tide set up in the bottom layers of the sea by the moon; Prof. F. T. Trouton, on peculiarities in the adsorption of salts by silica; Major Hills, on the infra-red spectrum; Prof. F. R. Watson (of Illinois), on the effects of air currents on sound; Prof. L. Vegard (of Christiania), on the properties of the radiation producing aurora borealis; and by Prof. W. H. Bragg, on the corpuscular nature of rays.

SECTION B (CHEMISTRY).—*Discussion on colloids:* The theory of colloids, Prof. Freundlich; (1) colloids in pharmacy, (2) the blue absorption compounds of iodine with starch and other substances, Dr. G. Barger; the colloid theory of cements, Dr. C. Desch; adsorption of bromine by graphite, Dr. E. Wechsler. *Discussion on indicators and colour:* The origin of general and of specific absorption, Dr. T. M. Lowry; absorption spectra of vapours, J. E. Purvis; absorption spectra and refractive power of metallic vapours, P. V. Bevan; the use of indicators in modern physico-chemical research, H. T. Tizard; the application of methyl orange for the determination of the affinity constants of weak acids and bases, Dr. V. H. Veley. Joint meeting with Agricultural Sub-Section (Monday). Discussion on the part played by enzymes in the economy of plants and animals, opened by Dr. E. Frankland Armstrong; some points in the treatment of wheaten flour, A. E. Humphries. *Papers:* Optically active systems containing no asymmetric carbon atom, Prof. W. H. Perkin and Prof. W. J. Pope; the diffusion of gases through water, Prof. C. Barus; the compressibility of mercury, Dr. W. C. Lewis. *Reports:* Electric steel furnaces, Prof. A. McWilliam, and those of the Research Committees.

SECTION G (MECHANICAL SCIENCE).—Joint discussion with Section A on aëronautics, opened by Mr. A. E. Berriman; over-type superheated steam engine, Captain H. Riall Sankey and Mr. W. J. Marshall; suction gas plants, Mr. Tookey; Diesel engines, Mr. Chas. Day; the vibragraph, Mr. Digby; experiments on wireless telegraphy, Prof. G. W. O. Howe; electrical steering, Mr. Haig; electrical drives for propellers, Mr. H. A. Mavor; smoke abatement, Dr. J. S. Owens; on the origin and production of corrugation on tramway rails, Mr. Worby Beaumont; crude oil marine engines, Mr. J. H. Rosenthal; portable wireless telegraphy equipment, Captain H. Riall Sankey; the gyro compass, G. K. B. Elphinston; the single-phase repulsion motor, T. F. Wall.

SECTION H (ANTHROPOLOGY).—The proceedings promise to be as interesting and as varied as usual. The chief feature will be a discussion on totemism, to be opened by Dr. Haddon, and to which papers are to be contributed by a number of distinguished foreign guests of the section, including Dr. Kohler, Prof. Graebner, M. A. Van Gennep, Prof. Hutton Webster, and Dr. Goldweiser; among the English anthropologists who hope to be able to contribute papers or to take part in the discussion are Prof. Frazer, Mr. Hartland, Dr. C. G. Seligmann, and Mr. R. R. Marett. Archæological papers will cover a wide field. Miss Adela C. Breton will exhibit paintings and frescoes from the Temple of the Tiger, Chichen Itza, and other ruins in Mexico and Yucatan, and will describe some recently discovered Costa Rican and Peruvian painted vases. She will also give an account of the present position of archæological study in Peru. European archæology will be covered by an important paper on the recent discovery of pleistocene man in Jersey by Mr. R. R. Marett, who has been in charge of the excavations of the caves in which the remains have been discovered; Dr. A. Keith, in a series of papers on palæolithic man will describe a second skull recently discovered in the same locality, and said to be from the same level as the well-known Galley Hill skull, a skull of Magnon type from Dartford, and remains of a pygmy race from Spain. Among papers dealing with the Mediterranean and Egyptian area may be mentioned Prof. G. Elliot Smith's paper on the foreign relations and influence of the Egyptians under the Ancient Empire, and Prof. Flinders Petrie's account of the Roman portraits discovered by him in Egypt during the last season's excavations. In ethnography and the study of religions, the papers to be contributed by Mr. W. Crooke on the cow and the milk, Major A. J. Tremearne's notes on Hausa folklore, M. Malinowski on the economic functions of magic, and Dr. C. G. Seligmann on the divine kings of the Shilluk, are of interest and importance. Mr. J. Gray will bring before the section the important question of the institution of an imperial bureau of anthropology, while a cognate matter will be discussed in a paper by Mr. H. Peake, in which the author urges the desirability of instituting an anthropometric survey of Great Britain.

SECTION I (PHYSIOLOGY).—Presidential address, Prof. J. S. Macdonald; discussion on ventilation in confined quarters, especially in relation to ships, Dr. L. Hill, Prof. N. Zuntz, Mr. L. Woolhard; discussion on inhibition, opened by Prof. C. S. Sherrington, followed by Mr. Keith Lucas, conduction between muscle and nerve, with special reference to inhibition, and Prof. J. S. Macdonald; frequency of colour-blindness in males, Dr. Edridge-Green; heat production and body temperature during rest and work, Prof. J. S. Macdonald and Dr. J. E. Chapman; rhythmical stimulation of cooled frog's nerve, Dr. J. Tait; electrical stimulation of the frog's heart, Dr. J. Tait; photochemical changes in yohimbine solutions, Dr. J. Tait and Dr. J. A. Hewitt; some considerations on the influence of hæmoglobin in the hæmolysis of red blood corpuscles, Dr. H. E. Roaf; the chemistry of heat coagulation of proteins, Dr. Harriette Chick and Dr. C. J. Martin; new researches on phagocytosis, Prof. H. J. Hamburger; a photometer for hetarochromatic photometry, Prof. C. S. Sherrington; model to illustrate Listing's law of the movements of the eyeball, Prof. C. S. Sherrington; comparison between the nervous taxis of the cat's knee and that of the anthropod claw, Miss S. C. M. Sowton and Prof. C. S. Sherrington.

SECTION K (BOTANY).—Presidential address, Prof. F. E. Weiss. Joint meeting with Sections C and E on the relation of the present plant population of the British Isles to the Glacial period, opened by Mr. Clement Reid. Discussion on the principles of constructing phyto-geographical maps. Semi-popular lecture, by Mr. Francis Darwin. *Papers:* Some petrified Jurassic plants from Scotland, Prof. A. C. Seward; recent work on the Jurassic plants of Yorkshire, H. H. Thomas; the structure of the oldest known synangium, and its bearing on the origin of the seed, Dr. M. Benson; on the mode of formation of the Pettycur material as gathered from internal evidence; a fifteen-year study of advancing sand-dunes, Prof. H. C. Cowles; new proposals in ecology, Prof. F. E. Clements; phytogeography as an experimental science, Prof. Massart; the vegetation of pebble beaches, Prof. F. W. Oliver; the brown seaweeds of a salt-marsh, Miss S. M. Baker; the Swiss National Park and its flora, Prof. C. Schröter; the water-content of acidic peats, W. B. Crump; the wilting of moorland plants, W. B. Crump; the presumptive hybrid *Anagallis carnea*, Prof. F. E. Weiss; the morphology of leguminous nodules, Prof. Bottomley; nuclear osmosis as a factor in mitosis, A. A. Lawson; nuclear division in Spongospora, A. S. Horne; the polyphyletic origin of the Cornaceæ, A. S. Horne; the transference of sugar from the host plant to a parasitic Cuscuta, S. Mangham.

SUBSECTION AGRICULTURE.—Presidential address, Prof. W. Bateson; cider sickness, B. T. P. Barker and Mr. Hillier; the effect of grass on apple trees, S. U. Pickering; the inheritance of strength in wheat, Prof. T. B. Wood; crystalline nitrogenous constituents of mangolds, Prof. T. B. Wood; suggestions relating to the existing system of imperial avoirdupois weights, J. Porter. Discussion on bacterial diseases of plants, opened by Prof. M. C. Potter; bacterial diseases of the celery and swede, J. H. Priestley; bacterial gum diseases, F. T. Brooks; bacterial diseases of the potato plant in Ireland, Dr. G. H. Pethybridge; experiments on the wart disease of potatoes, G. T. Malthouse; potato disease, A. S. Horne. *Discussion:* How best may the university agricultural departments come into contact with the farmer, Principal Ainsworth Davis; the American and Canadian systems, R. Hart-Synnot: the place of the agricultural instructor, J. H. Burton. Joint discussion with the Chemical Section. The part played by enzymes in the economy of plants and animals. Popular lecture by Mr. A. D. Hall, the soils and farming of the Southdowns; commercial ovariotomy in pigs, F. H. A. Marshall and K. J. J. Mackenzie; temperature variations during the œstrous cycle in cows, F. H. A. Marshall and K. J. J. Mackenzie; the effects of ventilation on the temperature and carbon dioxide of the air of byres, J. Hendrick; the effect of minute electrical currents on the growth and metabolism of bacteria, Prof. J. H. Priestley and Miss E. M. Lee; the effect of high tension electric discharges and current electricity on plant respiration, Prof. J. H. Priestley and Mr. R. C. Knight; the effect of pyrophosphates on animals, Dr. J. A. Gardner; application of genetics to horse-breeding, C. C. Hurst; the inheritance of milk yield in cattle, J. Wilson. The *chief features* of the programme are: Discussions on problems at present of great importance in agriculture: (1) Bacterial diseases of plants; (2) the University Agricultural Departments and the practical farmer; (3) the *rôle* of enzymes in the economy of plants and animals; (4) some important live stock questions; (5) semi-popular lecture: a scientific study of the local agriculture.

NOTES.

THE Brussels correspondent of *The Times* announces that Prof. W. Spring, professor of general chemistry in the University of Liège, died on July 17 after an operation on the throat.

THE Council of the Royal Society of Arts attended at Clarence House on Friday, July 14, when the Duke of Connaught, president of the society, presented its Albert Medal to the Hon. Sir C. A. Parsons, F.R.S., "for his experimental researches into the laws governing the efficient action of steam in engines of the turbine type and for his invention of the reaction type of steam turbine and its practical application to the generation of electricity and other purposes."

A MEETING of the Institution of Mechanical Engineers will be held on July 25 and 26, at Zürich. The meetings will be held in the Swiss Polytechnikum. Among the papers to be read may be mentioned:—Electric traction in Switzerland, by Mr. E. Huber-Stockar, of Zürich; results of experiments with Francis turbines and tangential (Pelton) turbines, by Prof. Franz Prášil, of Zürich; some new types of dynamometers, by Dr. Alfred Amsler, of Schaffhausen; rack-railway locomotives of the Swiss mountain railways, by Mr. T. Weber and Mr. S. Abt, of Winterthur; high-pressure water-power works, by Mr. L. Zodel, of Zürich.

THE annual general meeting of the Society of Chemical Industry was held last week in Sheffield, under the presidency of Mr. Walter F. Reid, a summary of whose address appears elsewhere in this issue. Dr. Rudolf Messel, of London, was elected president for the ensuing year. The applied science department of the University was visited, and in an address given to the visitors, Prof. Arnold said that for the future students of the Royal School of Mines, if they wish to obtain the School of Mines diploma for iron and steel metallurgy, must take their fourth year of study in the metallurgical department of the University of Sheffield, and must pass its examination. Numerous visits were made to factories in and near Sheffield, and the visitors were entertained at several receptions.

AN important Act has been adopted by the New York legislature dealing with the sale in New York State of wild American game. Owing to the efforts of Senator H. R. Bayne to secure the passing of the Bill, the new Act is often called the Bayne law. Stated briefly, the new law prohibits in New York State, at all seasons, the sale, or importation for sale, of any species of American wild game, save hares and rabbits. These rodents have been declared a pest to fruit-growers. No longer will it be possible for ruffed grouse, pinnated grouse, any American quail, woodcock, snipe, or any American shore-bird, wild goose, brant, or wild ducks of any species, to be sold in the State of New York, no matter where they may have been killed. The Bayne law provides, however, that certain species of game that can be reared successfully in captivity, and killed by hand, may be sold and consumed, under certain restrictions.

THE twenty-sixth congress of the Royal Sanitary Institute is to be held in Belfast on July 24 to 29. Dr. Louis C. Parkes, deputy-chairman of the council of the institute, will deliver a lecture to the congress on "The Prevention of Tuberculosis: A National Task." Prof. H. R. Kenwood will deliver the popular lecture on "The Open Window." More than two hundred authorities, including foreign and colonial Governments, Government departments, county councils, county boroughs, and other sanitary authorities, have already appointed delegates to the congress; and as there are over four thousand members and associates in the institute, a large attendance is expected. A health exhibition of apparatus and appliances relating to health and domestic use will be held, as practical illustration of the appliances and carrying out of the principles and methods discussed at the meetings. There will be many exhibits relating to the planning of cities and towns arranged by the executive committee of the Town Planning Exhibition. The meetings of the congress have been arranged in two sections, one concerned with sanitary science and preventive medicine, the other with engineering and architecture. Conferences have been arranged during the meeting of municipal representatives, port sanitary authorities, medical officers of health, engineers and surveyors, veterinary inspectors, sanitary inspectors, women on hygiene, and on the hygiene of childhood. The local honorary secretaries are Messrs. W. H. Bailie, J. Munce, and J. G. Harris.

THE fifteenth International Congress on Hygiene and Demography will be held in Washington, D.C., from September 23 to 28, 1912, under the honorary presidency of the President of the United States. Dr. H. P. Walcott, president of the State Board of Health of Massachusetts, will be the active president. Twenty-two Governments have accepted already an invitation to participate, and in addition each of the States of the Union has received an invitation which includes its contained cities. The committee on organisation includes Dr. Hermann Biggs, Dr. John S. Billings, Prof. R. H. Chittenden, Prof. Irving Fisher, Prof. Theobald Smith, and Prof. W. H. Welch. The secretary-general is Dr. John S. Fulton, Army Medical Museum, Washington, D.C. The official languages will be English, French, and German. The work of the congress will include an exhibition of recent progress and the present condition of the public health movement in the cooperating countries, and scientific meetings. For the latter the congress will be divided into nine sections. The sections, with the presidents, are:—(1) Hygienic Microbiography and Parasitology, Prof. Theobald Smith; (2) Dietetic Hygiene, Hygienic Physiology, Prof. R. H. Chittenden; (3) Hygiene of Infancy and Childhood and School Hygiene, Dr. A. Jacobi; (4) Industrial and Occupational Hygiene, Dr. G. M. Kober; (5) Control of Infectious Diseases, Dr. Hermann Biggs; (6) State and Municipal Hygiene, Dr. Frank F. Westbrook; (7) Hygiene of Traffic and Transportation, Dr. W. Wyman; (8) Military, Naval and Tropical Hygiene, Dr. H. G. Beyer; (9) Demography, Prof. Walter J. Willcox. Inquiries and applications for membership should be addressed to the secretary-general.

THE account in the July issue of *Man*, by Miss A. C. Breton, of some of the museums of archæology and ethnology in America, will excite among British students of these sciences mingled feelings—admiration at the enterprise and liberality of the American people, and regret that the contrast between the institutions of America and those in England is so clearly to our disadvantage. The museums described in this paper are the New York Natural History Museum, the Brooklyn Institute, the Peabody Museum of Harvard College, the Yale University Museum, the Philadelphia Academy of Sciences, the National Museum at Washington, and the National Museum of San José, Costa Rica. Practically all these representative collections are provided with suitable buildings and adequate staffs; each has its library, to which access is readily permitted, and arrangements are made by which the officials usually spend part of each year in field work, and are thus in a position to supply to inquirers first-hand information.

THE present uncertainty of some of the evidence on the ethnology of the Australian race is embarrassing to those who are engaged in the study of the aborigines of that continent. Prof. Frazer, for instance, in his recently published treatise on "Totemism and Exogamy," bases his conclusions regarding the customs of the Arunta tribe on the researches of Messrs. Spencer and Gillen, and dismisses the sources upon which the Rev. Mr. Strehlow has drawn in his description of another branch of the same tribe as "deeply tainted." Again, in the July issue of *Man* Mr. R. S. Mathews contradicts the statement of Dr. Howitt that descent among the Kaiabara tribe is patrilinear, and suggests that this error has led Mr. A. Lang into erroneous conclusions regarding them. Mr. Lang, again, in the June issue of *Man*, disputes Mr. Mathews' view that the phratries represent two ancient distinct races, one of the Papuasian type, with curly hair, the other fairer, with straight hair, akin to the Dravidians and Veddahs. It is much to be desired that the Federal Government, by the establishment of an ethnological bureau or by the appointment of a special commission, should undertake an official investigation into the ethnology of the aborigines before they finally disappear, and arrange for the preparation of a series of authoritative monographs on the native races, such as the valuable series which we owe to the enlightened Government of the United States on the American Indians.

IN *The Entomologists' Monthly Magazine* for July, Mr. E. G. Bayford directs attention to the potency of electric light in attracting insects, and its consequent value to collectors, more especially those to whom beetles are the chief favourites.

To *Naturwissenschaftliche Wochenschrift* for July 2, Mr. P. J. du Toit, of Zürich, contributes an elaborate and well-illustrated summary of Dr. Broom's views with regard to the derivation of mammals from the theromorphous or (in the wider sense of the term) anomodont reptiles. After referring to the development of the idea of the existence of such a relationship, the author describes the mammalian features observable in the theromorphous limb-skeleton and limb-girdles, and then proceeds to discuss Seeley's views as to the reptilian nature of Tritylodon. While admitting the possibility of that genus being a mammal, Mr. du Toit points out that its resemblances to the theromorphs are so marked that there is considerable justification for including it in that group. As regards the mammalian features in the theromorph skeleton, the following are regarded as the most important:—The union of the pubis and ischium to form an innominate bone, which is unknown in any other reptiles except certain chelonians. An entepicondylar foramen to the humerus, found also in the tuatera. The fusion of the coracoid with the scapula—paralleled among certain salamanders. The differentiation of the teeth into series. The union of the quadrate with the adjacent elements of the skull. The relations and mode of articulation of the two-headed ribs. The resemblance of the tarsus (especially as regards the tibio-tarsal position of the line of flexure) and phalanges to those of the monotremes. These features become more and more pronounced in the specialised types until they culminate in a form like Tritylodon, which may be regarded as a reptile actually in process of conversion into a mammal. By an increase in the length and strength of its limbs, accompanied by increasing power of sustained locomotion, and likewise by a special development of its dentition and jaws, one of the primitive theriodonts acquired, in consequence of this greater activity, a better kind of blood-circulation, warm blood, and a mobile, hairy skin—in other words, became a mammal.

PROMINENT among the articles in *Tropical Life* (June) is an account of two plantations of Ceara rubber in German East Africa. In this colony the trees of *Manihot Glaziovii* mature so rapidly that tapping of a very light nature is permitted already, in the third year. At this stage the incision method of pricking necessitates careful manipulation, and is said to produce about ½ lb. of rubber per tree. In the first instance the trees were planted about 10 feet apart; but latterly a more open formation, in which they are set 13 feet apart, has been adopted. The chief pest is the white ant, which has to be combated by discovering and destroying its communities.

AN article on the Coniferæ, communicated by Dr. A. W. Gothan to *Naturwissenschaftliche Wochenschrift* (June 18), deals mainly with the distribution of the various subfamilies in past epochs as compared with their distribution at the present time, but the author takes the opportunity of referring to changes in family relationships that have been proposed as a result of paying more attention to vegetative characters; in this connection reference is made to the proposition enunciated by Dr. F. Vierhapper, that the Taxaceæ, Taxoideæ, and Cupressineæ should be united in one family, the Taxocupressaceæ, on account of similarity in wood and leaf structures. The author also directs attention to the interest attaching to the fossil genus Baiera as a constituent of the group of Gingkophyta.

THE sweet potato, *Ipomoea Batatas*, is one of those cultivated products of which the origin may be conjectured, but cannot be positively determined, and the varieties are so numerous and confused that identification and classification present unusual difficulties. These complexities are discussed in a bulletin issued as vol. iv., No. 1, of Contributions from the Botanical Laboratory of the University of Pennsylvania, where the author, Dr. B. H. A. Groth, describes a novel analytical method of scheduling that offers certain advantages, as in the incorporation of new forms. Representing each character by a letter, and the different variants of this character by numbers, each variety is scheduled under a series of arbitrary marks; thus the index of the variety Georgia begins A1B2C1D1 . . ., while A2B2C2D2 . . . is the beginning of the index of the variety Ticotea.

WE learn from *The Agricultural News*, No. 236, that the Botanic Gardens of St. Vincent contain the only known specimen of *Spachea perforata*, a large tree estimated to be at least 100 years old. The leaves are lance-shaped, while the flowers are borne in terminal racemes, each flower containing small rosy petals and stamens, which are all fertile; the fruits are small. It is further stated that the flowers are distinct and attractive, and produced in great profusion; they are largely visited by bees. The tree is not only of botanical interest, but is decorative as well.

FROM the report on the operations of the Department of Agriculture of the Madras Presidency, 1909–10, recently to hand, it is possible to obtain a fair general idea of the work a handful of Englishmen are doing among the natives in improving systems of agriculture that have for centuries remained unchanged. Much of the time of the staff is occupied in teaching; but the value of their work is being increasingly recognised, and numerous samples are now sent in to the laboratories for report. Each year the report shows that some fresh progress has been made and some new economy discovered; the value of drilling seeds, of saving on the seed rate, and other matters are dealt with here.

THE Bulletin of the Department of Agriculture, Jamaica, vol. i., No. 4, contains an excellent account, by Mr. Cousins, of the cultivation of the banana and the conditions under which success has been attained. Restricted as this plant was in the early days to virgin soils only, it was thought to be a crop that must soon cease to count in the islands. But the growers have learnt how to irrigate bananas, and also how to grow them on heavier types of soils, so that now there seems no obstacle to their cultivation wherever they would be thought useful. There are also some articles on local farm animals that will be of much interest to the technical reader, and, as usual in this publication, some excellent illustrations. Altogether the bulletin is an excellent number, on which its editor may be congratulated.

IT has long been recognised that a liberal supply of protein is necessary for dairy stock, and the earlier German investigations pointed to the conclusion that a cow in full milk should receive 2·5 lb. of digestible protein daily per 1000 lb. live weight, and that the albuminoid ratio, *i.e.* the ratio of digestible protein to non-nitrogenous foodstuffs should be 1 : 5·4. But practical men soon began to depart from these values, and investigations in America justified their action, showing that less protein was necessary. An investigation recently published by Messrs. Woll and Humphrey, and published as Research Bulletin No. 13 of the University of Wisconsin Agricultural Experiment Station, while emphasising the need of an ample protein allowance, brings out the fact that only large milk-yielders can economically receive a large protein diet.

COLORADO affords an interesting example of a country formerly devoted to ranching, and now becoming more closely settled, and consequently requiring a more general system of farming. An agricultural college and experiment station has for some time been engaged in studying the numerous problems involved in the transition, and the members of the staff issue frequent bulletins giving advice to settlers. No subject is too trivial for study; among a batch recently to hand is one on the care of farm machinery, and another showing how to build a wall or a house of adobe, a local soil that may be made to set like concrete. Exportable crops like fruit and potatoes naturally come in for considerable attention, and directions are also given for raising such crops as are needed for home consumption.

MR. E. C. ANDREWS, of the Mines Department of New South Wales, has issued in the Journal of the Royal Society of New South Wales (vol. xliv., 1911, pp. 420–480), an interesting paper on the structure of eastern Australia. He adopts the view that Australia has not been subjected to any recent folding, and that the main features of its present relief are due to vertical earth movements. Australia has been thus divided into a western "horst" and an area of Eastern Highlands separated by the Great Plains. The Eastern Highlands are a peneplane, which, according to the author, were in Miocene times but little above sea-level.

The whole of the eastern coast of Australia is a geographical unit, and is due to a series of step faults. Mr. Andrews accepts this coast as constructed on the Pacific type. He holds that Australia was uplifted at the end of the Tertiary, and the resultant plateau has since been deeply dissected by the formation of the canyons. For the period of the uplift he proposes the name of the Kosciusko Period after the highest part of the plateau. His paper includes a valuable list of the fault scarps and sunken areas in eastern Australia.

A RECENT number of *The Geographical Journal* (vol. xxxvi., pp. 537–553) includes a valuable paper by Messrs. A. E. Kitson and E. O. Thiele on the geography of the Upper Waitaki basin in New Zealand, illustrated by a series of beautiful photographs. The authors describe the structure of this country in some detail, and with especial reference to its glaciation. In opposition to Haast's view, that the country was a plateau dissected by glacial action, they claim that the great valleys were all formed in pre-glacial times. From the authors' summary of the recent literature on the glacial geology of this part of New Zealand, it appears to be now generally accepted that the glaciers have only modified valleys which were pre-glacial in origin. The authors conclude that the lakes, valleys, and fiords originated along radial fractures. Their work throws considerable doubt upon the existence of the ice sheet, which is supposed by some authors to have covered most of the South Island of New Zealand. The three great lakes of the Waitaki basin are shown to be moraine dammed.

THE Board of Education has issued the reports for the year 1910 (price 9*d.*) on the Geological Survey, the Geological Museum in Jermyn Street, the Science Museum at South Kensington, and the work of the Solar Physics Committee. The activity of all these bodies represents an important contribution by the State to scientific education. We note that, among many practical questions considered by the Survey, building stones are to be placed on the roof at Jermyn Street for comparative tests of the effect of the London atmosphere. We have also received three recent publications of the Geological Survey from the Board of Agriculture and Fisheries. Mr. Strahan describes the geological model of Ingleborough and district, now in the museum at Jermyn Street. This pamphlet (price 4*d.*) is beautifully illustrated by a geological map and a photograph of the model before colouring, and will appeal to teachers of geography. Dr. B. N. Peach provides another educational pamphlet in his "Description of Arthur's Seat Volcano" (price 6*d.*), which includes a geological map showing the relation of the mass to the city of Edinburgh. Messrs. Reid, Barrow, and Dewey have written the explanation of the colour-printed sheets 335 and 336 of the English map (price 1*s.* 6*d.* each), the memoir being on the country around Padstow and Camelford (price 2*s.* 3*d.*). The petrography is of interest, especially in connection with the pillow-lavas, and the district includes old workings for stream-tin, pits in china-clay, and the great quarry of Delabole in slate of Devonian age. A quarto palæontological memoir by Mr. T. Thomas deals with the British Carboniferous Orthothetinæ (price 2*s.*), and is accompanied by a fine plate by Mr. Brock.

THE officiating director-general of Indian observatories (Mr. J. H. Field) has issued a memorandum, dated June 8, on the conditions prevailing before the advance of the south-west monsoon of 1911. The monsoon rainfall in India is known to be affected by many external conditions, and among those believed to be the most important are the barometric pressure in South America and the Indian Ocean and the snowfall in North-west India, &c. After examining these conditions on the plan adopted by Dr. Walker, it is estimated that the total rainfall for the period June–September will not differ from the normal by more than about 5 per cent., a defect being more likely than an excess.

THE results of rain and river observations made in New South Wales during 1903–8 have been published by the Commonwealth Bureau of Meteorology. These include all available rainfall totals from 2298 stations, with monthly maps and notes for each of those years. In addition to the rain maps and tables for the above period, the records are given for all previous years. These values have been included in an average map for all stations for which means of not less than fifteen years were available; some of the results of this map were referred to in NATURE of September 22, 1910. The list of heavy daily rainfalls previously published by the late Government astronomer has also been brought up to date.

THE Akademische Verlagsgesellschaft of Leipzig has issued a small pamphlet on "Radiumnormalmasse und deren Vervendung bei radioaktiven Messungen," by Prof. Rutherford. It deals with the necessity of producing an international standard of radium, which has arisen owing to the differences recently discovered between the standards used in different countries. For the comparison of standards it suggests a compensation method, depending on the use of a constant source of radiation like uranium oxide and of the inverse square law. For small standards, such as are used in the determination of the radium content of rock specimens, solutions of radium salts containing one millionth of a milligram of radium per cubic centimetre are suggested. The conclusions as to the establishment of the radium standard arrived at by the Brussels conference last year are reproduced. They have already been given in these columns (October 6, 1910, vol. lxxxiv., p. 430).

THE *Revue General des Sciences* for June 30 contains the annual *revue* of astronomy for the year 1910 by M. P. Puiseux, of the Paris Observatory. It is divided into sections, which are devoted to planets and comets, the sun, the stars and nebulæ respectively. In the first section, the work of Cowell and Crommelin on Halley's comets, of Eddington on the theories of formation of the tails of comets, of Backlund on Encke's comet, and of Lowell, Campbell, and Albrecht on the markings of Mars, all receive attention. The section on the sun is devoted mainly to the work of Hale and of Deslandres on the constitution of sun spots; that on the stars to the spectroscopic work which has been done in order to determine the motions in the line of sight of a greater number of stars, and so provide means of testing more accurately the theories of Kapteyn and of Eddington that there exist two lines of main drift in their proper motions.

IT is difficult for anyone with normal colour-sense to appreciate the mental picture of a colour-blind person. An interesting experiment for illustrating what is seen by people with a defective red sensation—the commonest form of colour-blindness—has been devised by Mr. C. R. Gibson. The device consists of a pair of spectacles with plane signal-green glasses and a series of coloured wools. When the glasses are put on, of course, no red rays can enter the wearer's eyes, so he is in the position of a person who cannot distinguish red as a colour. He will thus match scarlet wool with black, yellow with green, pink with light blue, or crimson with dark blue, and will see any coloured object as the majority of colour-blind people see them. The experiment is instructive as well as amusing, and it provides a simple means of realising the effects of colour-blindness. The spectacles and wools are manufactured by Mr. J. Trotter, optician, Glasgow, and the price at which they are sold is 2*s.* 6*d.*

WE have received from Messrs. Isenthal and Co. their latest publication on Moscicki condensers, and Giles valves as applied to the protection of electric power transmission lines against atmospheric disturbances and surges. High-tension condensers for radio-telegraphy in particular are also dealt with. The publication is exceedingly well produced, the theory of surges and the practice of line and station protection being dealt with in part i., while part ii. deals chiefly with condenser batteries and choking coils and radio-telegraphy. A summary of the contents of various standard books dealing with these subjects is briefly given and set out with remarkable clearness in the brief description given. A noteworthy chapter is that dealing with the selection and design of plant, including generators, motors, transformers, and switches, and some very useful tables are included, giving safety coefficients for cables. The pamphlet is well illustrated with photographs and diagrams of the apparatus described. The Moscicki condensers and Giles valves are once again very fully dealt with, together with a list of places where they have been installed.

MESSRS. WATSON'S price list of apparatus for electro-therapy and diagnosis is too well-known to require detailed description. The novelties are principally found in the therapeutic section. The "Prana" carbon dioxide snow apparatus is described and illustrated. It is intended for the treatment of nævi and lupus, warts, and other superficial diseases. The apparatus is made in three different sizes. The carbon dioxide is contained in a cylinder, and is allowed to escape into a receptacle which permits of free evaporation with the production of carbon dioxide snow in the form of a crayon 5 inches long by 1 inch or ½ inch in diameter. A special high-frequency apparatus is constructed for diathermy or thermo-penetration. In this apparatus the heating effect of the high-frequency current is encouraged and used. Considerable benefit appears to have been obtained in various rheumatic conditions and neuralgia, sciatica, &c. These new high-frequency currents are at a voltage less than 3000 volts, but currents of 500 to 3000 milliamperes are used, and with the strongest doses the patient feels absolutely nothing except the increase in temperature. Thermometers introduced in animals prove that the increase is internal, and greatest in the path between the electrodes. Beyond the effects produced by the heat there are no other physiological or chemical effects. When the current is employed long enough, albumin coagulates; and tumours, &c., can be destroyed by these means: coagulated tissues behave like foreign bodies, and are gradually expelled. In the radio-active substances meso-thorium, of the same activity as pure radium bromide, is quoted for at the price of 12*l.* 10*s.* per milligram. Radio-thorium is listed at the price of 1*l.* per gramme. Several special radium applicators are illustrated.

Engineering for July 14 contains an illustrated description of a "Stock" oil-fired converter which is in operation at the works of the Darlington Forge Co., Ltd. All classes of steel can be manufactured in this converter, from soft-steel castings to special steels of the highest class. In form it resembles the ordinary Bessemer converter; it is lined with ordinary silica fire brick, and is used, not only for the conversion or blowing of iron, but also for melting the actual charge of iron and scrap by means of oil fuel, no separate cupola being required. The oil fuel—crude petroleum—is used for melting the charge, and when this has been effected the oil pipes are withdrawn and blowing commences. The air does not enter at the bottom and pass up through the molten metal as in a Bessemer converter, but is blown down on the top of the metal. For a three-ton converter, melting takes about 1½ hours and blowing from fifteen to twenty minutes, the total time, including charge, being about two hours. As an example of the punishment the steel will stand, the following may be mentioned: A steel wheel, about 4 feet 9 inches in diameter, was dropped edgewise on a steel ingot from the following heights—5 feet, 10 feet, 15 feet, and 20 feet, without showing signs of fracture. A drop of 40 feet on the rim broke one spoke. After this four more drops of 40 feet on edge caused no further fracture either to the rim or the spokes, and the wheel was finally broken up by a steel three-ton ball dropped ten times on the boss from a height of 40 feet. Some remarkably thin castings have been made.

OUR ASTRONOMICAL COLUMN.

COMET, 1911*b*.—Observations of the new comet discovered at the Lick Observatory on July 6 are recorded in No. 4511 of the *Astronomische Nachrichten*. Prof. Abetti, at Arcetri, on July 8, estimated the magnitude as 6·0, and Prof. Wolf found, the same day, that the photographic magnitude was 7·5; his photographs show a tail.

MM. Lagrula and Schaumasse observed the comet at Nice on July 8, and, in No. 2 of the *Comptes rendus* (July 10), they describe it as a bright object presenting a globular condensation surrounded by a nebulosity which is extended towards the S.S.W.; the whole appears to have a diameter of about 2·5′.

From observations made on July 6, 8, and 9, Prof. Kobold has determined the following elements, which are said to be similar to those of Comet 1790 I.

Elements.

J = 1911 June 20·6354 (M.T. Berlin)

$$\left.\begin{aligned} \omega &= 99^\circ\ 31{\cdot}99' \\ \Omega &= 172^\circ\ 27{\cdot}52' \\ i &= 148^\circ\ 39{\cdot}25' \end{aligned}\right\} 1911{\cdot}0$$

$\log q = 9{\cdot}89936.$

An ephemeris derived from these elements gives 4h. 26m. 27s., +32° 54·0′ as the position for July 20 (12h. Berlin M.T.), with a daily decrement of about 2m. in R.A. and 13′ in declination. The calculated magnitudes for July 12 and July 20 are 6·5 and 6·4 respectively. Given a clear horizon the object should be visible, with opera-glasses, from midnight to dawn; at about 10.30 it rises some 30° east of north, and at 2 a.m. is about 20° above the horizon. The present position is about one-third the distance between ι Aurigæ and ζ Persei from the former star along a straight line joining the two.

THE SOLAR ECLIPSE OF APRIL 28, 1911.—Dr. L. A. Bauer sends us a detailed narrative of a journey to Tau Island of the Manua group, where observations were made of the total solar eclipse of April 28, 1911. The U.S. cruiser *Annapolis* took Dr. Bauer from Pago-pago harbour, Tutiula Island, to Tau. Dr. Bauer's prime object was to secure magnetic observations during the eclipse, and he arranged for simultaneous observations to be made at the five magnetic observatories of the U.S. Coast and Geodetic Survey, as well as at Apia, Christchurch, and Melbourne. His attention was, therefore, devoted to this subject, and the astronomical observations were made by officers of the ship.

Mr. Abbot, director of the Astrophysical Observatory of the Smithsonian Institution, provided Dr. Bauer, at short notice, with a hand-driven, equatorially mounted, double-lens camera of about 11½ feet focus, and suggested one exposure of 15s., and another as long as possible—about 1m. 10s. These exposures were made, and four negatives were obtained as the result. On account of a difficulty with the sighting telescope just before totality, a hastily-constructed finder had to be employed, and this did not prove wholly successful as a means of keeping the image central upon the plates. The photographs show, however, the inner corona and some details and extensions mainly on the north-eastern and south-western edges, reaching out in places to a distance of more than half the sun's apparent diameter. The size of the photographic image of the sun's disc upon the plates is nearly one and one-fifth inch. No member of the shore party, or of the party aboard the *Annapolis*, reported having seen these coronal extensions, or any stars, which fact is probably due to the comparative brightness during totality, writing being easily legible. The times of the four contacts were observed by the shore party, as well as aboard; the observed duration of totality was 2m. 1s.

The magnetic observations cannot be discussed until those made at other stations within and without the eclipse track are available for comparison.

THE LIGHT OF ALGOL'S COMPANION.—In a previous paper Mr. Joel Stebbins arrived at the conclusion, from his selenium photometer observations, that the companion of Algol is brighter on one side than the other, the difference being caused by reflection and by the heating effect of the primary on the one side, chiefly the latter. His argument for the untenability of the reflection theory having been questioned, he returns to the subject in No. 5, vol. xxxiii. of the *Astrophysical Journal*, and shows by a different method that only a small portion of the extra light can be due to reflection. Our knowledge of the radiations emitted by the satellite is insufficient to determine the question definitely, but it is evident that radiation, and not reflection, is the chief cause of the extra brightness of the one side.

OBSERVATIONS OF MIRA.—The maximum of Mira which took place in July, 1910, was observed at the Catania and Utrecht observatories, and the results appear in No. 4506 of the *Astronomische Nachrichten*.

Dr. Bemporad finds that the maximum, mag. 3·3, took place on July 21, 1910, and the neighbouring minima on March 25, 1910, and February 17, 1911, respectively; for the maximum, this was fourteen days earlier than predicted by Guthnick's ephemeris. The mean period would appear to be about 318 days, and the range of magnitude nearly 7.

Prof. Nijland's observations give a maximum, of mag. 3·2, on July 20, 1910, and a tabulated comparison of observed dates, with predicted dates for the last seven maxima, shows a period ranging from 342 to 310 days.

MICROMETER MEASURES OF JUPITER.—Dr. Lau continues his series of papers on Jupiter in No. 4509 of the *Astronomische Nachrichten*, where he records the micrometer measures, made during the opposition of 1910, of many different features. A number of minor changes from the previous oppositions were noted, the matt-white egg-shaped mass which was so marked a feature of the 1905 opposition being totally invisible. The geometrical network joining bands iii. and iv. was frequently seen and its points measured. Sketches of the Red Spot region show that while on April 10, 1910, the spot was of the usual pointed-egg shape, on May 4 its western extremity had become rectangular, and on May 10 dark masses of matter at the middle of both sides gave it an egg-boiler form.

PHOTOGRAPHS OF THE AURORA BOREALIS.—Prof. Carl Störmer, of Christiania, sends us abstracts from the *Comptes rendus*, in which he describes his method of taking simultaneous photographs of the aurora for the purpose of determining its altitude, and gives the results so far obtained. The photographs accompanying the paper of May 1 are very striking, and were taken in northern Norway during February and March, 1910, while from the diagrammatic summary of the results it is seen that the greatest proportion of auroræ measured were at altitudes ranging from 100–150 kms.

THE EPHEMERIS FOR HALLEY'S COMET.—Preliminary measures of plates showing Halley's comet, taken with the Crossley reflector during the period March 27 to May 27, are published by Dr. H. D. Curtis in No. 4506 of the *Astronomische Nachrichten*. A comparison with Dr. Ebell's ephemerides shows that the necessary corrections to the latter are of the order of only +12s. and −0·2′ to −0·9′.

THE DIFFERENTIAL QUALITY OF THE MOON'S REFLECTED LIGHT.—No. 4510 of the *Astronomische Nachrichten* is accompanied by a splendid two-colour photographic reproduction of the full moon, showing the different quality of the light reflected by different regions of the lunar surface. The reproduction is from negatives obtained by Dr. Miethe and Herr Seegert, whose work and results have already been described in these columns.

SUTTON DOUBLE STAR OBSERVATIONS.—Dr. Doberck continues his record of double star observations made at Sutton in No. 4507 of the *Astronomische Nachrichten*. These particular observations were made during 1910–11, and deal with more than 100 doubles, including α Geminorium and α Leonis.

THE CANYON DIABLO, OR COON BUTTE, METEORITES.—An interesting paper by Mr. C. R. Keyes, dealing with the multeity of meteorites in the Painted Desert, Arizona, appears in No. 9, vol. xix., of the Transactions of the Academy of Science of St. Louis. After discussing the volcanic nature and the general geology of the surrounding land, the author arrives at the conclusion that Coon Butte, a conspicuous mound, was not formed by any abnormal meteoric fall, as has been frequently suggested, but is probably of volcanic origin. That such immense numbers of meteoric stones ("heavy stones" or "green stones") have been secured in the immediate neighbourhood he explains by the extraordinary dryness of the atmosphere preventing weathering, and the assiduity with which the objects have been sought; in fact, he suggests that any desert district enjoying similar climatic conditions would probably prove as fruitful in these objects as has the Painted Desert.

UNIVERSITY DEVELOPMENT IN WALES.

OPENING OF NEW BUILDINGS BY THE KING AND QUEEN.

THE visit of the King and Queen to North Wales in connection with the historical ceremony of investiture of the Prince of Wales at Carnarvon has been happily associated with two events of international as well as national interest: the opening of the new buildings of the University College of North Wales at Bangor by the King, and the laying of two foundation stones of the National Library of Wales at Aberystwyth by King George and Queen Mary.

The development of the university movement in Wales will probably stand out as a unique feature in contemporary history, owing to the large extent to which its success depends on popular enthusiasm and support. It owes its inauguration to the foundation, in 1872, of the institution in Aberystwyth, which still bears the name, "University College of Wales." When the establishment of colleges for North and South Wales was decided on as a result of the deliberations of the Government Committee appointed in 1880, the appeal for funds met with an enthusiastic response, not only from the wealthier, but also from the poorest classes of the community, the miners and quarrymen at Bethesda contributing their shillings, and even the children in the board schools contributing their pence. The question of permanent buildings was, however, deferred until the movement had time to mature, with the result that the work of the University College at Bangor has up till this year been carried on entirely in the buildings of the old Penrhyn Arms Hotel, while until recently the college at Cardiff was wholly located in what had previously been an infirmary.

It was only four years ago that King Edward laid the foundation stone of the buildings which were opened by his son last Friday, and in the interval there has been raised in Upper Bangor a fine college, the architectural features of which will compare favourably with those of the more ancient foundations of Oxford and Cambridge. As will be seen from the illustrations, the college stands on a hill overlooking the old town of Bangor, in a park the slopes of which are in the spring covered with bluebells. It is quadrangular in form, the class-rooms being on the first and second floors facing the park, while the other sides of the quadrangle are occupied by administrative buildings, examination rooms, and studies, and the Prichard Jones hall. On the left of the tower are seen the museum and library, which, when the scheme is completed, will form the side of a great outer quadrangle, the remaining sides being allocated to the science departments. The work of these is, however, for the present, being continued in the old college. The new building, in which the arts departments are located, thus forms the first step in a larger scheme, for the completion of which further funds will have to be raised. It has been built at a cost of 130,000*l*., and was opened by the King nearly, if not quite, free of debt.

The largest individual contribution has been the *Aula magna*, given by Sir John Prichard Jones, whose name it bears, built at a cost of 15,000*l*. The library, given by the Drapers' Company at a similar cost, is an excellently equipped building, which, though so new, reminds one of the college libraries at Cambridge. In addition to this gift, the Drapers' Company has further maintained for many years a department of electrical engineering in conjunction with the department of physics. But in passing between these buildings we notice a stained glass window bearing the inscription, "Presented by the Postmaster and Staff of the Bangor Post Office." As another example of the varied character of the contributors, we note the recent donation of 100*l*. to the building fund by a member of the teaching staff of the Girls' County School. The site of the college, valued at 15,000*l*., was given by the "Mayor, Aldermen, and Citizens of Bangor," and this gift was followed by a further contribution of several thousands to the building fund from the same source.

A special feature of the new college is the open cloisters

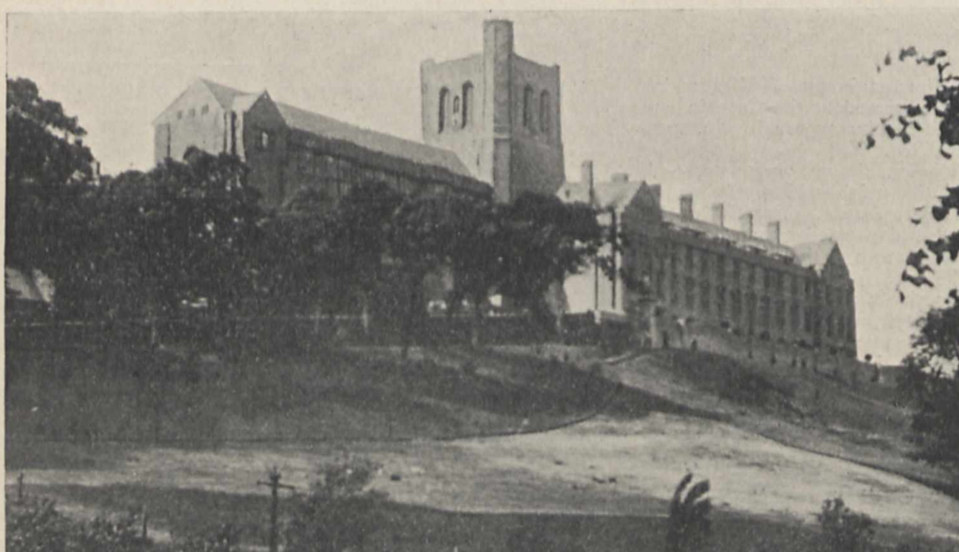

FIG. 1.—Front view of the new buildings of the University College of North Wales, Bangor. To the left of the tower are the museum (lower floor) and library (upper floor). Right of the tower are students' common rooms (ground floor)] opening on terrace, lecture room (first and second floors) and Professors' rooms (in the attics).

outside the lecture rooms, as shown in our second illustration, thus ensuring efficient ventilation.

The opening ceremony was performed in the presence of a large and representative gathering. We had Mr. Balfour and Mr. Lloyd George, not only sitting together on the same side of the house, but sharing a programme; Lord Hugh Cecil, the master of the Drapers' Company, and other distinguished guests. At the preliminary banquet, Mr. Balfour, in his speech, expressed the opinion that those who have planned and carried out this work have proceeded on right lines. They have not been modest in their ambitions, and they have been right. The building was planned on a scale that is not only adequate, but has the germs of development, which will render it adequate to future strains. Much of the advantage of a university education lies in the memories of those who have enjoyed it. When great architecture is linked with beautiful surroundings, subtle impressions are formed which move men until their dying day. It is well worth while to have great ideals as to the work. This breadth of view as to the ideals of education and culture is animating all those who preside over and control the courses of study, and Mr. Balfour advised them to be as magnificent in their ideas as the architect has been in the edifice. There are those who attach supreme value to the training of the youth and the utilisation of opportunities otherwise unused, of talents that would otherwise fall out. We should not narrow our ideals to training intelligent youths to pass difficult examinations. Apart from examinations, youths educate each other often most effectually, and each one who looks back on what he gained at the university finds that it does not always consist only in the advantage derived from lectures. There is another function that every university should aim at. In dealing with knowledge, art, and literature they should be the custodians of all that is highest, and not the less so because we are living in a democratic age. Wales and its colleges feel this ideal as much as any community. Wales has had its share of those divisions of opinion that are the effects and causes of national vigour, but in university education Wales is a land of brothers. All classes are animated by the same ideals, and make the same sacrifices in the great cause. But this brotherhood goes far beyond the limits of nationality. This place is not merely a Welsh seat of learning, for learning knows no limitations; it will take its place in the wider brotherhood which extends throughout the civilised world. There are many occasions on which national differences may arise, but the function of a university is to make the country a community of nations, one army conquering the same enemy, one band of workers united in a common cause.

The National Library of Wales, the foundation stones of which were laid at Aberystwyth the following day, owes its origin to the same movement. It was founded by Royal Charter in March, 1907, and its objects embrace "the collection, preservation, and maintenance of every form of literary and artistic production, whether printed or manuscript, relating to Wales and to the Celtic peoples and languages, as well as all literary works, whether connected or not with Welsh subjects, composed, written, or printed in whatsoever language, on whatsoever subject, and wheresoever published, which may help to attain the purposes for which the University of Wales, the university colleges, and other educational institutions were created and founded, *especially the furtherance of higher education and of literary and scientific research*." The foundation of this library is largely the result of the efforts of Sir John Williams, Bart., who for more than thirty years has been purchasing books, which he has presented to the library. These have been temporarily housed in the Aberystwyth Assembly Rooms.

The site of the permanent buildings, situated on a hill overlooking the town, has been presented by Lord Rendle. The Exchequer grants which the library has received up to the present have been proportionally far below those made to similar institutions in Scotland and Ireland. The new library will, it is hoped, receive some of the privileges enjoyed by the libraries of Oxford and Cambridge with regard to the acquisition of copyright books. It is, however, clearly understood that a condition of such a concession is the maintenance of the international character of the library, and of the provision contemplated in the charter as a safeguard against its becoming a purely Welsh institution. In these circumstances we confidently hope that scientific literature of all nations will be adequately represented. At the same time, it is important for English workers to realise the scientific importance of much that comes under the more Welsh side of the library. At present numbers of manuscripts and documents, full of historic interest, are scattered about in remote districts, and the foundation of a central collection cannot fail to bring to light important new contributions to our knowledge of history and anthropology. A further step in the same direction is the National Museum at Cardiff, of which the foundation stone will be laid next year, and which will, it is hoped, serve to preserve records of the druidical and other remains which are gradually disappearing under the devastating influence of utilitarianism. The astronomical interest connected with these remains will be well known to readers of NATURE. A photographic survey of the antiquities of Wales might, one would think, be inaugurated with

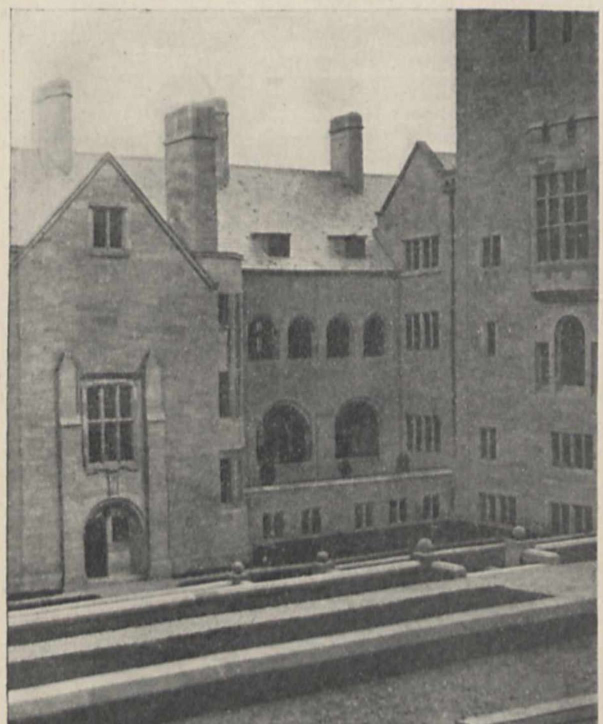

FIG. 2.—Interior of the quadrangle, showing the open cloisters by which the lecture rooms are approached. On the left-hand side is the block ontaining the Assistant Lecturers' private rooms; on the right a corner of the tower.

advantage in connection with either the library or the museum, perhaps both.

The proceedings in Aberystwyth were attended by delegates from most of the universities of the United Kingdom, as well as the Royal Society and similar bodies, and these received hospitality at the Alexandra Hall (the residence of the women students), which thus became the scene of pleasant meetings between the brotherhood of university workers so well described by Mr. Balfour. The memories which we shall carry away of this gathering will be ranked in the same group with our pleasantest reminiscences of British Association meetings. We could have wished that royal honours had been conferred on some representative of science, as it is probable that such a distinction would have given an impetus to an aspect of the university movement which must always be kept prominently in the foreground.

G. H. BRYAN.

TECHNICAL TRAINING AND UNIVERSITY GRANTS.

IN the House of Commons on July 13, in Committee of Supply, the President of the Board of Education made his annual statement reviewing the work of the Board during the previous year.

Dealing with the museum work of the Board of Education, Mr. Runciman referred to the controversy over the question of a site for the Science Museum. He said:—"Since the first announcement was made about the site of the Science Museum I have entered into negotiations with the Trustees of the British Museum, and we have now arrived at an agreement which will give us the land we require for the Science Museum and will not interfere with the development of the Natural History Museum, so that we shall have in South Kensington a group of museums which will be the envy of foreign nations."

In the course of his further remarks, Mr. Runciman referred to technical training and university grants. Subjoined are a few extracts from *The Times* report of his speech.

HIGHER TECHNICAL TRAINING.

"I regret to say that from all I learn of the work done in the provinces and of the work done on the Continent, I have to confess that it is in the field of higher technological forces that we have most leeway to make up.

"It is true that in many directions large sums of money are being devoted to the endowment of technological chairs in almost every modern university. Great bequests have been made during the past year. The University of Liverpool has recently founded a professorship of naval architecture, largely owing to the generosity of Mr. Elder. They have also created a department for the study of the problems of town planning—a new and rather interesting department. There are at the present time at least two departments in modern universities for the study of aëronautics. A professorship has been founded at Leeds for the study of the gas, coal, and fuel industries. In the same university instruction is being provided in wool-combing and spinning, for which the Clothworkers' Company has given a sum of no less than 50,000*l.*, making, I believe, the school at Leeds one of the most valuable technical schools in Europe. In the north of England a sum of 35,000*l.* has been applied for the teaching of mechanical engineering, and in three universities sums of 30,000*l.*, 50,000*l.*, and 70,000*l.* respectively have been provided for the promotion of chemical science.

"In London 60,000*l.* has been set apart by the University Association for the training of women in the study of the science of the household. Great progress has been made, I am glad to think, in the departments of metallurgy and chemistry in the north. In the sciences at the Imperial College great improvements have been made in the last twelve months, and I believe now that the leaders of the great industries are well alive to the fact that in the development of higher technological work lies much of the hope for their future success. I need not mention agriculture except in passing. Two agricultural colleges have been linked up with modern universities.

"When one records all, there is still left the feeling that in England there is not full appreciation of higher technological work, and when we make comparison of the number of students at German and English universities it is all to the advantage of Germany and not to our credit. In the eleven modern universities of England at the present time full time students number 9600, and if you add 7000 at Oxford and Cambridge of under- and post-graduates, you have a total for England and Wales of 16,600 students. It sounds like a large number, but when you remember that Germany has 63,000 students in similar institutions we may well say we have a long journey before us."

UNIVERSITY GRANTS.

"The most important departure made in the administrative work of modern universities is to be found in the change in distribution of the Treasury grant. Over a long period the Treasury grants given in large sums were spent at the discretion of the modern universities under the advice of a committee set up by the Treasury. There is no other education work for the Treasury to do, and there was unfortunately a certain amount of overlapping, because technological work came under the Board of Education, and it was felt that for administration in these matters and, I think, also for the simplification of regulations under which modern universities work, it was of the first importance to avoid waste in administration and overlapping, and the universities themselves agreed. With that object the Government have decided to transfer the distribution of this annual grant to the Board of Education, and now the only Government department modern universities have to deal with is the Board of Education. I am glad to think this meets with the approval of modern universities, and in the many conferences I have had with their representatives they have shown the desire to do their best to work with us for the common end, the extension and efficiency of the work falling under their guidance and control.

"I cannot pretend to say that the Board of Education is at the present time sufficiently equipped to do the whole of the work undertaken by the advisory committee appointed by the Treasury. I have, therefore, set up a small advisory committee to deal with the distribution of these grants. I am glad to say I have secured the service of Sir William McCormick as chairman, who is well known for his services under the Carnegie bequest, and was one of the most active members of the Treasury committee. Associated with him are Sir J. A. Ewing, C.B., F.R.S., Sir William Osler, F.R.S., Miss Emily Penrose, Sir Walter Raleigh, Sir John Rhys, and Sir Arthur Rücker, F.R.S. They are a small and, I may add, a very distinguished committee, and they have already started their meetings, one of their first arrangements being to give Hartley College, Southampton, now struggling to exist as a university college, another year in which to accumulate funds for carrying on university college work."

APPLICATIONS OF SCIENCE TO INDUSTRY.

THE annual meeting of the Society of Chemical Industry was held at the Cutlers' Hall, Sheffield, on Wednesday, July 12, the president, Mr. Walter F. Reid, being in the chair. In his presidential address, Mr. Reid dwelt on the rapid developments of the application of science to industry, and said it was quite impossible for anyone to keep up to date in all branches of applied science. But, though the tendency of the present age was towards specialisation, too minute sub-division had its disadvantages, and there would always be a demand for trained men who had a good general knowledge of science and of the methods of applying it. Manufacturing chemists frequently receive advice from those engaged in other industries to employ more skilled assistants in the factories. Mr. Reid quoted some figures given by Mr. Barker North, in his recent presidential address to the Association of Teachers in Technical Institutions at Southport, showing that the chemical factories stood at the head of all our great industries as regards the proportion of skilled supervision employed. The value of the net annual output per head of those employed in the manufacture of chemicals, coal-tar products, drugs, and perfumery, was also considerably in excess of that in any other of the nine chief trades of the country, the amount being 185*l.* per year, while the next was iron and steel with 118*l.*

It was sometimes alleged that the nature of the training given to students in this country was not of a sufficiently practical character, and that some foreign nations were superior to us in this respect. He did not think it could at present be said that the facilities for acquiring knowledge were less in Great Britain than in any other country—in fact, in some of our institutions they were superior. The most important piece of evidence upon which a final judgment could be passed, however, was wanting. They had no information as to the careers of students after they left the colleges or universities. This alone was the final measure of success. Degrees or examinations were but milestones along the road, although they were sometimes quoted as if they were the main end to be attained. Each centre of tuition could, no doubt, give the names of some former students who had been successful in their careers, but what interested him most was the ultimate fate of the rank and file, who supplied the bulk of the assistants in factories. Frequently he had had to engage assistants for various industries, and in one respect they were all deficient. They did not realise that the object of the industrial chemist, like that of the alchemist, was to produce gold, and that every factory operation must yield a profit, failing which it must inevitably cease. In this direction their German colleagues were, perhaps, more advanced, for "Waarenkunde," or knowledge of merchandise, was a recognised subject of tuition, and current price lists were not unknown to students.

In another way, students met with difficulty at the beginning of their career; they were not taught what kind of apparatus and plant was likely to be available for them in practice. Teachers who had not worked in factories could not properly teach students practical work in industrial chemistry. The problem for the student was how to acquire practical knowledge at the commencement of his career. In this he thought employers might materially assist by giving their younger employees more leisure to attend meetings of societies such as the Society of Chemical Industry, and by procuring journals and other literature which the assistant was unable to purchase. A good factory library was of the greatest pecuniary benefit both to employer and employed, but in how many factories did they find one? The rapid march of progress necessitated continuous study. They must all remain students. Sometimes an apparently casual observation might lead to important results if it was followed up, but if the factory chemist was taught to consider himself merely as a kind of teaching machine, and original observation was discouraged, business could not progress.

Mr. Reid recalled how many great industries had arisen from very small beginnings. The fixation of atmospheric nitrogen as an industry was still in its infancy. In 1781 Cavendish found that, on passing an electric spark through a mixture of carbon dioxide and hydrogen, nitrous acid was produced. He communicated his observation to Priestley and Lavoisier, neither of whom could obtain the same result. Cavendish's observation was more accurate than his method, for he made his experiments in vessels containing only a partial vacuum, and the nitrogen and the residual air yielded nitrous acid. In 1784 R. Kirwan repeated the experiment with atmospheric air, and again found acid. Here we had the English origin of what was destined to become one of the great industries of the world, but which was being developed chiefly in foreign countries. When Tyndall made his classic researches on glaciers, he little imagined that factories would arise in the Alps with a glacier at one end of the system and nitric acid of 98 per cent. running into carboys at the other.

The history of the development of modern smokeless powder had never been told. Soon after graduating at Berlin, Mr. Reid was commissioned by the Argentine Government to report on the mineral resources of that country. In carrying out the work, he had to penetrate into a wild region where his gun was the chief source of the daily food. There were few opportunities for cleaning the gun when work was finished, and as a result the gun was ruined by rust. When he returned to England, he endeavoured to find some means whereby rust might be prevented. He heard of the work done by Von Lenk with gun-cotton, and he also heard from the officials of the Patent Safety Gun-cotton Co., Stowmarket, that the manufacture of powder for firearms had been abandoned because of the great irregularity of the explosions and the number of accidents that had happened. He made a long series of experiments, and finally found that by gelatinising nitrocellulose, either completely or partially, the explosion could be rendered quite uniform. Some of the first experiments were made with a paste forced through a perforated plate similar to those used in the gutta-percha industry. The threads thus produced were cut into short lengths, and gave good results. But in those days, when cartridge cases and gun or rifle chambers were adapted to black powder, which was twice the bulk of the new product, there was a great disinclination to make the necessary alterations. A partially-gelatinised, bulky powder had, therefore, to be made for the market. It was called "E.C." powder—the initials of the Explosives Co., Ltd., who were then owners of the Stowmarket Works. It was only recently that sporting guns and cartridge cases had been specially made to suit the fully gelatinised powder, which had now almost supplanted black powder for sporting purposes. The utility of the new powder for military purposes was evident to civilians from the beginning, but our military authorities, after testing it, said that it could not be adopted, because the trajectory was so much flatter than any powder then in use, and that the sights of all army rifles would require alteration. The British rifles being so short-sighted, he had no option but to turn to our neighbours of France. In November, 1881, he showed the powder and method of manufacture to the military attaché at the French Embassy, but it was some time afterwards before the French produced their powder "B," and this forced the hand of our military authorities at home. To-day, even the sights of our military rifles had been altered; in fact, he believed there was no part of either rifle or cartridge that had not been altered, and the art of war had been changed throughout the world.

Fifteen years after the process had been worked out, he learned that a German botanist, Hartig, had made experiments in the same direction in 1847. The pamphlet in which he described his experiments was extremely scarce. He knew of only one copy of it in Great Britain, and he had been unable to obtain it in Germany, so that his ignorance on the subject in 1881 might perhaps be excused.

The president next gave illustrations of the discovery of the method of silvering glass, a paper on which was written as long ago as 1867 by Justus von Liebig; of the discovery of Portland cement by Aspdin, the Leeds mason; and how both these discoveries led to important industrial results. He showed how fogged photographic plates led to the discovery of the Röntgen rays. Bolsover, in repairing the handle of a knife composed partly of silver and partly of copper noticed that these metals adhered to one another when fused. This laid the foundation for Sheffield plate. Dr. John Wright's invention of the use of cyanide of potassium in electro-plating was the outcome of research, and about the same time another inventor was busy on the same subject. One of the brothers Siemens found a method of electro-plating which he considered new, and brought it to England, where he offered it to Elkington. The latter was able to show him an almost identical process already at work. Mr. Reid next referred to the discovery of the vulcanising of india rubber by Hancock, which showed the necessity, not only of patient work, but also of perseverance and careful observation. Hancock had made a number of mixtures of india rubber with various substances, none of which appeared to have any particular advantage. The samples were put on one side for some months, when the whole of them were treated with oil. It was noticed that a portion of one sample was not acted upon by the oil, and on looking up his records of the samples Hancock found that this particular one had been heated to about 300° F., and that it contained sulphur. Incidents of this kind could be multiplied. He hoped he had shown the younger members of the society the advantages, first, of original work in connection with their industries; secondly, of careful observation and diligent inquiry into anything that might appear new to them; and thirdly, of perseverance until they had obtained some definite result.

TRIALS OF ROAD MATERIALS AND CONSTRUCTION.

THE use of motor vehicles has so completely altered the conditions of the wear and tear of the roads, that it has become necessary to find some new method of maintaining the surface and preventing the nuisance of the dust arising from the wear of the surface by the wheels of the motors. During the last few years various processes have been tried, chiefly directed to finding some more durable means of binding the surface material with which the roads are covered. The most successful so far have been by the use of tar asphalt or oil for binding the broken granite or other road material used for repair.

The new Road Board, with the view of securing a service test under uniform conditions, has made arrangements with the Kent County Council for carrying out a series of experiments on trial lengths of a main road, to be carried out under the direction of its advisory engineering committee. The site selected for these experimental trials is on the main road from London to Folkestone between Eltham and Sidcup. This road is thoroughly representative of the average condition of heavy road traffic. The average number of vehicles using this road in one day includes 322 motors of all kinds, and 454 horse-drawn vehicles, the traffic density amounting to 500 tons per yard of width.

The experiments are to be carried out under the direction and superintendence of Mr. Maybury, the county surveyor of Kent, who has paid special attention to this subject, and has so far succeeded in maintaining the surface of the main roads in Kent in excellent order. The special subjects to be taken into consideration are:—The first cost of the coating, and the future cost of maintenance and efficiency. Twenty-three different processes are to be given a trial, each extending over a length of a hundred yards. They include ordinary water-laid and rolled macadam; the same with a tared surface; tar macadam; and several patent processes.

Arrangements have been made for an inspection of the work while it is going on by those interested, and a pamphlet has been issued by the Road Board, giving full particulars and copies of the conditions and specifications under which the trials are to be carried out. This pamphlet is to be obtained at Messrs. Waterlow and Sons, London Wall, E.C.; price eighteenpence.

METEOROLOGICAL REPORTS.

PHILIPPINE WEATHER BUREAU (1908).—The part of the annual report now received includes (1) the administrative report for the fiscal year ending June 30, 1908, and (2) hourly meteorological observations made at the Manila Central Observatory during the calendar year 1908. The activity and popularity of the department dealing with storm warnings may be gauged from the fact that during a typhoon 160 telephonic inquiries were received in a single day. Telegraphic observations were received twice daily from twenty-nine foreign stations, and include reports from Japan, China coast, Formosa, and Indo-China. Special attention is directed to the "immense service" to shipping and other interests which the Eastern Extension and Great Northern Telegraph Companies have for years rendered in allowing free transmission of meteorological messages. The mean temperature of the year 1908 was 79·2° (rather below the normal); the maximum, 97·2°, occurred in May, and the minimum, 61·7°, in February. The rainfall was 97·7 inches (about 21½ inches above the normal); none fell in April (the average being 1·2 inches). Among the large number of seismic disturbances reported from different localities in the fiscal year only one violent shock occurred, viz. on November 24, 1907, in south-east Luzon.

Davos Meteorological Station (1910).—The annual summary, printed as a supplement to the monthly weather charts published by the Curverein, gives the mean maximum temperature in January and July, respectively, as 29·7° and 59·5° F.; mean minimum, 12·9° and 39·6°; absolute maximum, 77·5°, in July; minimum, −9·6°, in February. Rain (and melted snow) amounted to 45·6 inches (9·3 inches above the normal). Snow fell in every month except June and August. Sunshine was recorded during 1605·6 hours, which was much below the average (1790·7 hours for 1885–1905).

Bombay and Alibag Observatories (1910).—The mean temperature of the year was 79·1°, being 0·3° below the normal; the maximum hourly temperature was 92·7°, in June, and the minimum 61·5°, in January. The rainfall was 67·86 inches, being 7·3 inches below the normal (1873–96); June received a fall of 23·92 inches, being 3¾ inches above the average. Milne's seismograph registered fifty-seven earthquakes; those of November 9 and December 13 and 16 were great disturbances. The mean magnetic declination was 0° 57′ 43″ E.; inclination, 23° 35·7′; horizontal force, 0·36845 C.G.S. units. During the year there were 102 calm days, 236 days of small, 25 days of moderate, and 2 days of great disturbance. Part of the observatory is still infested by white ants, although the floor has been cemented; it is now proposed to use Minton tiles.

Falmouth Observatory (1910).—The report of this important station, maintained by the Royal Cornwall Polytechnic Society, and one of the normal meteorological observatories subsidised by the Meteorological Committee, is of more than usual interest. It contains meteorological means for the lustrum 1906–10, and for the forty years 1871–1910; also sea-temperature observations taken about one mile outside the harbour for the same lustrum, and means for thirty-one years, compiled with great care by the superintendent, Mr. E. Kitto. The monthly means of air temperature in 1910 were:—January, 44·2°; July, 58·2°; year, 51·1° (0·4° above the normal). Rainfall for year, 52·84 inches (7¾ inches above the normal, due partly to an unusually heavy fall, 9·22 inches, in December). The percentage of possible duration of sunshine was 38 (which was exactly normal). The mean temperature of the sea in 1910 was 52·1°; the only months in which the mean was below that of the air were May–August. In the valuable work of terrestrial magnetism the observatory received grants amounting altogether to 100*l.* from the Royal Society and British Association. The principal mean values for the year were:—declination, 17° 41·6′ W.; inclination, 66° 29·1′ N.; horizontal force, 0·18802 (C.G.S. units).

The Fernley Observatory, Southport (1910).—The principal station of this important observatory is situated in the Hesketh Public Park; the equipment is very complete and in duplicate. There are also branch stations at Marshside (for anemographs), Birkdale, and Barton Moss. The director, Mr. Joseph Baxendell, is an enthusiast in the work, and meteorologists are indebted to him for various improvements in self-recording instruments and for inquiries into many interesting details. Among several such matters in the present report we may mention (1) the alteration of a Richard hair hygrograph to enable daily instead of weekly traces to be obtained from the instrument, and some valuable results have already been obtained. (2) Careful experiments have shown how the readings of a thermometer were vitiated by the metallic fittings of an instrument in the enlarged Stevenson screen. The mean temperature of the year was 48·7° (0·5° above the average); maximum, 78·2°, in July; minimum, 16·0°, in January. The rainfall was 35·04 inches (2·14 inches above the average). Bright sunshine, 1568·4 hours (11·9 hours above the average). A rather surprising cold wave was felt by the deeper underground thermometers; its greatest effect was at 10 feet in February and at 20 feet in March. The very useful table of comparative statistics at other health resorts and large towns again appears in the report.

Mysore Meteorological Department (1909).—This seventeenth annual report, carefully compiled by Mr. N. V. Iyengar, chief observer in charge, contains detailed observations at the high-level stations Bangalore (3021 feet), Hassan (3149 feet), Mysore (2518 feet), and Chitaldrug (2405 feet), with means for the seventeen years 1893–1909. As in former years, the results have been worked out in great detail. Over the province as a whole the departure of the mean annual temperature from the normal was insignificant. The highest monthly mean maximum was 96·1°, in March and April at Chitaldrug, and the lowest mean minimum was 57·2°, in January at Hassan. Absolute maximum, 100·6°, in April at Chitaldrug; minimum, 52·2°, in January at Hassan. The mean rainfall was nearly 16 per cent. above the average. The rainfall statistics have been separately published (NATURE, February 16).

Deutsche überseeische meteorologische Beobachtungen (1909).—The nineteenth volume of this series of observations, published with the assistance of the Colonial Department, now extends to 116 quarto pages, and is divided into three sections:—(1) monthly and yearly means at certain hours at stations under the immediate control of the Deutsche Seewarte in various parts of the world; (2) observations at stations in German East Africa; and (3) observations in Togoland (West Africa). The monthly and yearly results for all stations in sections (2) and (3) will be eventually published in the *Mitteilungen* from German protectorates by Baron v. Danckelman. Full particulars about instruments and references to information about stations are given, and the extreme values are printed in thick type. These observations are of the greatest importance to meteorological science, and yearly increase in value.

Sonnblick Society (1910).—As a preliminary to the investigation of the influence of climate upon the variations of the Goldberg glacier it was decided, with the financial assistance of the Vienna Academy of Sciences, to have a survey made of the district. After removal of many difficulties, Baron v. Hübl proposed to make use of Dr. Pulfrich's stereoscopic method; the work was satisfactorily carried out by the Military Geographical Institute, and a coloured plan has been added to the present report. The following are some of the meteorological results for the Sonnblick Observatory (Rauris, Austria), altitude 10,187 feet:—mean temperature: January, 7·9° F.; July, 30·4°; year, 19·6°; absolute maximum, 47·7°, in July; minimum, −13·5°, in January. Melted snow and rain, 67·8 inches, on 258 days. Fog occurred on 281 days; each month had at least twenty days. Particulars relating to other mountain stations are given, as in previous reports.

BIRD-NOTES.

THE April number of *The Emu* contains an interesting account, by Mr. S. W. Jackson, of the nesting haunts of the rufous scrub-bird (*Atrichornis rufescens*), which, together with *A. clamosa* of Western and South-Western Australia, represents a peculiar family group. The expedition, which took place in September, 1910, was directed to the high Dorrigo scrubs at the head of the Bellinger River, New South Wales, where the first known nest and eggs were taken twelve years earlier. In addition to obtaining a second nest and eggs, it was the object of the expedition to procure a female, of which no example was then known. The nest finally discovered, of which photographs are given, was a large dome-shaped structure, with a tubular entrance, built amid thick bush in a tussock of dead carex grass. It was constructed of this grass and leaves, with a lining of a hard dry material made of wood-pulp, upon which the two eggs rested. The latter were removed by constructing a kind of extemporary ladle, but were eventually returned for a time to the nest as a lure to the female, who, however, eluded all attempts at her capture. A pair of lyre-birds had their nest and playground a short distance away.

To the May number of *British Birds* Mr. A. L. Thompson contributes a summary of the most recent records of stork-migration. It is now established that there is a south-easterly migration of storks across Europe in autumn, birds ringed in Denmark having been taken respectively at Brandenburg, near Frankfort-on-Oder, and in Austrian Silesia. This migration is remarkable in that its line cuts at right angles the route taken by the great majority of birds at the same season. As regards migration to and from Africa, Prussian storks have been taken in Syria, Palestine, and near Alexandria in some instances in the first, and in others in the second, year after marking. One Hungarian stork was also taken in Syria. On the other hand, three Prussian storks were severally taken during their first autumn near Lake Chad, on the Blue Nile, and on the Victoria Nyanza; a bird which left Pomerania at the end of August was taken in north-east Rhodesia early in December, while a Prussian stork was shot in the Kalahari during its first winter. Further, there are records of seven Prussian storks taken in the Transvaal, Natal, Basutoland, and the north of Cape Colony, and also of about a dozen Hungarian birds from the same area, while one was obtained so far west as German South-West Africa. With one exception, all these birds were taken during the northern winter; but the exception was captured in July. So far as the records admit of generalisation, it appears that storks generally return to their original summer haunts; but there is a notable exception in the case of a bird hatched near Brunswick in 1908, which made its appearance a couple of years later about 437 miles away, in eastern Prussia. This instance, together with the Lake Chad and German South-West African records, and the one noted below, indicate that further inquiry is necessary before our knowledge of the subject can be regarded as anything like complete. Very remarkable is the capture near Barcelona in September, 1910, of a bird hatched in the neighbourhood of Cassel, as this west German stork took a line of flight almost exactly the opposite of that followed by its fellows hatched in Denmark and north-east Germany.

Mr. J. H. Gurney in the course of his report on Norfolk birds for 1910 (*Zoologist* for May) alludes to the increasing scarcity of the corn-crake—which he attributes to the shooting of these birds in the south of France—and likewise to the recent visitation of crossbills. Most of the latter have departed, but when and where they went is another matter. A crane shot at Thornham in August was one of the rarities. In a note on the food of starlings, the author adduces evidence to prove that these birds are harmful to young wheat and oats, eating the sown grain as, or before, they sprout. On the other hand, they undoubtedly destroy large numbers of noxious insects.

Among several "Educational Leaflets" received from the American National Association of Audubon Societies, reference may be made to the so-called Virginian quail, or "Bob White" (*Colinus virginianus*), a bevy of which forms the subject of the illustration here reproduced. The

A Bevy of Californian Quail. From U.S. Educational Leaflet."

bird is a valuable asset to the United States, partly on account of the revenues derived from shooting rights and partly owing to the quantity of noxious insects and weeds it destroys. It is estimated that a family of a dozen quail would consume about 800,000 insects and 60,000,000 weed-seeds in the course of a year. When reposing, the members of a bevy arrange themselves in a circle with their heads directed outwards, and in such a position, except, of course, when snow lies on the ground, are stated to be almost invisible, even at a very short distance.

To the June number of *British Birds* Messrs. Ticehurst and Jourdain contribute an article, illustrated with maps, on the distribution of the nightingale in Great Britain, the subject being treated county by county. As regards the extreme south-western and northern limits of the range of the species, the authors endorse the view that neither in Devonshire nor Yorkshire has there been any extension within the period when, if it had occurred, it could be definitely traced. In Yorkshire, nightingales appear to have bred a century ago as far north as they normally do at the present day, occasional occurrences beyond the usual range having probably occurred in the past in much the same manner as is the case nowadays. It is noteworthy that the range of the bird in Yorkshire is strictly limited to the lowlands, only one instance of its breeding above the 250-feet contour being recorded. The alleged instances of the occurrence of nightingales northward of Yorkshire are regarded as not proven.

In an article in *The Irish Naturalist* for June Mr. R. M. Barrington attributes the great rush of birds observed in the south-east of Ireland during the night of March 29 to a combination of special circumstances affecting the ordinary spring migration. Owing to the prevalence of north-east winds over a great part of Europe, the birds had probably to halt in the south, where they collected in numbers. At Valentia, Pembroke, and the Scilly Islands the wind veered to the south on March 29, although north-east winds continued over the rest of the British Isles. The night was moonless, and after the birds had crossed the Channel they encountered a bank of fog off Ireland, which caused their hosts to become disorganised and attracted first by the lighthouses and then by the lights of the towns.

Exquisite photographs of birds and other animals illustrate a pamphlet on the "Ross Bird-stalker," written by Mr. C. Dixon, and published by Ross, Ltd., New Bond Street. The pamphlet advertises a stereo-prism binocular, stated to be well fitted for the purposes of the field-naturalist. R. L.

AMERICAN ETHNOLOGY.[1]

THE study of the Chippewa songs and music collected by Miss F. Densmore in Minnesota is of exceptional interest. Every phase of Chippewa life is expressed in music. Many of the songs are very old, and are found in several reservations; others are said to be the more recent compositions of certain men who composed them "during a dream" or "upon awaking from a dream." It is still customary for the Chippewa to celebrate an important event by a song. None are the exclusive property of families or clans; a young man does not inherit the right to sing his father's songs, but if he likes he may learn them by giving the customary gift of tobacco. As with the songs of the Murray Islanders of Torres Straits, the melody is considered more important than the words. It is permissible and customary to compose new words for old tunes, but they are always similar in general character to the words previously used, the idea being the important thing. Indian songs are not recorded in a definite system of notation, and a standard of absolute exactness is lacking; the melody-trend and the principal rhythm of the song, however, are constant. "Indian music seems to belong to a period in which habit takes the place of scale consciousness. Habit in the choice of musical intervals is formed by following a line of least resistance or by a definite act of the will, or may be the result of both, the voice at first singing the intervals which it finds easiest, and afterward repeating these intervals voluntarily. . . . The present study is not an analysis of fractional tones, but of melodic trend and general musical character; therefore the ordinary musical notation is used, with the addition of a few signs in special cases." A vibrato or wavering tone is especially pleasing to the singers; it is difficult for them to acquire, and is considered a sign of musical proficiency.

The songs fall into several classes, such as Dream songs, War songs, Love songs, Mocassin-game songs, Woman's-dance songs, and *Mide* songs. The *Mide* (Grand Medicine) is the native religion of the Chippewa. It teaches that long life is coincident with goodness, and that evil inevitably reacts on the offender. Its chief aim is to secure health and long life to its adherents, and music forms an essential part of every means used to that end. Both men and women are eligible for membership. There are eight degrees, persons being advanced from one degree to another on receiving certain instructions and bestowing valuable gifts. Meetings are held in the spring of each year, but it is permissible to hold initiation meetings in the autumn.

[1] Smithsonian Institution, Bureau of American Ethnology. Bulletin 45.—"Chippewa Music." By F. Densmore. Pp. xix+216. Bulletin 37.—"Antiquities of Central and South-Eastern Missouri." By G. Fowke. Pp. vii+116. (Washington: Government Printing Office, 1910).

All members are expected to attend one meeting each year for the renewal of their "spirit power." The life enjoined on the members is a life of rectitude. They are taught that membership does not exempt a man from the consequences of his sins. Lying, stealing, and the use of liquor are strictly forbidden. Various stages of initiation are described, and the appropriate songs with their music are given, each of which is accompanied by a reproduction of the mnemonic pictograph. All the songs are recorded in mnemonics on strips of birch bark, each record serving as a reminder of the essential idea of the song. The following examples illustrate these pictographs.

The Medicine song, illustrated by a figure, is: "Light—Around you—Chief—Woman." The picture was drawn by a woman, who stated that the horizontal line represents the edge of the wigwam, along which are arranged various articles of value indicated by the dots. At each end are torches, the light of which falls on the gathered wealth, causing many of the articles to glitter. These articles belong to a woman standing with upraised hands and wearing a pearl necklace with a locket. In singing this song the woman pointed to one portion of the picture after another, tapping the birch bark lightly as she sang.

The fourth song (p. 59), for initiation into the Sixth Degree of the *Midewiwin* (Grand Medicine Society), is: "Who is this—Sick unto death—Whom I restore to life?" The pictograph represents the body of the person to be initiated, on whom are seen lines representing the "strength" he is to receive through the *Mide*. "The words of the song refer to the person who is being initiated. Many sick persons are initiated in order that they may be restored to health. The *Mide* comprehends health of body, mind, and spirit in one general idea." It is somewhat unfortunate that this short memoir is simply entitled "Chippewa Music," for on reading the title a non-musical person might be led to overlook a piece of work which, as we have seen, covers a much wider ground.

As the result of two seasons' field work, Mr. Gerard Fowke has published a memoir on the mounds near the Missouri river, mainly between Gasonade River and Moniteau Creek. The mounds were erected on narrow ridges, with no regard to orientation; each contained a vault with sides sloping outwards, and composed of irregular stones. They contained one or more skeletons, either doubled up or disarticulated, the flesh having been first removed; in these cases the bones sometimes appear to have been thrown carelessly into the vault. The bones were in such a decayed and friable condition that very few could be preserved or measured. Dr. A. Hrdlička states that most of the crania are of the dolichocephalic Indian type, two or three being extreme forms in this respect, suggesting similar specimens recovered in New Jersey from the burials of the Delawares and also from the mounds of the Illinois River. A large number of the vaults are figured, as well as objects found within them. The author states that:—"As the Osage Indians never ascended the Missouri farther north than the Osage River, and as the stone vaults above that point show progressively more skill in their construction, we must attribute them either to the Kansa Indians or to some tribe whose name is now lost."

A. C. HADDON.

RADIANT MATTER.[1]

THE velocity with which helium is cast out by radio-active bodies at the moment of change varies considerably from one element to another. Thus the radiant atoms of radium C possess a far higher velocity than those of uranium or ionium. This fact is apparent in the greater distance to which the α rays of the former will penetrate in air or in any other substance. The distance traversed in air is known as the "range." The following table shows the ranges of α rays from the various known radio-active elements. Thus we see that whereas the helium from radium C is projected nearly 7 centimetres, that from uranium only reaches 2·7 centimetres. In the thorium series, one of the elements, thorium C, attains a range of 8·6 centimetres. This is the longest known.

[1] From a lecture delivered before the Royal Dublin Society on February 3, by Prof. J. Joly, F.R.S.

Range in Air.

	cm.		cm.
Radium C	7·06	Thorium C	8·6
Radium A	4·83	Thorium X	5·7
Emanation	4·23	Thorium emanation	5·5
Radium F	3·86	Thorium B	5·0
Radium	3·54	Radiothorium	3·9
Ionium	2·8	Thorium	3·5
Uranium	2·7		

	cm.
Actinium X	6·55
Actinium emanation	5·8
Actinium B	5·5
Radioactinium	4·8

By a most ingenious series of observations, Bragg has revealed some unexpected and interesting features attending the ionisation effects of the α rays upon gases through which they are projected. By measuring the amount of ionisation effected at different points along the path of the ray, Bragg and Kleeman have shown that at first, when the velocity is greatest, the ionisation effected is least, and that the amount of ionisation—that is, the number of ions created—greatly increases just before the atom comes to rest.

Let the ray be supposed to move along the line AB—this line representing the range. If at each point of its

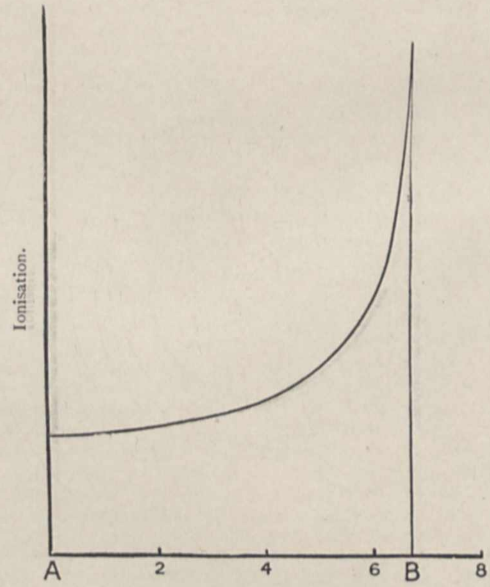

FIG. 1.—Range in cm. of air.

path we erect a perpendicular line proportional to the number of ions created by the flying helium atom, then, by joining up the ends of these lines, we obtain the curve shown. It will be noticed that a very well-defined maximum exists, after which the ionisation rapidly drops to nil. The curve reproduced is due to Geiger, who has added considerably to our knowledge of the subject.

Here is a small speck of the substance, pitchblende—the uranium ore from which radium is derived. All the elements of the uranium series are present. We are sure, then, that every α ray proper to this series, the ranges of which are given in the table, is being emitted by this particle of pitchblende. Let us form a mental picture of what is going on around it.[1]

Furthest out of all, the helium from radium C is projected. It attains a distance of 7 centimetres. The greater part by far of its ionisation is done near the end of its flight. Hence, remembering that these rays are darting radially in all directions from the piece of pitchblende, there is a shell of intense ionisation of spherical form existing around this pitchblende, and at a distance

[1] This might, possibly, be realised by condensing water vapour upon the ions according to the method described by C. T. R. Wilson (Proc. R. S., June, 1911).

of between 6 and 7 centimetres from it. This is entirely due to radium C. Within this shell we have a spherical shell due to radium A. It is the next we meet as we go inwards. It has an extreme diameter of 4·8 cm. The next shell is created by emanation. Its radius is 4·2 cm. The shell due to radium F succeeds at 3·8 cm.; then comes that made by radium, and, lastly, a very intense one due to the nearly coincident effects of three rays, two due to uranium and one to ionium. The weight of this particle of pitchblende is about one-tenth of a gram. If all its rays escaped freely at its surface, some 9600 α rays would leave it per second, and the number of ions created in the air per second would be about 960 millions. The diagram (Fig. 2) shows the successive shells, as they could be formed in air, to half scale.

We shall now pursue the study of radiant matter within the confines of another branch of science—that which deals with the nature, origin, and structure of the rocks. We gain this much by the transfer, that the invisible effects we have just been endeavouring to picture to ourselves as taking place around a radio-active body in equilibrium may be studied at our leisure, visibly inscribed in the ancient rocks. We require the microscope, however, in order to carry on our observations.

If we extract a flake of brown mica from the granite near Dublin and look at it through the microscope, we

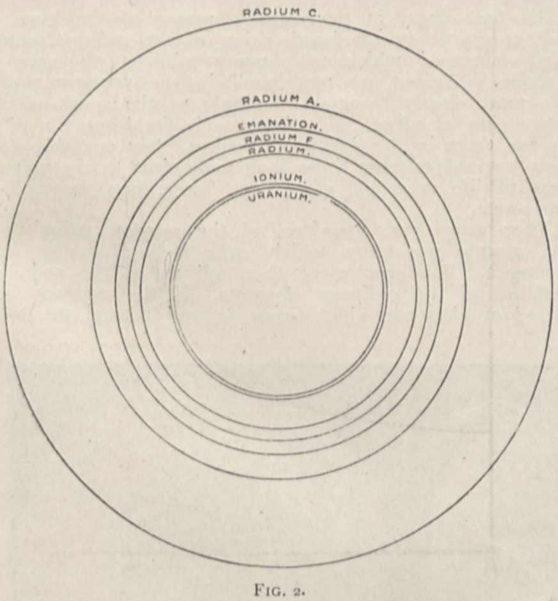

FIG. 2.

find here and there dark circular or disc-shaped marks. In the centre of each is a small crystal. This in most cases is the mineral zircon, which became enclosed in the mica at an early stage in the formation of that mineral. The dark area extends around the zircon like a darkened border, and, if the crystal is small enough, takes on the form of a perfectly true circle.

The remarkable occurrence of these dark circular spots, or "pleochroic haloes," as they are called, has been known to more than one generation of petrologists, and has always excited interest. Their origin has until lately been unexplained. Sollas, some years ago, prophetically stated his belief that they were to be ascribed to the presence of some rare earth in the zircon. When the minerals of the rocks were searched by Strutt for radio-active bodies, it was found that zircons were intensely radio-active—a concentration of uranium having in some manner taken place in these early formed bodies. The minerals apatite and allenite are also sometimes conspicuously radio-active, and around these, also, haloes often exist.

Let us then suppose that the halo is due to the radio-activity of the minute crystal around which it extends. We know that the radio-active elements in the zircon discharge helium atoms at high velocity into the surrounding mica. If these α rays have power to affect the mica by ionisation, just as they colour glass or affect a photographic plate, then there will be a certain region affected extending just so far as the rays can penetrate and no further. It will be a test of this explanation if the radius of the circular marks is found to be just the correct distance to which the rays could travel in mica.

Now Bragg and Kleeman have determined the principles upon which we may estimate from the observed ranges in air the range of α rays in any substance the chemical nature and density of which are known. Accordingly, we may calculate the ranges of several α rays in biotite. The table below gives the results.

Range in Biotite.

	mm.		mm.
Radium C	0·033	Thorium C	0·040
Radium A	0·023	Thorium X	0·026
Emanation	0·020	Thorium emanation	0·025
Radium F	0·018	Thorium B	0·023
Radium	0·017	Radiothorium ...	0·018
Ionium	0·013	Thorium	0·016
Uranium	0·013		

We see, as might have been expected, and as, indeed, was shown to you at the beginning of this lecture, that the mica is much more effective in stopping the rays than is the air. The extreme penetration of the rays from radium C is only thirty-three thousandths of a millimetre—a distance invisible to the unaided eye. This should be the limiting radius of a halo formed from the elements derived from uranium. If the thorium series was responsible, then we might expect haloes having a radius extending to the range of thorium C, that is, about forty thousandths of a millimetre. Now these are just the dimensions we find in the rocks when, by suitable appliances, we measure the sizes of haloes. Some have a radial dimension of 0·033 mm., and are then easily identified as due to the uranium series, and some scale 0·040 mm.; these are thorium haloes. Many scores of measurements confirm these results. Actinium haloes are not found; and this fact supports the inference already alluded to, that this element is derived from uranium as a very subordinate derivative, its effects being masked by the much greater vigour of the radiations from the radium series of elements. There is, then, no doubt, from the foregoing evidence alone, that haloes are the result of radiant matter.

It is of much interest to note that Rutherford has generated the equivalent of a halo in glass. In the course of experiments in which he had radium emanation contained in a capillary tube, the halo developed as a coloured border around the capillary, the radial dimensions being just such as corresponded with the penetration of α rays in glass. In the figure (Fig. 3), which I owe to the kindness of Prof. Rutherford, the central dark band is the capillary, the bordering narrow shaded area the halo.

It may also be mentioned that the experimental application of radium to biotite produces just such a darkening of the mica after some months as we see in the natural halo.

The circular or disc-like appearance of the halo is due to the fact that it is presented to us as the cross-section of a sphere. The true form is spherical. This is proved by the fact that when a crystal of mica is cut across the cleavage, the form is still circular (Fig. 5). This shows that the α rays are projected equal distances, or at least produce equal effects, along and across the cleavage—a fact not without considerable interest in itself, for it would hardly be expected on first consideration.

In the haloes which we have seen upon the screen there is no differentiation between the effects of the slower moving rays and those which move faster. The effects of the former must lie inside those due to the latter. The obliteration of the inner shells or spheres of ionisation is explained on the same principles as account for the loss of detail upon an over-exposed photographic plate. In the case of over-exposure the contrast is lost, because the effects of the lower lights have overtaken those of the higher lights, a uniform blackening ultimately resulting. If the radiant matter has been acting intensely on the mica for a very long time, the several shells of ionisation are merged in the accumulation of the feebler effects which are always progressing at all points along the path of the ray as shown in the Bragg curve.

We should expect, however, to meet cases where, either from the smallness of the quantity of radio-active material or from the recentness of the formation of the rock, there is a proper or correct exposure, so that the successive shells of ionisation, which we may picture to ourselves as surrounding a particle of pitchblende in air, would, as developed in the mica, be made visible to the eye. In this anticipation we assume that Bragg's laws apply to the ionisation of a solid.

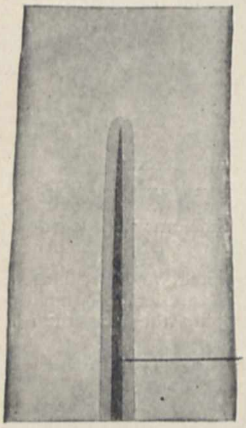

FIG. 3.

Now we do indeed find the several spheres of ionisation—or at least many of them—beautifully depicted in certain minerals, and thus we, at one and the same time, find additional, indeed overwhelming, evidence that the haloes are due to α rays, and also, what would be hard to establish experimentally, that Bragg's laws govern the effects in the solid medium.

Here is a group of well-exposed haloes in the biotite of co. Carlow. You see the outer ring due to radium C, and the gap of feebler ionisation between it and the shell due to radium A. We even find some which are actually "under-exposed." These often have got no further than the record made by the intense triple effect due to uranium and ionium. I show you this photograph again, but this time with an engraved scale of hundredths of a millimetre, which was photographed without disturbing the microscope; so that it is possible for you to verify the fact that the dimensions of the fully formed haloes are all over the plate alike, and just that which the radiant matter from the uranium series of elements would account for.

It is possible to trace the development of haloes by observation of those arising from a feebler and feebler central radiation. A succession of photographs taken to the same enlargement reveals that the innermost sphere is first formed. Then this widens under the rays from radium and emanation, and the outermost sphere, for some unexplained reason, often becomes conspicuous before radium A has produced much effect. The effects of the latter rays sometimes appear as a distinct ring.

We find a striking comment on the immense age of the haloes and of the containing rocks by a study of these objects, for it is easy to show that the growing haloes we have now been looking at are the accumulated effects of ionisation acting with extreme slowness. It is calculable directly that, even if we supposed the minute nuclei of some of these haloes to consist, not of zircon, but of the most radio-active ore known, pitchblende, the rate of expulsion of the α rays has, owing to the smallness of the quantities of radio-active substances involved, been fewer than eighty in a year. But this is not all. Some of the nuclei are identified with certainty as zircons. If we ascribe to these a radio-activity even greater than Strutt found in his highest measurements, one or more years would have elapsed between one expulsion of consecutive helium atoms and another. But geological time is long; and we may still recognise in the feeblest haloes the work of many millions of atoms of radiant matter, each exerting its own small effect, but these effects carefully preserved and accumulated. In short, we recognise the halo and detect its nature and origin on the same principles as we recognise by their light-effects accumulated upon the photographic plate the presence of stars invisible to the eye.

We find, then, in the rocks a record of the laws of radiant matter in the handwriting of the radiant matter itself—a record which took many millions of years to inscribe. Haloes are not found in the younger rocks. We must clearly recognise the halo as the result of the integration of effects of unimaginable feebleness; and as we see them in the Archæan granites, they probably date their beginnings from times long antecedent to the appearance of life upon the globe, not fewer than 100 million years ago.

They assure us, therefore, of the remote antiquity of the atomic instability which calls radiant matter into existence. But even more they tell us of the enduring stability of the ordinary elements. If the common and abundant elements which occur in and around the mica emitted radiant matter, even at the slowest rates, the clear transparency of the mica must long ago have vanished, and the whole become obscured under the effects accumulated during the ages which have elapsed since the formation of the rocks.

We seem entitled to conclude that the atomic stability and instability which we observe to-day have prevailed during geological time.

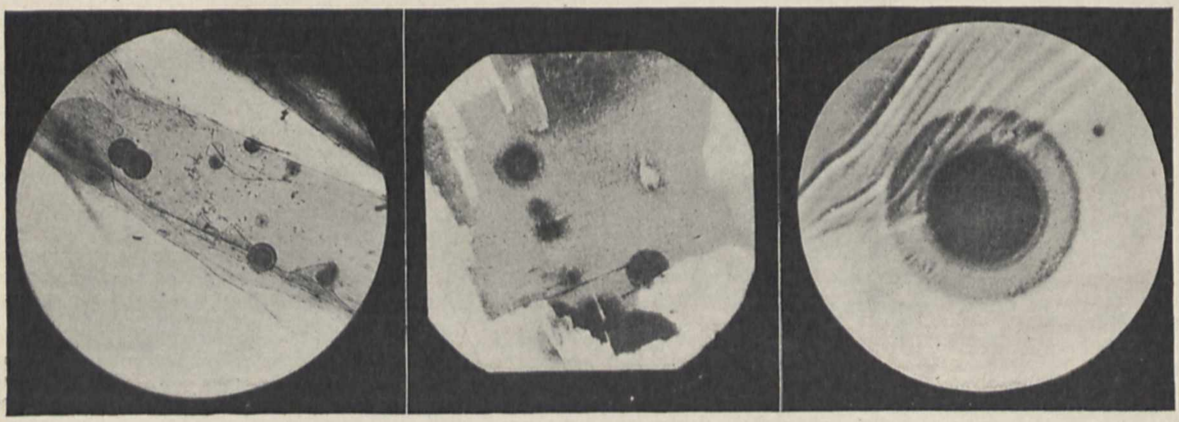

FIG. 4.—Radium haloes in cleavage plate of biotite (co. Carlow); enlarged about 76 diameters. Two overlapping haloes are present, as well as a few under-exposed haloes.

FIG. 5.—A radium halo (lower right-hand part of the field) and a thorium halo (upper left-hand part) in brown mica in a granite. The mica is cut across the cleavage. Enlargement about 114 diameters. The thorium halo shows an inner sphere due to the thorium X. The ratio of the diameters of inner and outer spheres will be found to be as 2·6 : 4·0.

FIG. 6.—A single radium halo from the Carlow biotite. It is enlarged to about 500 diameters. The inner dark disc is due to emanation. The radium A sphere succeeds and appears to be less developed than that of radium C. Viewed on cleavage.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—A special degree congregation is to be held on July 27 in connection with the meeting of the British Medical Association, in Birmingham, at which it is proposed to confer the honorary degree of LL.D. on the following gentlemen:—The Rt. Hon. John Burns, President of the Local Government Board; Sir Francis Lovell, K.C.M.G.; Dr. R. H. Chittenden, professor of physiology in Yale University, U.S.A.; Prof. H. Oppenheim, Berlin; Prof. Paul Strassman, Berlin; Dr. Byrom Bramwell, president, Royal College of Physicians, Edinburgh; Dr. J. A. Macdonald; Dr. R. A. Reeve, professor of ophthalmology, Toronto; and Prof. Sims Woodhead.

It is announced in *The Times* that the Chinese Minister has consented to become patron of the United Universities' scheme for a university for China. The Rev. W. E. Soothill has been appointed acting president of the university for five years. Mr. Soothill was formerly principal of the Imperial University, Shan-si, China, and is the author of standard works on the Chinese language.

THE French Physical Society, the International Society of Electricians, and other learned societies, are cooperating in the inauguration of a fund to honour the memory of the late M J. Joubert, of the Pasteur Institute. The object of the fund is to found a scholarship, with which the name of Joubert will be associated, tenable at one of the institutions with which he was connected as pupil or teacher. Subscriptions may be sent to M. Gauthier-Villars, 55 quai des Grands-Augustins, Paris.

THE issue of the *Johns Hopkins University Circular* for May takes the form of the "Johns Hopkins University Register, 1910–11." The historical statement with which the volume opens shows that the university was incorporated on August 24, 1867, and its original endowment amounted to about 600,000*l.* This fund has been supplemented by several gifts, including 200,000*l.* in 1902, until now the income-bearing funds amount to more than 900,000*l.*, the total assets being 1,300,000*l.* In June, 1909, the General Education Board offered to contribute to the university 50,000*l.* towards the endowment, provided the institution could secure, on or before December 31, 1910, a supplemental sum of 150,000*l.*, in cash or pledges. By the date mentioned the sum of 188,600*l.* was secured, more than sufficient to meet the condition imposed by the General Education Board. The Legislature of Maryland, too, has this year made a grant of 5000*l.*, which will be repeated next year.

THE fifteenth Oxford Summer Meeting will be held at Oxford from August 3 to 28. The general scheme of lectures is intended to illustrate the place and part of Germany in world history, and its contribution to literature, art, science, theology, and philosophy. The inaugural address will be given by Viscount Haldane. One section of the meeting will consist of lectures on the epoch-making names in German science. These discourses include: Humboldt, by Mr. H. J. MacKinder, M.P.; Helmholtz, by Sir Joseph Larmor, F.R.S.; Liebig and Bunsen, by Sir William Tilden, F.R.S.; Johannes Müller, by Prof. F. Gotch, F.R.S.; Von Bär—the founder of modern embryology, by Prof. G. C. Bourne, F.R.S.; the evolution of medicine in Germany, 1850–1900 (Virchow and Koch), by Sir W. Osler, F.R.S.; and Gauss and modern astronomy, by Mr. J. A. Hardcastle. There will also be a special class for instruction in field map-making under Mr. Mackenzie, and classes in educational psychology.

THE Royal Commissioners for the Exhibition of 1851 intend to put into operation at an early date a scheme of industrial bursaries. The scheme is as follows. The commissioners propose to establish a scheme of industrial bursaries for young men who, after a course of training in a university or approved technical college, desire to enter engineering, chemical, or other manufacturing works. The bursaries are intended to enable suitable applicants to tide over the period between their leaving college and obtaining remunerative employment in industry. The value of the bursary will depend on the circumstances of the candidate, but will, as a rule, not exceed 100*l.* a year. A bursar will be elected in the first instance for one year, but the tenure of his bursary will ordinarily be prolonged for a second year provided that the commissioners are satisfied with the work done by the bursar during his first year. In special circumstances a bursary may be renewed for a third year. The appointments to the bursaries will be made by the commissioners from among candidates recommended by the authorities of certain selected universities and technical schools. In dealing with these recommendations, great weight will be given to evidence that a candidate has the practical abilities likely to lead to his advancement in manufacturing work, academic success alone being an insufficient recommendation. The candidate must be a British subject under the age of twenty-five. The candidate must have been a *bona fide* student of science for a term of three years. The candidate must further satisfy the commissioners (*a*) that he has obtained, or can within one month of election obtain, a post in some engineering or other manufacturing works approved by them; (*b*) that he is in need of pecuniary assistance to enable him to accept such a post. A bursar may, if the commissioners approve, spend part of the tenure of his bursary in studying a special industrial process or processes in works either at home or abroad. No bursar shall enter a firm as a premium pupil without the special consent of the commissioners. A bursar must submit a report of his work to the commissioners on the expiration of each year of his bursary. Forms of application may be obtained from the secretary to the commissioners.

SOCIETIES AND ACADEMIES.

DUBLIN.

Royal Dublin Society, June 27.—Prof. T. Johnson in the chair.—Prof. G. H. **Carpenter**: Injurious insects and other animals observed in Ireland during the year 1910. The points of interest in this paper are the record of a second brood of the codling moth (*Carpocapsa pomonella*) in the south-west of Ireland, and the occurrence of the maggots of *Scaptomyza flaveola* and an unknown Cecidomyid on turnips in county Louth.—Prof. J. **Joly** and L. B. **Smyth**: The radium-emanation content of soil gases and its escape into the atmosphere. The emanation content of soil gas is measured by filling a suitably calibrated electroscope with gas drawn from certain depths in the soil. The rate of its escape at the surface of the soil is investigated by means of a collector, which covers a certain area of the soil, and beneath which a slow current of air circulates. The air current is finally led through a charcoal absorption tube. It is believed that natural conditions are best realised by this collector. It is found that the conditions favouring the maximum rate of exhalation are dryness and openness of the capillaries of the soil. These conditions also lead to a fall in the emanation-content beneath. In accordance with this, the daily readings of emanation-content and of exhalation at the surface when plotted show opposing curvatures. The amount escaping at the surface is very considerable. The rate of escape is often more than sufficient to account for the decay of the emanation in a radio-actively homogeneous atmosphere extending to a height of 5 kilometres, and possessing an emanation-content equal to the average found by Eve and others. Soil within the city of Dublin is found to contain less emanation and exhale less than soils in the suburbs. To the south of the city the soil is specially rich, the quantity of contained emanation near the surface per litre being such as would be in equilibrium with a quantity of radium of the order 10^{-9} gram, the quantity exhaled per square metre per hour being also of this order. The causes influencing the quantity of radium emanation in the soil are under investigation, as well as the influence of the emanation upon vegetable life.

PARIS.

Academy of Sciences, July 10.—M. Lippmann in the chair.—B. **Baillaud**: Remarks on a volume of the photographic catalogue of the sky, Paris zone.—M. **Renaut** was elected a correspondant for the section of anatomy and zoology, in the place of the late M. Armand Sabatier.—MM. **Lagrula** and **Schaumasse**: The Kiess comet, 1911*b*. Observations made at Nice. Three observations are given for July 8. The comet appears as a bright globular condensation surrounded by a nebulosity.—

M. **Javelle**: The Wolf comet. Observations made at Nice with the Gautier equatorial of 76 cm. aperture. Data given for July 5 and 7. The comet appears like a star below the 14th magnitude.—Silvanus P. **Thompson**: A new method of harmonic analysis by the algebraic summation of determined ordinates. The method described is specially adapted for the harmonic analysis of tides, of diurnal magnetic variations, and of the periodic motion of the mechanisms for the distribution of steam in steam engines.—G. **Sagnac**: Interferential strioscopy and striography analogous with the Foucault and Töpler optical method of striæ.—Ch. **Fabry** and H. **Buisson**: The radiation from mercury vapour lamps. The numerous applications of quartz mercury vapour lamps renders desirable precise measurements of the yield of radiation, visible and ultraviolet, under various conditions of employment. The proportion of ultraviolet rays emitted by a given lamp depends greatly on whether it is water-cooled or not, and also upon the age of the lamp.—L. **Benoist**: The application of the chemical harmonica to chronophotography. An acetylene flame, issuing from a fine jet, is placed in a glass chimney, and from the pure note thus obtained the time of vibration can be determined with considerable accuracy. A mirror is fixed to the rotating apparatus the velocity of which it required to measure. The high actinic power of the flame renders the application of photography very easy.—M. **Girousse**: A means of suppressing the troubles caused on telegraph lines by energy-carrying cables. A description of a simplification of the method proposed by Voisenat. The immunity obtained against an alternating current has been proved experimentally, and details are given.—R. **Boulouch**: The sine relation of Abbe is a condition of stigmatism. The condition of true aplanetism.—A. and L. **Lumière** and A. **Seyewetz**: The development of photographic images after fixing. If a very dilute solution of sodium thiosulphate is used for fixing, the Neuhauss method can be much simplified. The formulæ of the solutions taken are given, and also an alternative solution containing mercury salts instead of silver.—Marcel **Guichard**: The extraction of the gases from copper heated in a vacuum. The complete elimination of the gases from copper by heating is difficult to realise, and requires in all cases a very lengthy period of heating.—H. **Gault**: The lactonisation of the α-ketonic esters, α-ketoadipic ester, and in general, the esters of α-ketomonoacids and α-ketodiacids under the influence of condensing agents, forms lactones by the elimination of a molecule of alcohol between two molecules of the ester. Several examples are worked out in detail.—Ph. **Dumesnil**: The preparation of some unsymmetrical benzyl-dialkylacetic acids. Starting with ketones of the type $C_6H_5.CO.C(R_1R_2R_3)$, prepared by the method of Haller and Baur, the prolonged action of sodium amide in boiling xylene upon these ketones gives the amide $NH_2.CO.C(R_1R_2R_3)$, from which the corresponding acid is readily obtained by hydrolysis with sulphuric acid.—E. **Léger**: The constitution of some nitro derivatives obtained by the action of nitric acid upon the aloins.—A. H. **Richard**: A dimethylpentene obtained by the action of heat upon a dimethylcaoutchouc. Methyl-isoprene polymerises in exactly the same manner as isoprene. Under the influence of light and heat it gives a rubber-like mass: the dry distillation of the latter gives a homoterpene as the principal product.—M. **Gard**: Is the law of uniformity of hybrids of the first generation absolute? It has been found that for the genus Cistus the uniformity found by Naudin is not fixed.—J. E. **Abelous** and E. **Bardier**: The influence of oxidation on the toxicity of urohypotensine. The toxic power of urohypotensine is increased by oxidation.—H. **Bierry** and J. **Larguier des Bancels**: The action of the light emitted by the mercury lamp upon solutions of chlorophyll.—M. and Mme. **Lapicque**: The useful duration of the discharges of condensers: experiments on the snail.—A. **Imbert**: A graphical study of work done by a file. The curves obtained showed clearly the differences between an apprentice and a practised workman: pathological conditions in the latter are also clearly brought out, a fact of medico-legal importance.—J. **Bergonié**: The respiratory exchanges in chronic articular rheumatism and the modifications which they undergo by muscular exercise electrically stimulated. The respiratory exchanges, in subjects affected by chronic articular rheumatism, are very appreciably lowered, in one case to about 3/5 of the normal. The light bath appeared to be without any influence on these cases, but muscular exercise, electrically stimulated, caused these exchanges to approach the normal.—Jules **Courmont** and A. **Rochain**: Vaccination against the pyocyanic infection by the intestinal method.—A. **Sartory**: The value of Meyer's reagent in the examination of the blood. Meyer's reagent ought not to be considered as a specific test for blood in chemico-legal researches, and should only be used for corroborative purposes.—A. **Fernbach** and M. **Schoen**: Some observations on the mechanism of the mode of action of the proteolytic diastases.—Alexandre **Lebedeff**: The mechanism of alcoholic fermentation.—J. **Wolff** and E. **de Stoecklin**: The specificity of various combinations of iron from the point of view of their peroxidasic properties. A reply to some criticisms of H. Colin and A. Sénéchal, the authors giving the results of fresh experiments in support of their views.—Paul **Hallez**: The double function of the ovaries in some Polyclads.

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