THURSDAY, DECEMBER 2, 1909.

JOHN DEE.

John Dee (1527–1608). By Charlotte Fell Smith. Pp. xvi+342. (London: Constable and Co., Ltd., 1909.) Price 10*s.* 6*d.* net.

IN the personal history of learning there is probably no more interesting or more perplexing figure than the subject of this book. The story of John Dee reads more like a romance by Sue or a *feuilleton* by the elder Dumas than as a sober, veracious narrative of an actual human career. The achievements of the man, his learning, the range of his knowledge, his aberrations, his vicissitudes of good and evil fortune—mainly evil—taken together, make up a tale which has hardly a parallel in biographical literature, certainly not in the biography of science.

There is a time-honoured adage that a man is to be judged by the company he keeps. John Dee certainly mixed in very questionable company during one period of his extraordinary career, and his memory has greatly suffered from that circumstance. Although he enjoyed the patronage, and to some extent the protection, of the great—mainly from motives of self-interest—his contemporaries for the most part looked askance at his performances, and his life in consequence became a continuous and prolonged struggle with prejudice, misrepresentation, and slander.

Miss Fell Smith may be congratulated unreservedly on her work. Even in this age, which has witnessed many attempts to reverse the adverse judgment of a man's fellows, it needed some courage to try to rehabilitate John Dee in the good opinion of posterity. But, by treating her subject in the spirit of science, that is, by patiently investigating the facts, carefully sifting and weighing the evidence, and skilfully unravelling the tangled web of truth and fiction which has hitherto enveloped his history, his latest biographer has for the first time succeeded in laying bare his true character, and in revealing the hidden springs and motives of his actions. In the record she has put together, Miss Fell Smith has elaborated her testimony and presented the case for the panel, as the Scotch say, with no ordinary literary ability, and the dispassionate reader must admit that she has succeeded in clearing the old philosopher's memory from the charges of deceit, dissimulation, and knavery which lay heavy on it.

In reality, John Dee was a man born out of due season. His age was not ready for him. In the times of the Tudors there was no place in the body politic for the professed man of science, unless he practised his science covertly as a physician or a priest. Even then its pursuit was attended with a considerable measure of personal peril. John Dee, it is true, dabbled in medicine, as he dabbled in most things that had any connection with the science of his period, and he was thereby of occasional service to his suffering fellows. For a time, too, his only means of subsistence came from a couple of wretchedly endowed country livings to which he was presented. But he was never recognised as a practising physician, or as a professed priest. His life's work was the pursuit of truth merely for the sake of elucidating it, an occupation unintelligible to his age. Apparently every aspect or form of truth was of equal importance to him; but, naturally enough, the direction in which he searched was influenced by his environment and the circumstances of his time. It was inevitable that such a man should sooner or later come into conflict with his age—a hard, unrelenting, pitiless age; and it was equally inevitable that he should be worsted in the fight. The spectacle of a strong man struggling with adversity is, we are told, a sight loved by the gods. We cannot help thinking that it is the spectacle of a sorely tried albeit misguided man, bent and well-nigh broken by the storms of fate, that has touched and quickened the womanly sympathy of the author of this book. Its compilation has evidently been a labour of love, or of the pity which is akin to it. Every page bears testimony to the patient care and trained skill with which the author has searched all available records and followed every clue which might serve to unravel the mystery of her hero's life.

John Dee was born in London in 1527. His father, Rowland Dee, was a gentleman server in the court of Henry VIII. The boy was sent to the Chantry School at Chelmsford, and thereafter, at the age of fifteen, to St. John's College, Cambridge, where he graduated in 1546, and was made a fellow of Trinity at its foundation by Henry VIII. Two years later, after taking his M.A. degree, he entered the University of Louvain, and thence passed on to Paris, where he gave lectures at the university on Euclid. Returning to England, he produced one or two astronomical works, and a book on the cause of the tides, presumably for the use of Edward VI. On the accession of Mary he got into trouble, and was thrown into prison on a charge of magic, and eventually of treason, and stood his trial by the Star Chamber. Nothing could be proved against him, and he was liberated, only to be handed over to the tender mercies of Bishop Bonner. He escaped even this ordeal, and subsequently presented Mary with a project for the establishment of a great national library in which to preserve "the treasure of all antiquity," the priceless collections of ancient literature which had been scattered by the dissolution of the monasteries and religious houses. Nothing came of the suggestion at the time. A couple of centuries had to elapse before the British Museum was founded, and it was only in the opening years of Queen Victoria's reign that keepers of the public records were appointed and the Historical Manuscripts Commission was brought into existence.

Easier times came to Dee with the advent of Elizabeth. He was already well known to her. She had corresponded with him when confined to Woodstock. His position as a mathematician had been established, and the name of the editor of Billingsley's "Euclid" was known throughout the learned world. The friend of Mercator—"my Gerard," as he calls him—he was esteemed, too, as a geographer skilled in cartography, and was constantly consulted by the

great sea-captains of his time—Gilbert, Davis, Frobisher, Hawkins, Cavendish, and others of the remarkable band that created the sea-power of England. Dee had settled at Mortlake, where he was frequently visited by the Queen. Elizabeth had ever an eye for a comely man, and Dee was remarkably handsome, tall, stately, and of a dignified mien. The picture which Miss Fell Smith draws of his home life there, with his second wife—"his paynful Jane," as he calls her, the staunchest, truest friend he ever had—with the great Queen, either when "taking the ayre" or when on her way from Hampton Court or Isleworth to her palace at Greenwich, cantering up to his garden gate in order to get sight and speech of her courtly philosopher, is a charming piece of word-painting. But these were not altogether halcyon days for Dee. Elizabeth was gracious, even profuse in promise, but she was a very niggard in performance, and her astrologer was occasionally hard put to for the means of living.

Edward Kelley—*alias* Talbot—clipper, coiner, forger, and thief, now appears upon the scene, and the aspect of things becomes very grim. This man was Dee's evil genius. Their connection is one of the most astonishing and perplexing circumstances of his history. How Kelley could have acquired such complete ascendancy over his patron is almost inexplicable. Kelley was a first-class ne'er-do-well, a lover of loose company and of strong waters, and a consummate liar. He professed to be a clairvoyant, a skryer, or crystal-gazer, and Dee's passion for occultism was such that no tale of mystery or message from the spirit world was too gross or outrageous for him to swallow, as his own records of their *séances* demonstrate. Dee was an operative alchemist of no mean reputation, and the supposition is that Kelley sought to worm himself into Dee's confidence in order to gain information concerning the manufacture of the philosopher's stone, about which Dee never professed any knowledge. It is impossible here to go into any detail of the extraordinary partnership into which the pair entered, or to tell how they were induced, mainly at the instigation of a Polish adventurer, to wander, with their wives and Dee's children, on to the Continent, through Holland, North Germany, Poland, and eventually to Prague, where Kelley took service under Rudolph II., the "Hermes of Germany."

The story of that morose, half-witted, loose-living fanatic, who secluded himself for years in his gloomy palace at Prague, occupying himself with astrology, thaumaturgy, alchemy, necromancy, and every other form of aberration of which the human mind was then capable, is one of the most striking chapters in the book. Here Kelley was in a congenial atmosphere; he became wealthy—how is not very clear—flourished, in fact, like the bay tree, and was ennobled, only to fall more rapidly than he rose. He had previously shaken off Dee; he had no further use for him. The poverty-stricken, disillusioned man, after six years' wandering over Europe, now set his face once more towards Mortlake, only to find that, in his absence, his precious library of 4000 volumes had been rifled, and his instruments and apparatus broken by his neighbours. Well might he exclaim:—

"Have I so long, so dearly, so farre, so carefully, so painfully, so dangerously, fought and travailed for the learning of wisedome and atteyning of vertue, and in the end am I become worse than when I began? Call you this to be learned? Call you this to be a philosopher and a lover of wisdome?"

Could anything be more dramatic? The peaceful home on the banks of the Thames, into whose "silver" stream Dee's children occasionally tumbled without risk of being poisoned by the filth of Brentford; the surprise visits of the Queen; the advent of Kelley, and with him all the ghastly, skrying, crystal-gazing business—just as it is done to-day in Bond Street—communings with Annael, Anachor, Anilos, Uriel the Spirit of Light, Bobogel, Michael with his fiery sword, Gabriel, Raphael, II, Ave, and the rest. Then comes Madimi, the first of the female angels who appeared to the pair, sometimes as "a pretty girl of seven or nine years attired in a gown of Sey, changeable green and red, with a train," and at other times as "a wench in white," and who had learned Greek, Arabic, and Syrian on purpose to be useful. Next enters the Mephisto of the story—Laski, the Polish adventurer, introduced by an angel named Jubanladec—who enjoined him to "live better and see himself inwardly." At his solicitation the pair decide to go with him to Poland. Then comes the journey across Holland, and along the devious peat-coloured waterways of East Friesland and out to sea by the islands up to Embden, and so to Oldenburg, Bremen, and Lubeck. Thence to Cracow, and eventually to Prague, where we have the mad Emperor, and all the diabolical doings in chicanery and fraud which bring the cropped-eared Kelley to his end. Lastly, we have the return of Dee—a ruined man, cheated by those he trusted, shunned by his acquaintance, scorned by his enemies—to the wrecked house at Mortlake he called home.

What a phantasmal tragedy it all seems! And yet it is sober history, capable of being verified in detail, as Miss Fell Smith demonstrates in her vivid, scholarly, and deeply interesting narrative.

T. E. THORPE.

THE PRECIOUS METALS.

The Precious Metals, comprising Gold, Silver, and Platinum. By Dr. T. Kirke Rose. Pp. xvi+295. (London: A. Constable and Co., Ltd., 1909.) Price 6*s.* net.

DR. ROSE, as is well known, is the author of the chief text-book on the metallurgy of gold; a book on the "Precious Metals" from his pen is, therefore, most welcome, and although in dealing with this subject details of processes and methods are for the most part left out, yet nothing of importance as introductory to the study of these metals is omitted.

The author states in the preface that his aim "has been to provide an introduction to the study of the precious metals and an elementary book of reference for those who do not wish to pursue the subject further." This aim has been admirably attained.

In the first chapters we have a brief but accurate summary of the history of gold from the earliest times, followed by an account of the properties of the metal and its compounds of special value to the metallurgist. The important subject, the alloys of gold, is treated at greater length in the fourth chapter, which is one of the most valuable parts of the book, and contains an account of these alloys, brief, it is true, but no essential points have been overlooked. The attention of the metallurgical student is especially called to this chapter, as it forms a comprehensive introduction, such as is not found elsewhere, to the detailed study of these interesting mixtures of gold with other metals. The constitution of these alloys, according to modern views, as deduced from freezing-point curves and micro-structure, is ably and clearly explained. In the subsequent chapters dealing with gold, the occurrence of the metal in nature and the methods of extracting it from ores are dealt with. Commencing with the simplest and most primitive method of extraction, that of simple "washing" practised from the earliest times and culminating in the modern system of "dredging," the various processes of amalgamation are passed in review, and, finally, the so-called "wet" processes are considered. Of the latter, the cyanide process, to which we owe the extraordinary production of gold in the Transvaal, is dealt with at considerable length in the eighth chapter.

Silver, now of much less importance than gold, since it is no longer in use for the standard coinage of most countries, occupies only about half the space given to the nobler metal.

The alloys, compounds, and ores of silver are first discussed, and then methods of extraction. The important methods are described, and even those which have become, or are becoming, obsolete receive fitting attention. The time-honoured *patio* process in Mexico, where the climate and other conditions were specially favourable for its success, which has produced many millions sterling of the metal, has evidently had its day, is being replaced by the modern cyanide process, and is now mainly of historical interest. The same is true of other "wet" processes in many silver-producing districts.

An entire chapter is devoted to the processes employed in the refining of gold and silver, operations dealing annually with enormous values. Thus gold to the value of 50,000,000*l.* is refined every year by the sulphuric-acid process, 12,000,000*l.* by the chlorine process, and about 4,000,000*l.* by electrolysis.

The chapters on assaying, minting, and the manufacture of gold and silver wares are written with great clearness, and give the best brief and trustworthy account which has yet been published on these subjects. They will be read with interest by both technical and non-technical readers. Platinum, although not usually included in the term "precious metals," yet, being in common use and more valuable weight for weight than gold, has been rightly given a place in the book. The condensed account given of it deals with its occurrence, properties, alloys, extraction, purification, and assay.

The volume concludes with a series of statistics relating to the production and consumption of the precious metals.

The accounts of the various operations by which these metals are extracted from their ores and refined or adapted for minting or industrial use, although brief, are clear and accurate, and the essential points in each process on which its success depends are carefully set forth. A valuable feature, too, is the chemical reactions and changes which occur in the operations, and the principles on which they are based, which appear under each metal.

Dr. Rose is to be congratulated on his book. He has succeeded in compressing within the limits of 295 pages an excellent summary of the metallurgy of gold, silver, and platinum, marvellous in conciseness, quite up-to-date, and without the omission of anything of serious importance.

It deserves many readers, and can be strongly recommended to metallurgical students, by whom it can be studied with advantage before or at the same time as the larger text-books. W. G.

FLOWER CULTURE.

Beautiful Flowers and how to Grow Them. By Horace J. Wright and Walter P. Wright. Pp. 198. (Edinburgh: T. C. and E. C. Jack, n.d.) Published in seventeen parts at 1*s.* each, or two volumes at 10*s.* 6*d.* each.

THIS work will take a high place amongst recent publications dealing with the popular and fascinating art of floriculture. The authors have made a selection of the best and most beautiful flowers for cultivation in the garden and greenhouse. These flowers, numbering 100 in all, are illustrated in full-page coloured plates, which are excellent reproductions of flower paintings by such well-known artists as Beatrice Parsons, Eleanor Fortescue Brickdale, Anna Lea-Merritt, Hugh L. Norris, Lilian Stannard, Margaret Waterfield, A. Fairfax Muckley, and Francis E. James.

Such a collection affords a very valuable guide to amateurs as to which flowers are likely to give them most pleasure, and, in the majority of cases the kinds presented will be found amply sufficient for their study; but, not only so, the plates will prove useful in two further directions. In the first place, many of the pictures depict the particular flowers grouped with other kinds with which they harmonise perfectly in the garden, and, in the second place, as the paintings were in most cases prepared from first-class specimens, they set before the amateur a high standard of culture he will do well to emulate. Both these lessons are given in such plates as a "Bed of La France Roses," "Dwarf and Climbing Roses, with Zonal Geraniums," "Madonna Lily (*Lilium candidum*) and Roses," "Pyrethrums and Lupins," "Foxgloves and Poppies," "Asters, Phloxes and Sweet Peas," "Hippeastrums," "Single Dahlias," "Rose-arch and Campanulas," "Hardy Chrysanthemums," and "Water Lilies." In certain others a supremely satisfactory result is obtained by showing a single plant depicted in all its glory, such, for instance, as

"Fibrous-rooted Begonia," in which the peculiar form and colour of a well-flowered plant are clearly set forth; *Lycaste Skinneri, Masdevallia Harryana,* and *Paphiopedilum* (*Cypripedium*) *Curtisii.*

It will be seen that orchids are well represented; indeed, the subjects are selected from almost every class of flowering plant; even the window garden is not forgotten, but, on the contrary, one of the plates illustrates a window-box filled with suitable plants in full flower. It can be said of only a small number that they fail to rank with the best, and in these few cases the original drawings were insufficiently definite in character or the plants depicted were scarcely satisfactory specimens.

So far we have referred only to that portion of the work which answers to the first half of the title, namely, "Beautiful Flowers," but in the text the second half of the title is justified, "How to Grow Them." The authors, being well familiar with their subjects, have related in pleasant, but plain, language all the details of cultivation that are necessary to enable the merest amateur to obtain success. It is satisfactory to note that this is done without the petty gossip and extraneous information that mar so many modern gardening books. In short, the writing, though pleasantly entertaining, is serious, and its main object, namely, that of imparting information, is always kept in mind. Part i. is exclusively devoted to the rose, which is treated at greater length than most of the subjects. Carefully compiled lists of roses specially suitable for particular forms of culture will save the amateur a great amount of research in catalogues, which is seldom satisfactory unless the cultivator has already considerable knowledge of the habits of the different types. Roses are followed by chapters on bulbs, which extend into part iii. Then follows a long article on hardy herbaceous plants, these being amongst the popular flowers of the day.

In part vi. herbaceous plants give place to rockery plants, and these to greenhouse and stove plants. In succeeding parts articles are devoted to sweet peas, carnations, dahlias, chrysanthemums, and all the most beautiful garden flowers, until near the end we come to the floral aristocrats, the orchids. There is a good index, and, in addition to the coloured plates, there are line drawings inserted in the text for the purpose of illustrating some of the cultural processes, such as budding, grafting, and other systems of propagation, also potting, tying, &c. The publishers may be congratulated on the excellent type and the general good appearance of this book, which is suitable for the drawing-room table.

BRITISH CATTLE.

The Evolution of British Cattle and the Fashioning of Breeds. By Prof. James Wilson. Pp. viii + 147. (London: Vinton and Co., Ltd., 1909.) Price 7*s.* 6*d.* net.

THE author of this book exhibits a considerable knowledge of the literature which bears upon the subject of the origin and development of British cattle. His references range from Cæsar's Gallic war to Thomson's recent book on heredity; they embrace not only husbandry in the old and agriculture in the new sense, but political and social history, and such details of the modern sciences of palæontology and Mendelism as are necessary for his purpose. Thus a knowledge of the habits of the peoples dealt with and of the circumstances affecting them at various times is brought to bear upon the problem of the migration of cattle and of the blending of different breeds in olden days, while the evidence he has culled from various writings of the seventeenth and eighteenth centuries is especially noteworthy and valuable to the student of heredity, inasmuch as it throws light on the causes which influenced the establishment of modern breeds during a period of which but little is generally known of stock breeding.

In his opening words the author asserts that it will be his duty to question and sometimes to destroy many fondly cherished beliefs as to the origin, history and evolution of the cattle of these islands. We think he has fulfilled that duty in a clear and convincing manner, and not only so, but has succeeded, as he hoped, in placing before his readers a sounder knowledge of the subject.

After a chapter on *Bos primigenius,* in which he disposes of the evidence advanced to show that this species has ever been represented here, he quotes the work of many modern palæontologists to demonstrate that *Bos longifrons* is the species which was present in the Neolithic age, and was the original native breed. It was this black breed, he says, which was driven with their Celtic owners before the successive invaders of Britain, and remain till this day in Scotland, Ireland, Wales, Cornwall, and the north of England.

He then claims that with the Romans came the white cattle of Southern Europe, from which the wild white cattle found at the time of the Norman invasion and the present wild herds are derived. That with the Anglo-Saxons came the red cattle which dominated the south of England down to the eighteenth century, and of which our Lincolns, Devons, Herefords, Norfolks, Suffolks, and Sussex are the representatives; while with the Norse people came the polled cattle.

After the Norman conquest until the seventeenth century he believes there was but little migration of cattle about the country, and that not until later still was crossing of breeds at all freely carried on. What he calls the "Dutch invasion" of cattle in the seventeenth and eighteenth centuries, caused by England's sympathy with the Netherlands, gave rise to the first shorthorn blood, and, as at this time "landowners had become business men," great impetus was then given to breeding.

He then deals in an admirable manner with the production and evolution of the various breeds which exist to-day; he calls to his aid Mendel's theories, and shows their practical value for the elucidation of such complex problems.

Especially interesting are his chapters on the causes, natural and artificial, which stimulated or checked the spread of the Hereford, longhorn, shorthorn, and Aberdeen Angus breeds; on Bakewell, Charles Colling, Hugh Watson, and other great breeders, and how they all brought their special breeds to perfection, first

by their judgment and ability to select good stock, secondly, by judicious inbreeding, and, thirdly, by ruthlessly discarding unsatisfactory animals.

We have no hesitation in recommending this book to all who are theoretically or practically interested in the subject of breeding.

GEOGRAPHICAL MANUALS AND GUIDES.

(1) *A General Geography of the World.* By H. E. Evans. Pp. xii+439. (London: Blackie and Son, Ltd., 1909.) Price 3*s.* 6*d.*

(2) *The Oxford Geographies.* (Oxford: Clarendon Press, 1909.) (*a*) *The Practical Geography.* By J. F. Unstead. Part i, pp. 120; part ii, pp. 112; complete in one volume. Price 2*s.* 6*d.* (*b*) *The Elementary Geography.* By F. D. Herbertson. Vol. i; *A First Physiography.* Pp. 80. Price 10*d.* Vol. iii; *Europe, excluding the British Isles.* Pp. 112. Price 1*s.*

(3) *Cambridge County Geographies. Norfolk.* By W. A. Dutt. Pp. viii+156. *Suffolk.* By W. A. Dutt. Pp. viii+136. *Hertfordshire.* By R. Lydekker. Pp. ix+173. *Wiltshire.* By A. G. Bradley. Pp. xi+156. (Cambridge: University Press, 1909.) Price 1*s.* 6*d.* each.

(4) *By Road and River: a Descriptive Geography of the British Isles.* By E. M. Wilmot-Buxton. Pp. viii+154. (London: Methuen and Co., 1909.) Price 2*s.*

(5) *A Systematic Geography of the British Isles.* By G. W. Webb. Pp. viii+94. (London: Methuen and Co., 1909.) Price 1*s.*

(6) *Highways and Byways in Middlesex.* By W. Jerrold. Pp. xviii+400. (London: Macmillan and Co., Ltd., 1909.) Price 6*s.*

(7) *Growls from Uganda.* By Critolaos. Pp. 120. (London: Elliott Stock, 1909.) Price 2*s.* 6*d.* net.

(1) IF the student of geography can be taught to appreciate the value of a work of general reference, strictly arranged on a systematic plan, Mr. Evans' "General Geography" should meet with a demand. But it is not difficult, on the other hand, to imagine the school-child quailing before these serried ranks of facts, figures, and names, baldly presented, thrust forward by means of heavy-faced type, summarised (where there is need) in tables. It is to be hoped that no attempt is made, in these days, to teach geography out of such a book alone; but as a medium for refreshing the memory on essential points before an examination, it should be of great value. To enhance this value, a number of examination questions are given. Another noteworthy feature is that the index is made to serve as a guide to pronunciation, a matter in which students (and, for the matter of that, most other people) are commonly at fault owing to the difficulty of obtaining guidance in it.

(2) Mr. Unstead's "Practical Geography," as its name suggests, is a guide to practical work in geography. The guidance is provided by series of exercises, each group of which is preceded by an introductory statement. There are two parts in this volume. The first deals with map-reading, field work (*i.e.* the study of local geographical features on the spot), weather, and the British Isles. The second part is for students somewhat more advanced; it deals with map-making, weather changes, and their causes, the form and movements of the earth, the principal countries, and the comparative growth of population and development of commerce in Great Britain and other countries. Full directions are given for plotting on maps or illustrating by diagrams the various classes of geographical information, under the above headings, which are capable of such treatment. The exercises appear to be carefully thought out and suggestive, and ought to interest every student who once acquires an aptitude for them.

It would be hard to keep the requirements of the most elementary teaching more carefully in view than Mrs. Herbertson has in the two volumes of "The Elementary Geography" under notice. There is certainly an art in writing from this point of view. The two volumes are slight, but must needs be so. Simplicity in language and construction of sentences has been strictly adhered to. In this series the extreme value of illustrations has been realised, and some good photographs, selected according to their relevance to points in the text, are provided, with an explanatoin beneath each. A few simple exercises are provided for each subject taken up. These little volumes should supply a real need; their use as an introduction to geography must be manifest, in contrast with volumes of stock questions and answers.

(3) The four volumes of the "Cambridge County Geographies" now under notice are by different hands from those previously commented upon in these columns. While they adhere strictly to the model laid down for the whole series, the style is somewhat less rigid than that of the earlier volumes, and this is undoubtedly an improvement. Line drawings have not been used in the present volumes, and the photographs call for particular commendation as being well chosen and well reproduced. It may be repeated that the series deserves every encouragement, and it is to be hoped that it will be carried to completion in the same good style as marks Mr. Dutt's works on the two eastern shires, Mr. Lydekker's on Hertfordshire, and Mr. Bradley's on Wiltshire. The volumes are really remarkable value for their price.

(4) A school-book with the title "By Road and River," suggests something of a novelty. And Mr. Wilmot-Buxton's treatment of geography as a school subject is a decided departure from the ordinary lines. For the most part, we like it very well, and so should the children who learn from it. Premising that most children have no great opportunity for learning geography by the very best method—travelling—the author invites them to "*pretend* to go on journeys from place to place" by rail, road, or river. The result is instructive and entertaining, even if the author occasionally goes rather far in colloquialism in order to keep his style attractive. Moreover, the sketch-maps and illustrations are quite above the average in such books—the illustrations are particularly well chosen. A few questions for exercise accompany each chapter.

(5) Mr. Webb's "Systematic Geography of the British Isles" forms a complete contrast to Mr. Wilmot-Buxton's book just noticed. The two might advantageously be used together, Mr. Wilmot-Buxton providing lighter reading to alleviate the hard facts which Mr. Webb makes little attempt to soften by picturesque writing. The study of geography in the skeletonic form in which Mr. Webb presents it is no doubt a necessity, and his book is a model of careful arrangement. He lays a greater stress than usual on geological formation, tabulating and explaining the different rocks found in these islands as simply as possible. A point open to criticism is found in the historical notes sometimes attached to the names of chief towns. Some of these remarks, in order to be understood, would either presuppose detailed historical knowledge, or necessitate so long an explanation that they had better have been omitted.

(6) The volume on Middlesex in that favourite series, "Highways and Byways," takes a high place among its companions. Mr. Hugh Thomson's illustrations are charming; we could almost blame them because they even beautify some of their subjects, when the artist shows us picturesque fragments divorced from the unlovely surroundings characteristic of suburban villages. The author admirably practises the style best suited to these volumes, a blend of pleasant description and historical gossip. It is well that such history should be preserved in accessible shape, when so much of the external evidence for it has been effaced.

(7) We cannot pretend to find much value in "Growls from Uganda." It is true that the author gives us some impressions, conveyed by a very ready pen, of his life in Uganda and his travels in British Columbia, and in these two countries he presents us with a perfect contrast, if nothing else. But the essays in which he offers views on various features of social life in England, even though they touch upon genuine abuses, seem generally to show little more than a mastery of the obvious, or to provide (as in the case of the tirade against motor cars) little else than a protest against the inevitable. Frankly, we should not have supposed these parts of the book worth printing, from whatever quarter of the globe they had been addressed. O. J. R. H.

OUR BOOK SHELF.

Weather Indicator. Compiled and designed by Wm. Ballance. (London: G. Philip and Son, Ltd., n.d.) Price, in sheet form, 2*s.* 6*d.*; mounted, &c., 3*s.* 6*d.*

THIS is an issue in map form of what the publishers term a "weather indicator," to be obtained either in a sheet or mounted on rollers. The notes, tables, &c., have been compiled by Mr. W. Ballance, and the publishers suggest that the "weather indicator" will be found useful for schools, clubs, public libraries, hotels, boys' brigades, and boy scouts. The information given seems too elaborate, and might easily have been rendered more simple; it is not very scientific, but it probably aims to be chiefly of a popular character. Many of the so-called weather signs which are collated, especially those relating to the movements of animals, birds, and insects, have been handed down to us from the ancients, and are somewhat amusing. For country life, some quoted should undoubtedly receive attention, but the general belief in all would tend to much confusion. For town life many are altogether inapplicable. Such statements as "A white frost never lasts more than three days," "Quick thaw foretells long frost," "Hoar frost predicts rain," are bold, but probably incorrect. The wind scale given is not in accordance with recent knowledge; the equivalent velocity in miles per hour, and equivalent wind pressure in pounds per square foot for the several units of the wind scale, are very different from those now generally accepted. To be told as a sign for fair weather the barometer should be steady, or rising about 0·004 inch per hour; for rain falling slowly about 0·004 inch per hour; for wind falling gradually about 0·011 inch per hour; for wind and rain falling moderately about 0·015 inch per hour; and for stormy weather falling or rising rapidly about 0·021 inch per hour is precision which meteorologists have no knowledge of, especially when most of our barometers only read to hundredths of an inch.

Science and Singing. A Consideration of the Capabilities of the Vocal Cords and their Work in the Art of Tone Production. By Ernest G. White. Pp. 72. (London: The Vincent Music Co., Ltd., n.d.; Boston, Mass.: Thomas J. Donlan, 1909.) Price 4*s.* 6*d.* net.

THE writer of this book endeavours to show that the tones of the human voice are not produced by the vibrations of the vocal cords, but by means of movements or pressures of the air in the sinuses found in the frontal, supermaxillary, sphenoid and ethmoid bones, and which all communicate with the cavities of the nose; in short, his theory may be called sinus tone production. In our opinion the author has not succeeded in establishing his position. The facts of anatomy and physiology, and the data of experiment, are entirely against him. Nothing is more certain than that the vocal cords vibrate, and, on the other hand, one cannot conceive how vocal tones could possibly be produced by the cavities we term sinuses. These, no doubt, have their effect in modifying the qualities of vocal tones by resonance, and the quality of a so-called head voice may be so explained. The merit of the little book is that it is written in an interesting, breezy style by one who is obsessed by an idea, and that it is illustrated by a number of beautiful diagrams, evidently from actual photographs, showing the anatomical position of the various sinuses. The various pictures are admirable.
J. G. M.

Butterflies and Moths of the United Kingdom. By Dr. W. Egmont Kirby. Pp. lii+468. (London: Geo. Routledge and Sons, Ltd.; New York: E. P. Dutton and Co., n.d.) Price 7*s.* 6*d.* net.

THIS is a book comprising descriptions of the larger British lepidoptera (macro-lepidoptera), with coloured figures of them all in their perfect state, and many in the larval stage. There are also a few pages given to the micro-lepidoptera, with coloured illustrations of their characteristic species. It is a book of the popular rather than the scientific order, one for information and reference useful to collectors who wish to know where and when to find the objects of their pursuit. The coloured plates, of which there are no fewer than seventy, each comprising usually some twenty or thirty figures, are, as might be expected from the price of the work, not of a high order, but are often good, and probably always sufficient for the purpose of recognition, which is the main value of a work of this kind.

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.*]

A New Ocea ographical Expedition.

IN NATURE of November 18 (p. 71) there is a notice of a new oceanographical expedition, to be undertaken by the Norwegians in their surveying vessel *Michael Sars*, on the suggestion of Sir John Murray, and mainly at his expense. It is very gratifying to meet with cooperation of this kind in the prosecution of deep-sea research, and the investigation of the portion of the North Atlantic contemplated in the programme cannot fail to furnish interesting and useful results.

In the account of the expedition I note the following passage :—"The application of methods of high precision to the determination of the temperature and salinity of sea-water has yielded results which have raised considerable doubt in the minds of some investigators as to the validity of the earlier observations made by the *Challenger* and other expeditions, and the cruise of the *Michael Sars* should not only afford much entirely new information, but provide a means of valuing the earlier work."

As chemist and physicist of the *Challenger* expedition, I feel that this is a reflection, not only on the name of Challenger, but also on myself. I was a professional chemist of recognised standing at the date when the expedition was planned, and it was to this fact that I owed my selection for the post nearly a year before the ship sailed. During the whole of this time I was occupied with the study of the work to be done and of the methods to be employed in doing it. Some of these were devised by myself, and none were approved before they had been thoroughly tested on land; nor were they finally accepted until they had passed the probation of the first three months at sea. The regular work of the expedition began with the sailing of the ship from Teneriffe on February 15, 1873. By this time the scheme of the routine work of my department had taken definite shape, and it suffered but little alteration during the cruise. All the actual work was done by myself, and no method was employed which I had not myself tested and found to give, in my hands, thoroughly trustworthy results.

I think it is due to me and to the readers of NATURE that the investigators, in whose minds doubts have been raised as to the validity of the *Challenger* observations, should state them, with the grounds on which they rest, and also indicate how they expect the cruise of the *Michael Sars* to provide a means of valuing the earlier work.

November 27. J. Y. BUCHANAN.

Gametogenesis of the Sawfly *Nematus ribesii*. A Correction.

IN the *Quarterly Journal of Microscopical Science*, vol. li., 1907, p. 101, I described observations on the gametogenesis of *Nematus ribesii*, some of which subsequent work has shown to be erroneous. Since my statements have been quoted in several recent papers, I think it necessary to correct the mistakes as far as possible, although I have not yet reached a satisfactory solution of the phenomena. The errors arose partly through misinterpretation of the phenomena observed and partly through imperfect fixation, for I find that, unless the material is very accurately fixed, the chromosomes tend to adhere together and give the appearance of a smaller number than the true one. The same cause has led other observers to make similar mistakes.

Re-investigation of Nematus shows, in the first place, that there is only one division of the spermatocytes; the first division described in my paper is not a true mitosis, but is probably comparable with the abortive division observed in the spermatogenesis of the bee. I have not yet been able to determine the chromosome number with certainty. In the spermatogonia the number appears to be about sixteen, and that in spermatocyte mitoses about eight, but if eight is the true reduced number, the occurrence of sixteen in the spermatogonial mitoses of larvæ derived from parthenogenetic eggs is unexplained. In the bee, and as I find also in a Cynipid (to be published shortly), the spermatogonial number is the same as that of the spermatocytes.

I have not yet obtained fresh material for re-investigation of the maturation of the egg, but the results of my recent work on the spermatogenesis make it clear that my observations on the chromosomes in the polar divisions also require revision.

But the behaviour of the chromosomes in *Nematus ribesii* is so difficult to follow that it is possible that the true interpretation will be obtained only by the discovery of some nearly related species in which they are more clearly distinguishable. LEONARD DONCASTER.

University of Birmingham, November 27.

Are the Senses ever Vicarious?

[PROF. MCKENDRICK has sent us the subjoined letter received by him, and his comments upon it.—ED. NATURE.]

MY attention has just been directed to a letter which appeared in NATURE of March 11 (vol. lxxx., p. 38). It was signed by Prof. McKendrick, and dealt with the vexed question of the blind and their faculties.

I am a blind man, and have mixed with blind people of all ages for the past thirty years. You will grant that I ought to know something about the question you discuss in your letter.

Permit me to thank you for what you say about the popular notion that when a person loses his sight he is compensated by a gift of ability in one, if not all, his other faculties. The intelligent blind know how foolish this idea is, and constantly protest against it. The public, however, insist upon its accuracy, and calmly assume that the blind do not grasp the point at issue, or affirm that those who protest are unbelievers in the goodness of God. This assertion of compensation leads to all sorts of ridiculous notions, and has a very pernicious practical effect. The very people who assert the theory of compensation are among the number who shrink from providing facilities for the proper training and employment of the very gifted people they profess to look upon as the possessors of special talents. They impute to us the possession of all kinds of striking abilities, yet they decline to allow the specially talented to do what would earn or help to earn a livelihood. We are credited with mavellous powers in music, basket-making, &c., and yet when we assert our claim to live the ordinary life of the citizen these people are shocked at our audacity.

Now, the overthrow of the theory that we are specially compensated for the loss of sight will destroy the false impressions regarding our wonderful memories and all the other fantastic notions, and the way will be opened for common-sense treatment of the training and employment of the blind. It is notorious among the blind themselves that numbers of them are not at all musical, and that mechanical ability is not a conspicuous feature. Many blind are very deficient in hearing, in smell, and in the sense of touch itself. My own experience has compelled me to take heed of the varying degrees of what I shall call, for want of a better name, ear-power. The same variety exists in touch-power and memory-power. I should like to refer to these as well as many other interesting phenomena, but I fear I must content myself with asking your kindly attention to a problem which has baffled me for more than twenty years. Why does the voice call up before me the upper part of the speaker's face, and enable me to form a picture of the expression of the speaker? The expression of the eyes is frequently as vividly before me as when I could see. When people are speaking to me, they are never on guard to control their countenance as they would be if conversing with a sighted person. I am thus enabled to get a picture of the play of their emotions which helps me to come to conclusions as to character, &c. The lower part of the face was only once made visible to me, so that I could feel sure about it. I know when a person smiles, frowns, when the face lights up with an intelligence or when apathy and want of perception cloud the countenance. Sometimes I can follow the line of the glance and can point out where it would strike. When listening to public speakers I like to sit at an angle to them, and not in front. Can you point to anything that will aid me to come to a sensible conclusion on this matter of the voice convey-

ing the picture of the upper part of the face, and thus help me to fathom a question which I am persuaded contains the key to many other problems as to the constitution of sound and the organ of sound?

GEORGE IRONS WALKER.

Westbury Street, Sunderland, October 28.

WITH reference to Mr. Walker's interesting letter, which bears out the opinion of Prof. Kunz and others that there is no special development of the other senses in those who have lost the sense of sight, I feel at a loss to give an adequate explanation of the curious experiences described by Mr. Walker. The only suggestion I would venture to make is that Mr. Walker may, by long and almost unconscious practice, have learned to associate certain tones of the voice, as regards quality of tone, with certain movements of the head that he supposes are made by the speaker at the time he utters the words. Tones of inquiry, surprise, reproach, affection, interest, have each a certain quality indicative of states of feeling (unless they are produced by mimicry), and the blind man may draw conclusions as to movement and state of feeling on the part of the speakers. He has then what Mr. Walker calls "a picture of the play of their emotions." I cannot explain why Mr. Walker has almost invariably a picture of the upper part of the face, nor why he prefers to sit at an angle to a public speaker instead of in front. His experience supports the view that the blind have not more acute sensory perceptions than those who see, but that they have cultivated the habit of close attention. This, in turn, stimulates their imagination, and gives them mental pictures of external things that are of no special importance to those who see.

JOHN G. MCKENDRICK.

Movements of the Red Spot Hollow on Jupiter.

TRANSIT estimates of the Red Spot Hollow on Jupiter, obtained between 1908 December 20 and 1909 June 12 inclusive, show that that object exhibited an average monthly increase in longitude of 1·03°. Its motion, however, was not constant, inasmuch as it remained practically stationary in longitude during the last three months (April to June) of the apparition. The rotation periods of the three selected points of the Hollow, namely, the two shoulders and the middle, work out as under :—

p. Shoulder.

Date	Long.	No. of transits	Elapsed rotations	Mean daily drift	Rotation period
	°			°	h. m. s.
1908, Dec. 20 ...	358·5	16	... 408 ...	−0·0376 ...	9 55 42·2
1909, June 7 ...	4·8				
Middle.					
1908, Dec. 20 ...	13·6	15	... 420 ...	−0·0274 ...	9 55 41·8
1909, June 12 ...	18·4				
f. Shoulder.					
1908, Dec. 20 ...	31·1	20	... 420 ...	−0·0344 ...	9 55 42·1
1909, June 12 ...	37·1				

The mean rotation period of the Hollow, therefore, appears to have been, as nearly as possible, 9h. 55m. 42·0s., a period which is 1·4 seconds longer than that of the adopted value of System II.

At the commencement of the observations, in December, the middle of the Hollow crossed the central meridian about twenty-three minutes subsequent to the passage of the zero meridian, and half an hour at the close of the apparition in June. This lagging behind may be regarded as a distinctly normal movement on the part of the Red Spot.

When the planet was observed last month as it emerged from the sun's rays, the Hollow was found to have moved at an accelerated rate of velocity during the unobserved interval since June. From transits obtained on October 15, 25, and 30, the deduced mean longitude of the middle of the Hollow was then 16·4°. This shows a decrease of 2° when compared with the longitude for June. It is evident, therefore, that the motion of the object had latterly become quickened. Had the Hollow continued to drift at the same rate as was exhibited from December to June, it would have crossed the central meridian ten minutes later than was actually the case last month. Owing to this slight displacement in longitude, the rotation period from June to October was shorter than that for the previous six months, and works out at 9h. 55m. 40·0s.

Leeds, November 21. SCRIVEN BOLTON.

Secondary Kathode Rays.

IN a letter to NATURE of April 2, 1908 (vol. lxxvii., p. 509), I described some experiments of mine which showed that for the corpuscular rays produced in metals by Röntgen rays there was a lack of symmetry between those coming from the side of the metals on which the primary rays were incident and those coming from the side from which the primary rays emerged. The ionisation produced by the emergence secondary corpuscles was, in general, greater than that produced by the incidence corpuscles. This was in accordance with Prof. Bragg's results for the corpuscular rays produced by γ rays (NATURE, January 23, 1908, p. 270).

Since writing the above I have endeavoured to see if this lack of symmetry was dependent on the penetrating power of the primary Röntgen rays. Experiments were carried on only with gold and silver, and gave the following results. The average of four determinations with soft primary rays on silver showed the ionisation produced by the emergence to be 1·11 times as great as that produced by the incidence corpuscular secondary rays; eight determinations with hard primary rays gave an average ratio of 1·21. Five determinations with soft primary rays on gold gave the ratio of emergence to incidence ionisation as 1·03; nine determinations with hard primary rays gave a ratio of 1·09. The probable error of the mean in each case was ±0·01. It would seem, therefore, that there is a slight variation of the asymmetry with the hardness of the Röntgen rays, certainly in the case of silver, and very probably in the case of gold, the harder primary rays causing the ratio of the emergence to the incidence corpuscular rays to increase.

Though the hardness of the Röntgen rays could be varied, they were probably always very heterogeneous. I hope soon to repeat my experiments, using more homogeneous Röntgen rays, which have been recently made possible by the experiments of Prof. Barkla.

CHARLTON D. COOKSEY.

Sheffield Scientific School, Yale University, New Haven, Conn., November 17.

AN INTERNATIONAL MAP OF THE WORLD.

AN International Committee assembled in London on November 15 to consider the form in which it is desirable to prepare a uniform map of the world on the scale of 1/1,000,000, or about sixteen miles to the inch.

The proceedings of this committee have aroused keen interest among geographers, and the results of its labours will be anxiously awaited. The meeting of this committee marks an epoch in map-making, and if its proposals are generally adopted, as no doubt they will be, there will be prepared a map of the whole world, uniform in design and execution, on a reasonably large scale.

Hitherto each country has, in the preparation of its maps, had in view solely its own requirements, and has made no effort to assimilate its maps to those of other countries, either in regard to scale, projection, method of representing hills, or in other points. Maps have been issued differing widely in these respects from those even of the adjoining countries.

The difficulty caused by this diversity of map design has long been felt, not only by those little versed in map reading, but by those who have constant occasion to work with maps.

It was not until 1891 that the first important step was taken towards obtaining a more uniform map of the world. In that year the International Geographical Congress at Bern raised the question, and the London Congress of 1895 passed a resolution recommending the scale of 1/1,000,000, or about sixteen miles to the inch, as suitable for a map of the world. This resolution was communicated to the various Governments in the hope that this scale might be generally adopted.

It was some time before this resolution produced much effect, but eventually Great Britain published a map of the United Kingdom on this scale, and commenced the publication of maps of Africa and Asia, while France and Germany commenced the issue and the United States the preparation of maps on this scale. Meanwhile the opinion of experts was coming round to the view that for the map of the world uniformity in many points other than scale is desirable.

At the meeting of the International Geographical Congress at Geneva in 1908 the subject was again considered, and it was decided to recommend for the 1/1,000,000 scale map the adoption of a uniform design, *i.e.* that the projection, methods of representing hills and other details, the conventional signs, amount of detail to be shown, and other points should be similar throughout. The various Governments were asked to prepare specimens on the 1/1,000,000 scale to illustrate their views as to style, &c.

Great Britain then invited the different Governments to appoint delegates to meet in London in order to consider draft proposals, which had meantime been elaborated, for the preparation of this map, and it was the delegates appointed in response to this invitation who recently met in London. The principal Powers of Europe, the United States of America, Canada, and Australia sent delegates, and the *personnel* of the committee was so strong that its recommendations must carry great weight.

Its report has not yet been published, but it may probably be assumed that the recommendations are substantially as given in the *Times* of November 22. These may be briefly stated as follows:—

(1) The adoption of the modified polyconic projection, and the division of the map of the world into sheets, each distinguished by a letter of the alphabet and by a name.

(2) A scale of kilometres, and, if desired, also of feet, to be printed on each sheet.

(3) Altitudes to be given in metres, and, if desired, also in feet.

(4) Ground forms to be shown by contours in brown and by coloured layers, as used in Bartholomew's maps and in some of the more recent maps of the Ordnance Survey. The contours to be at 100-metre intervals in the lower ground, and at greater intervals in the higher ground; ground forms not to be shown at altitudes above 7000 metres.

(5) Water to be shown in blue, perennial being distinguished from non-perennial water, also navigable from unnavigable rivers. Obstructions such as dams, locks, &c., to be shown, also fresh and salt marshes. Depths below the sea to be indicated by blue contours.

(6) Main roads to be distinguished from secondary roads, railways in running order from those under construction or projected; lines of telegraph, post offices, boundaries, towns and villages, &c., to be shown. A table of conventional signs was drawn up.

(7) Names to be in Latin character in the form adopted by the country in which the object is situated. Special rules were drawn up for translating names from other languages into the Latin character.

I think that all geographers will agree that these proposals, taken as a whole, are thoroughly sound and worthy of the distinguished geographical experts who form the committee; but there are some details of importance as to which assent to the proposals of the committee is likely to be less general, although probably the views of the committee will be widely accepted.

The scale of the map, about 1/16 inch to a mile, is sufficiently small to make it difficult to show a great deal of detail without overcrowding, and thereby detracting from the clearness of the map. In many countries it will be advantageous and also easy to show without overcrowding, all the detail contemplated by the committee, but in closely populated country such as parts of France, Germany, Great Britain, and the United States, it will, at any rate, be very difficult. If one studies the existing 1/1,000,000 scale map of England, which has perhaps rather less detail than the scale will admit of, it will be seen that the addition of much detail might overcrowd the map. It is not suggested that the committee proposes to show too much detail, but there seems to be a danger, unless great judgment is used, of overcrowding the map in close country, and it is to be hoped that in the preparation of the map of such districts this danger will be recognised and care taken to avoid it.

Another point on which opinions will differ is the recommendation that ground forms be shown by the layer system. This system is better suited for country with moderate altitudes, such as England, where it answers well, than for a map of the world, in parts of which the altitudes are great, and many would prefer ground forms to be shown by contours and shading. There is much to be said on both sides of the question, but there are undoubtedly some advantages in the method proposed by the committee, and no doubt in the end its judgment will prevail.

I will only refer to one other point, the only one on which I feel a difficulty in agreeing with the view of the committee. It is proposed to give all altitudes in metres. Now the area of the countries using the foot as a unit is very large, and the population is large in proportion to the area. To this large population the rendering of all heights in metres would be a great inconvenience. I do not think that on this scale it would answer to show, as has been suggested, both feet and metres. The question arises whether on this point absolute uniformity is essential. It appears to me that it is not, and that an endeavour might be made to give the heights in metres in countries in which the metre is the unit, and in feet where the foot is the unit. Of course, some give and take would be necessary in parts like the centre of Africa, so as to avoid numerous changes of unit, and hence some countries would have their heights given in the unit they are not accustomed to; but this would be a smaller matter than giving altitudes in a unit unfamiliar to all countries using the foot. The loss of uniformity which this would entail would, in my opinion, be a less evil than that of giving all altitudes over a considerable part of the world, including some of the busiest countries, in terms of a unit not ordinarily used in the business of the country.

I have called attention to a few points in which the proposals of the committee may be questioned, as it seems advantageous that such points should be discussed, but these points sink into insignificance compared with the solid and undisputed value of the work done by the committee. The convenience of being able to get a map of any part of the world, on a reasonably large scale, uniform in style and execution with any other part, will be great to statesmen, business men, travellers, and to all who use maps. To statesmen they should be of special value. International disputes and many mistakes have been caused by working on defective maps of varying scales; when this new map is issued, as no doubt it soon will be, one source of such errors will disappear. It may be wondered now that a uniform map of the world has not been sooner projected. None the less credit is due to those who originated the idea, who persevered in advocating it in spite of some discouragement, and have elaborated the details with such thoroughness as to make the success of the map practically sure.

DUNCAN A. JOHNSTON.

TUBERCULOSIS AMONG THE INDIANS OF NORTH AMERICA.[1]

THE increasing prevalence of tuberculosis among the North American Indians has for some time attracted attention, and the results of a detailed investigation of hygiene in the Indian reservations form the subject of a report by Dr. Aleš Hrdlička, published in the 42nd Bulletin of the Bureau of American Ethnology.

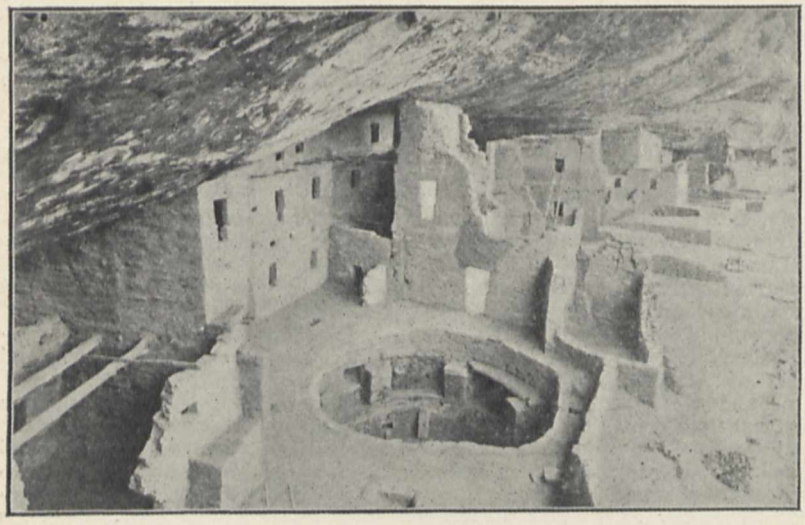

FIG. 1.—A Kiva of Spruce-Tree House—a large ruin in Mesa Verde Park, Colorado.

The facts disclosed in the course of this inquiry are striking and alarming. This disease, which threatens to exterminate the Indian population, seems not to have existed among the natives of the continent prior to the arrival of the whites. While the country was still largely unsettled they were accustomed to a natural and active life, were inured to hardship, and were, as a rule, provided with more suitable food. These conditions have changed with the advance of civilisation. At present the Indian is more susceptible to the disease than the white man; in other words, his system is less immune owing to the more recent introduction of infection among the race.

These inquiries sufficiently explain the etiology of tuberculosis among the inhabitants of the reservations. Infection is facilitated, particularly in the cold and rainy seasons, by the neglect of hygienic precautions, especially from overcrowding and lack of ventilation. No care is taken to destroy the infective sputum, the tubercle bacillus being dispersed by the common use of vessels, clothing, and musical instruments, while "pipe passing," the usual mark of hospitality, is common. In addition to these contributory causes, there seems to be now a well-established hereditary tendency, which is developed by exposure, dissipation, indolence, and other causes contributing to bodily weakness. There seems also to be little doubt that the disease is spread by milch cattle infected with tuberculosis. Lastly, the patient, with the well-known stolidity and resignation of his race, is unable to resist the progress of the disease as soon as he understands that he is infected.

The remedies suggested to improve this condition of things are increased attention to hygiene, disinfection of the sputum, and isolation of the sick. It is clear that there will be considerable difficulty in enforcing precautions of this kind among such a people. Dr. Hrdlička gives a significant warning that curators of museums should be on their guard against the danger of carelessly handling, without previous disinfection, articles, particularly fabrics, received from Indian homes.

The conditions of earlier Indian life are illustrated in an interesting way by the report published in the 41st Bulletin of the Bureau, by Dr. J. W. Fewkes, on the cliff-dwellings known as the Spruce-Tree ruins in the Mesa Verde National Park, Colorado. Here we find Kivas, or circular pit-dwellings, in connection with the series of caves once inhabited by a now forgotten race. With a view to mutual protection, a population of some four hundred souls was crowded within this narrow area. Dr. Fewkes believes that he can explain the reason why the Kivas are built underground and are circular in form, on the theory that both conditions are survivals from the ancient pit-houses or subterranean dwellings of a still earlier race. From this point of view the Kivas form the most ancient part of the existing ruins. These people lived in the age of stone, no metal implements, even those of copper, having been discovered. They had some belief in a world beyond the grave, because they laid mortuary offerings with the dead. Their conditions of life resembled those of the Pueblo population, and as these survived until comparatively modern times it is very difficult to assign a date to

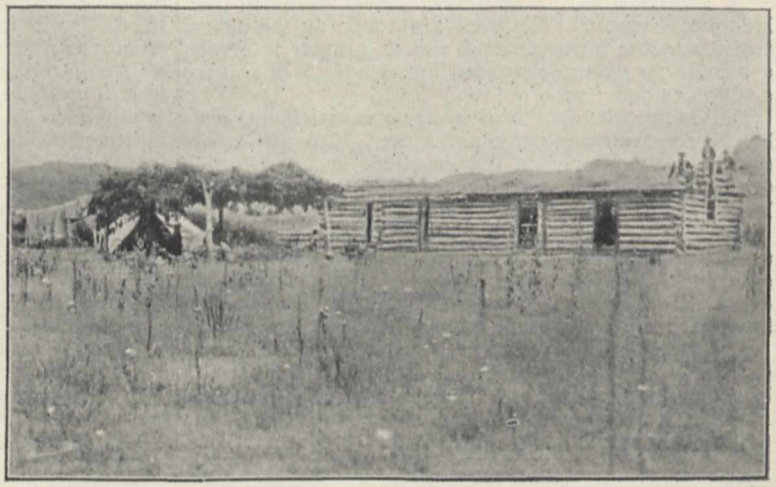

FIG. 2.—Oglala Dwellings. Triple log-house under construction and temporary tent-house.

[1] Smithsonian Institution. Bureau of American Ethnology.
Bulletin 41: Antiquities of the Mesa Verde National Park, Spruce-Tree House. By Jesse Walter Fewkes. Pp. viii+57; 21 plates. (1909.)
Bulletin 42: Tuberculosis among certain Indian Tribes of the United States. By Aleš Hrdlička. Pp. vii+48; 22 plates. (1909.)

the present ruins. They lived by a rude kind of farming, growing maize, beans, and melons; their women had some skill in pottery. They seem to have used their underground Kivas as places where they carried on a constant round of tribal ceremonial. They lived a retired life, and were little influenced by foreign culture. The ruins have now been carefully restored under the supervision of Dr. Fewkes, whose report, fully illustrated, gives an excellent account of a strange forgotten race.

LOW-TEMPERATURE RESEARCH AT THE ROYAL INSTITUTION.[1]

A SUMMARY of the work carried on with the aid of the Hodgkins Trust is, by the authority of the managers, incorporated in the Proceedings of the Royal Institution every seven years. Like the preceding report, which chronicled the solidification of oxygen, the liquefaction of fluorine, and the liquefaction and solidification of hydrogen, the essay in which the achievements of the years 1900 to 1907 are described by Prof. Armstrong is again concerned mainly with low-temperature investigations.

No fewer than thirty-five original publications are referred to, the main feature running through them being the discovery and use of the charcoal vacuum, a practical advance only less important than the introduction of vacuum vessels in the manipulation of liquefied gases. At the temperature of liquid air the absorption is from six to thirty-four times as great as at 0°, and depends but little on the pressure, so that very high vacua can be produced. The density of the occluded gas is substantially that of the liquid, 0·06 against 0·07 for hydrogen, and 0·17 against 0·15 for helium. Owing to their slight absorption by charcoal at −185°, the presence of hydrogen and neon in air can be detected readily by connecting a vacuum tube with a vessel containing charcoal cooled in liquid air; if the gas be enriched by starting with a larger quantity and submitting it twice to condensation by cold charcoal, the spectrum of helium can also be detected.

The fact that helium is not condensed by charcoal at −185° was made use of by Prof. Onnes in the experiments which culminated in the liquefaction of helium, the one gas which had resisted all attempts to liquefy it at the commencement of the period under review; only by this means was it possible to maintain the purity of the helium and to ensure that the circulation of the gas could be maintained undisturbed by condensation of solid hydrogen and solid air. The indebtedness which he owed to Sir J. Dewar's discoveries was fully and generously acknowledged by Prof. Onnes in recording this great achievement.

ANNIVERSARY MEETING OF THE ROYAL SOCIETY.

THE anniversary meeting of the Royal Society was held as usual on St. Andrew's Day, Tuesday, November 30, when the report of the council was presented, and an address was given by the president, Sir Archibald Geikie, K.C.B. An account of the main subjects that occupied the attention of the council during the past year is given in the report, from which extracts are here subjoined. Other matters mentioned in the report have been referred to already in these columns.

[1] Low-Temperature Research at the Royal Institution of Great Britain, London, 1900–7. Essay by Prof. H. E. Armstrong, F.R.S. II. The Charcoal Vacuum Septenate. Pp. 63. (Hodgkins Trust, 1909.)

REPORT OF THE COUNCIL.

Results of the National Antarctic Expedition.

The only part of the physical observations of the National Antarctic Expedition, of which the Royal Society undertook the preparation and publication, that remains to be completed is the second volume on meteorology, which is now in progress. It will consist chiefly of synchronous charts of sea-level pressure, with winds and temperatures, over the greater part of the southern hemisphere. It will thus embody, not only the results of the observations made by the *Discovery*, but information derived from many other sources. The preparation of these charts is in the hands of the Meteorological Office under Dr. Shaw. It is anticipated that this laborious task will be completed in time to allow the volume to be published next year.

Glass-workers' Cataract.

The inquiry into the disease known as glass-workers' cataract, instituted at the request of H.M. Government, and referred to in the last report, has been pursued during the year by the committee appointed by the council. The scheme of operations drawn up by the committee includes experimental research in the laboratory, and also investigations at some of the principal glass manufactories, with the view of obtaining data of the processes of glass-manufacture and of the incidence of the disease among operatives. Some progress has been made in this latter branch of the inquiry, but the work of the committee has been hindered by the refusal of certain glass manufacturers to allow the committee to visit their works. The experimental researches in the laboratory are proceeding.

The National Physical Laboratory.

The need for increasing accommodation is greatly felt in several departments. This is specially the case in the department of metallurgy, referred to by Lord Rayleigh in his address last year. With regard to this the executive committee of the laboratory report:—

"Investigations of very real importance have to be declined, because of the need of appliances, and the general scale of the arrangements is much too small. A site is available for a new metallurgical laboratory adjoining the chemical laboratory, and it is highly desirable that during the coming year active steps should be taken to secure the necessary funds. The committee commend this need to metallurgists interested in furthering investigations into the application of science to the practical treatment of metals and to other problems of importance."

The executive committee have nominated a special committee to raise the necessary funds for extension in this and other directions.

The most important event of the year, however, has been the work of construction of the national experimental tank, given to the laboratory with great generosity by Mr. A. F. Yarrow; this work is now well advanced. In April last Mr. Yarrow wrote to the secretary of the Institution of Naval Architects directing attention to the importance of such a tank, and offering to present a sum of 20,000*l.* on the understanding—

(1) That a tank of the most modern character can be established for a sum not exceeding 20,000*l.*, and that it be established at the National Physical Laboratory.

(2) That suitable provision be made, both as regards staff and means, for conducting research work, as well as for experimental investigations of a confidential character which private firms may desire, and for which they would pay suitable fees.

(3) That a sufficient sum be provided to ensure that the tank be efficiently carried on for a period of not less than ten years. This provision might take the form either of an endowment or of guaranteed subscriptions from shipbuilders and ship-owners.

Mr. Yarrow's letter continues:—"I believe that an adequate provision for maintenance would involve not less than 2000*l.* a year; that is to say, a total guarantee fund of 20,000*l.* would be required to maintain the efficient working of the tank for the above period."

In accordance with Mr. Yarrow's suggestions, a committee was formed by the Institution of Naval Architects to study the practicability of the scheme and the raising

of the maintenance fund. Towards the end of the year this committee informed the executive committee of the laboratory that about half the funds required had been promised, and that it was anticipated that the remainder would be forthcoming in due course; they also asked for an expression of the views of the executive committee and a statement of the conditions under which the tank could be worked as a department of the laboratory. The executive committee replied that if the guarantee fund were now raised to at least 1200*l.* a year, and if the experimental tank committee would undertake to continue their endeavours to increase it further with the view of research, the executive committee would be willing to take the responsibility for the expenses of working the tank in accordance with Mr. Yarrow's proposal. The governing body of the laboratory have thus made themselves responsible for an expenditure which may amount to 800*l.* per annum for ten years, and will receive in return the fees which are expected to come from tests carried out for ship-builders. On his part, Mr. Yarrow has paid over cash and securities to the value of at least 20,000*l.* to the treasurer of the Royal Society, and the president and council have conveyed to him the cordial thanks of the society for his most generous action.

During the year the executive committee have also, at the request of H.M. Government, undertaken important and onerous responsibilities on the scientific side of the experimental study and improvement of the conditions governing artificial flight.

International Catalogue of Scientific Literature.

The whole of the seventh annual issue of the catalogue has been published with the exception of D (chemistry), M (botany), O (anatomy), P (anthropology), and Q (physiology). These five volumes, as well as several volumes of the eighth issue, are in the press.

The International Council of the Catalogue, which had held meetings previously in 1900, 1904, and 1907, met again this year on June 3 and 4 in the rooms of the Royal Society.

The International Council made arrangements with the view of diminishing the cost of production of the catalogue, and also passed the following resolution:—

"That the regional bureaus be requested to confer, before April, 1910, with scientific workers in their several countries, so that any opinions and proposals of those to whom the catalogue is of consequence may be laid before the International Convention in 1910."

At the meeting of that convention important decisions must be made regarding the future of the catalogue; accordingly, the council of the Royal Society has appointed a committee to consider and report upon their relation to this undertaking.

Research on Tropical Diseases.

The investigations of the action of drugs upon trypanosomes, referred to in previous council reports, have been continued under the direction of a subcommittee, and accounts of the principal results of these investigations have been published from time to time. The latest progress report, by Mr. H. G. Plimmer and Captain Fry, "On the Experimental Treatment of Trypanosomiasis," appeared in Proceedings, B, No. 549, October 9.

During the present year the inquiry into sleeping sickness in Uganda has been actively pursued by the Royal Society's commission, which left England in October, 1908, under the direction of Colonel Sir David Bruce. Three papers on the work of the commission have been received from him during his stay in Uganda, and have been published in the Proceedings, viz.:—(1) "*Trypanosoma ingens*, n.sp."; (2) "The Development of *Trypanosoma gambiense* in *Glossina palpalis*"; (3) "A Note on the Occurrence of a Trypanosome in the African Elephant."

The second of these papers contains an account of an experiment carried out by the Commission, the results of which confirm the important conclusion arrived at by Dr. Kleine in German East Africa, that the tsetse-fly *Glossina palpalis* may be infective for a considerable period after the fly has fed on an infected animal. Previously it had been believed that the carrying of infection from a sleeping-sickness patient to a healthy person by the *Glossina palpalis* was a mechanical act, and that the power of transferring the disease was lost to the fly forty-eight hours after it had fed on an infected person. Dr. Kleine, however, has recorded observations of the fly remaining infective for much longer periods, extending up to sixty-six days, and now Sir David Bruce has reported further experiments, carrying the duration of infectivity as far as seventy-five days. This confirmation of Dr. Kleine's observations makes it necessary to revise previous conclusions on this point, the importance of which is obvious owing to its bearing on the nature of such preventive measures as have been hitherto attempted.

At the suggestion of Colonel Sir David Bruce, a conference, composed of medical (including veterinary) officers in British East Africa and Uganda, together with representatives of the administration of those protectorates, was held at Nairobi, in May, under the presidency of Sir David Bruce, to discuss and make recommendations as to preventive and remedial measures in regard to both human and animal trypanosomiasis.

Sir David Bruce is leaving Uganda this month, but arrangements have been made which will admit of the work of the commission being carried on after his departure.

Tyndall Donation.

During the current year Mrs. Tyndall, in pursuance of a wish expressed by her husband, the late Prof. Tyndall, has entrusted to the Royal Society the sum of 1000*l.*, to be administered at the discretion of the president and council for the purpose of encouraging and furthering research in all matters pertaining to mining, including such questions as ventilation, temperature, diseases incident to miners, and any other lines of scientific inquiry conducive to the improvement of mining and the lot of the miners.

PRESIDENTIAL ADDRESS.

In his presidential address, Sir Archibald Geikie referred first to the losses by death of distinguished fellows of the society since the last anniversary meeting. On the foreign list he had to record the decease of five men of wide reputation, namely, Albert Gaudry, Simon Newcomb, Anton Dohrn, Georg von Neumayer, and Julius Thomsen. The society also lost by death during the year the following fellows on the home list:—Daniel John Cunningham, David James Hamilton, Rev. W. H. Dallinger, Wilfrid Hudleston Hudleston, Harry Govier Seeley, Arthur Gamgee, Gerald Francis Yeo, Thomas William Bridge, Sir George King, Francis Elgar, Bindon Blood Stoney, George Gore, and William James Russell.

The special subject to which the president's address was devoted was the work in which the Royal Society is engaged. It is not commonly known that the weekly meetings and the publications to which they give rise, though they constitute the most important part of the labours of the society, so far as relates to the progress of discovery, form only a portion of a programme which is every year becoming fuller and demanding more time, thought, and funds for its accomplishment. Sir Archibald Geikie gave, therefore, a brief outline of the various directions in which the energies of the society are employed, in the hope that when some of the difficulties become more widely known, means may be found for adequately coping with them.

When the Royal Society was founded it was the only learned body in this country specially devoted to the prosecution of scientific inquiry, and such it continued to be for generations; but the rapid growth of science during the last century has shown that no single society can now serve to supply the needs of the whole vast field of investigation in every department of nature. Most of these departments, one after the other, have had special societies created for their exclusive cultivation, each of which records the progress of research in its own territory. At first the Royal Society, long accustomed to reign with

undisputed sway over the whole realm of natural knowledge, was disposed to look with disfavour on this multiplication of separate and independent institutions; but that time has long since passed away. Subdivision is now admitted to be necessary, and, if properly directed, even desirable. Hence this society, like a proud parent, now rejoices in the growth and energy of the increasing family which has grown up around her, while she in turn is regarded with respect and esteem by the various members of that family, among whom there is a general desire to be enrolled in her ranks.

Nevertheless, it is impossible not to perceive that the rise of all these younger societies has materially affected the position of the Royal Society in regard to the general advance of modern science. This society is no longer the general depository of the records of that progress in all its branches. So completely, for instance, do the Geological and Chemical Societies provide for the requirements of their respective fields of investigation that communications from these fields come now comparatively seldom before us. If one desires to follow the modern growth of geology or chemistry, one must turn for its record to the publications, not of the Royal Society, but of the two learned bodies that are specially devoted to the cultivation of these sciences. Nor can we see any reason why this process of devolution should not continue in the future. Hence, if the system of reading and publishing papers which has been in use here for so many generations is to be perpetuated without modification, there may come a day when every great department of natural knowledge will be provided with its own special society, and then we may ask in anticipation, what will be left for the meetings of the Royal Society? For myself I do not believe that such a time of impoverishment ever will befall us. We cannot, and would not if we could, do anything to prevent the foundation of fresh societies for sciences that have not yet been provided with them; but we may so adjust our programme as to bring it into harmony with modern conditions, and thus to maintain and extend the prestige and usefulness of the Royal Society. The danger to which I have referred, however, is by no means imaginary, and it should be faced before it has time to become serious.

Some years ago the society departed from the time-honoured practice of dealing with natural knowledge as one great subject, and now groups its papers in two separate series, one devoted to physical (A) and the other to biological (B) questions. It is undoubtedly a considerable convenience to have the memoirs in each of those two great divisions gathered together into a separate series of volumes. More recently the practice has grown up of introducing a similar principle in the grouping of papers to be read at the weekly meetings of the society. It was hoped that by taking the physical papers on one day and the biological communications on another a better attendance could be secured, especially of the representatives of each division. I cannot say that this arrangement has been attended with the success which was anticipated.

That there are some practical advantages in this separation of subjects cannot be gainsaid, and I would not for a moment seek to undervalue them; but I confess I am often led to consider this subject with feelings of regret and misgiving, and to ask myself whether the conveniences afforded by the subdivision are not more than compensated by the disadvantages that accompany them. Undoubtedly, the constantly quickening pace of the march of science makes it every year increasingly difficult for those whose lives are devoted to the active and engrossing prosecution of research in one special department of inquiry to keep in touch even with the broader features of the advance that is being made in other departments. We cannot be surprised that a man whose whole energies are absorbed in one line of study should neither care to listen to, nor to burden his library shelves with, papers in other lines, full of technicalities which he has had no time to master, and written, therefore, in a language which to him is more or less unintelligible. In this way the workers in widely separated fields of inquiry tend to be more and more completely isolated from each other.

But surely such isolation is a defect in our organisation which deserves serious attention. It cannot be for the general good of scientific progress that the eyes of an investigator should seldom or never be lifted from his own field of work, nor his ears be open to the reports of the advances made in other fields that lie outside his immediate interests. The wider his outlook, the greater must obviously be his capacity for judging of the general bearings of discovery in his own domain on other departments of research, and the broader and more intelligent will be his sympathies with the whole range of activity on which the continued march of natural knowledge depends.

The Royal Society is still the one great institution in this country which draws its members from the cultivators of every branch of science, and freely opens its publications to receive their communications of observation and discovery. It should thus be specially fitted to bring the workers on the two sides of science, physical and biological, into touch with each other. It has recognised, and in various ways endeavoured to discharge, its duty in this respect. In its Croonian and Bakerian lectures it has given to the world many masterly expositions of the progress of research in different branches of inquiry. It has likewise provided, by one of its standing orders, for occasional meetings devoted to the discussion of papers of general interest specially prepared for the purpose. Nevertheless, it may be urged that some more frequent and effective procedure might still be devised to lessen the evils of isolation and to make the work that is in progress in one section of the scientific domain more comprehensible in the others. It is futile to find fault with the technicalities of a science. These are its symbols and language with which its students cannot dispense; but without trying to provide for all the needs of the "man in the street," it is often possible to give the gist of an observation or a discovery in simple words that will convey a definite conception of what has been observed or discovered; and thus a subject which, when expounded in brief technical phraseology, repels men of another science, may yet be made interesting and suggestive to these same men.

It may be worthy of consideration whether in those branches of science which, having special societies of their own, are seldom represented by papers at our meetings or in our publications, some of their cultivators might not be invited from time to time to bring before the society reports of recent advances in their different fields of research. Would it not be practicable, for example, to find among the many distinguished chemists in our ranks a few who would be willing to present occasionally at our meetings, in language intelligible to a general audience of scientific men, an outline of the latest progress, present condition, and future problems of some section of their great science?

But, above all, there is an aspect of scientific thought which, although fully recognised by the early fathers of the Royal Society, is too apt to be overlooked amidst the engrossing pressure of modern research. I allude to the philosophy of science. At intervals in the progress of scientific inquiry it is desirable to look at the subject from the philosophical side, and to seek for a correlation and synthesis of the various processes of nature which discovery has revealed. The mental vision required for this quest is not given to more than a few gifted minds; but we can count among the number of our fellows more than one admirably qualified by wide knowledge and rare powers of generalisation to present a connected view of the broader bearings of discovery in the scientific domain in which each is a master. Memoirs of this type will, I trust, continue to be laid before us, perhaps at more frequent intervals, thus upholding the renown of our Philosophical Transactions and sustaining the prestige of the society.

Had the Royal Society no other duties to discharge save those in connection with the preparation of its publications, it would, like other scientific societies, have work enough on hand fully to occupy its time and absorb its resources; but the performance of these duties fills up only part of its programme. In this respect the society differs from other learned bodies. It possesses a large and diversified field of activities about which most, even of our fellows, know little, and the world outside still less. Our Year-book, indeed, presents a formidable list of the public func-

tions which have devolved upon the Royal Society. That list, however, conveys no adequate idea of the varied and even exacting character of some of its items; but, over and above the functions therein enumerated, others of a less public kind make large demands upon the time and thought of many of our fellows.

For many years past the Royal Society has acted as a kind of board of advice to the Government of the country in matters wherein scientific knowledge is required. In this informal capacity the society has been requested to undertake the conduct of many inquiries in the public interest. It has been likewise entrusted with the administration of funds voted by Parliament for the promotion of investigation.

Requests are not infrequently made to the society by different Government departments for advice or cooperation in matters wherein expert scientific knowledge is required. For years past we have had a tropical diseases committee, which, in association with the Colonial Office, has been carrying on investigations into the nature and prophylaxis of some of the maladies incident to the human and animal populations of our colonies and protectorates in warm climates. A commission dispatched by this committee to Uganda has for some time been at work, under Sir David Bruce, studying the decimating scourge of sleeping sickness, while another commission, under the same committee, is busy in London searching experimentally for some drug that may be effective in the treatment of that terrible disease. A few years ago, at the joint instance of the War Office, Admiralty, and Colonial Office, we dispatched a commission to Malta to investigate the peculiar fever which had for so long a time reduced the effective strength of our garrisons and fleets in the Mediterranean. The observers were fortunate in soon discovering the source of the disease, and were able to point out the steps to be taken to cope with it. The result has been that this serious malady has now been almost entirely banished from the hospitals of Malta. At present another committee of the society is engaged, at the request of the Home Office, in studying the disease known as glass-workers' cataract. The India Office likewise applies to us for advice, and we have an "Indian Government Advisory Committee" and an "Observatories Committee," the duty of which is to consider the reports of various public departments in the great dependency, and to offer suggestions towards the improvement of their scientific operations.

Although the Royal Society administers annually a considerable sum of money, by far the largest part of the disbursements is ear-marked for various special applications, and cannot be employed for other objects. So far, indeed, as its general purposes are concerned, the society cannot be regarded as adequately provided. For nearly two hundred and fifty years it has continued to hold aloft the torch of science, but the constantly augmenting demands of modern progress make its task increasingly difficult of satisfactory performance. I have referred to the growing cost of our publications, and there are other parts of our organisation wherein the development of our work is hampered by the lack of funds. Men of science are seldom rich; it is therefore all the more gratifying to be able to record examples of the continuous generous liberality of our fellows; but it is hardly from our own ranks that we can look for any substantial addition to our resources. Perchance in the general community there may yet be found some men who may be led to see that, besides the various laudable objects that have hitherto claimed their care, the advancement of science is likewise an important public and educational interest, and that benefactions are not unworthily bestowed in enabling the Royal Society adequately to maintain the great work which it has inherited from the past.

MEDALLISTS, 1909.

Copley Medal.

The Copley medal is this year awarded to Dr. George William Hill, For.Mem.R.S. Now that Simon Newcomb is no longer with us, Dr. Hill occupies, beyond challenge, the first position in the great subject of dynamical astronomy.

His processes are not only marked by extraordinary originality, the result of high mathematical genius, but also in every case his methods and researches are directed towards practical astronomical ends. His supreme work is probably contained in his researches on the theory of the moon's motion, which has remained the great problem of gravitational astronomy ever since the time of Newton. Here his introduction and development of the principle of disturbed periodic orbits has given an entirely new direction to the science, culminating recently in the lunar tables of E. W. Brown, which mark an epoch in the practical side of the lunar theory.

This work of Hill has been fruitful in new advances in many directions. His ideas have given rise, as developed by Poincaré and other investigators, to new departments of abstract mathematical analysis, while in the hands of Lord Rayleigh they have shed light on important and difficult problems of general mathematical physics.

His collected works have recently been published by the Carnegie Institution of Washington in four quarto volumes; the importance of their contents can hardly be overestimated. M. Henri Poincaré, in his introduction to these volumes, described Hill as "une des physionomies les plus originales du monde scientifique américain."

Astronomy owes to him new theories of the motions of the systems of Jupiter and Saturn, to which the whole of vol. iii. of his works is consecrated.

His shorter papers deal with nearly every problem in the lunar and planetary theories, with mathematical geodesy, and other subjects. All his work is characterised by its original points of view combined with practical aims, by maturity of thought, and high suggestiveness. It forms an index of the simplicity and aloofness of its author, who has been one of the main ornaments of astronomical science for more than a generation.

Royal Medals.

One of the Royal medals has been awarded, with the approval of His Majesty the King, to Prof. Augustus Edward Hough Love, F.R.S., in recognition of his numerous and important contributions to mathematics, and especially to mathematical physics. He has written many valuable papers on various branches of hydrodynamics, in particular on the theories of jets, of vortex motion, and of revolving gravitating masses of liquid. He is the author of a work on "Elasticity," now in its second edition, which is highly appreciated at home and abroad, and ranks as the standard treatise on the subject. In this he has incorporated various valuable researches of his own, which have appeared in the Philosophical Transactions and elsewhere. He has further investigated closely the circumstances of wave-propagation in air, in elastic solids, and in the electromagnetic medium, and has examined in particular the phenomena which present themselves at wave-fronts when the motion is discontinuous. More recently he has published remarkable papers on terrestrial physics, including a speculation on the origin of the present distribution of land and water, and an investigation of the precise extent of the inferences which can be drawn as to the internal constitution of the earth from the observed *data* relating to the heights of ocean tides of long periods, the lunar disturbance of level, and the approximate period of the small movements of the Pole over the earth's surface.

His Majesty has likewise approved of the award of the other Royal medal to Major Ronald Ross, F.R.S.

The name of Major Ross has become widely known on account of the important investigations which he has carried out on the life-history of the malarial organism and the means of preventing malarial infection. Following up a clue indicated by Manson, he began, in 1895, at Secunderabad, in India, in circumstances which entailed much difficulty and many delays, an investigation as to whether the malaria parasite, discovered by Laveran, passes part of its life-history within the body of a biting insect. After more than two years of fruitless experiments Ross discovered a stage of the human malaria parasite in the tissues of a mosquito (Anopheles) which had been allowed to feed on the blood of a malarial patient. In 1898 he proceeded to work out in detail the life-history of a malarial parasite found in sparrows and larks in India. He traced the complicated stages in the development of this parasite from its inception into the stomach of a gnat (*Culex fatigans*) which feeds on the blood of these

birds to its passage back into their blood through the secretion of the poison gland of the insect. At the same time he furnished conclusive experimental proof of the part played by the insect in propagating the infection. These fundamental observations have been confirmed and extended in various directions by other observers, both in the British Empire and elsewhere.

As a practical consequence of the discoveries of Ross and those who have followed in his footsteps, and of his own unceasing exertions and further investigations during the last few years, scientifically directed measures for the prevention of malaria have been initiated with striking success in many fever-stricken districts all over the world, and particularly within the British Empire. His investigations have also inspired similar work on the spread, by means of mosquitoes or other biting insects, of other formidable diseases, with the result that effective measures have been devised for preventing the spread of these diseases also.

Davy Medal.

The Davy medal has been awarded to Sir James Dewar, F.R.S.

Sir James Dewar has been a pioneer in the study of very low temperatures, their production, applications, and effects.

For many years he has worked continuously in this difficult domain, and his investigations have resulted from time to time in such achievements as the solidification of oxygen, the liquefaction of fluorine, and the liquefaction and solidification of hydrogen. His improvements in technique have been fundamental. By the construction of vessels in which thermal convection is avoided by the presence of a vacuous layer in their walls, he has enormously simplified the retention and manipulation of matter at very low temperatures. His application of the absorbent effect exerted on gaseous materials by charcoal at low temperatures has placed in the hands of chemists and physicists a most convenient and important method, not only for the production of high vacua, but also for the rapid separation of the constituents of gaseous mixtures. The modifications in the properties of matter at very low temperatures have been investigated, and remarkable results obtained, including the earliest exact investigations, jointly with Prof. Fleming, on the electric properties of insulators and of metals and alloys. The determination of the properties (critical points, boiling points, &c.) of refractory gases at very low temperatures has involved the practical downward extension of absolute thermometry, with the result that temperatures in the neighbourhood of the absolute zero can be determined correctly to within a degree. Lastly, recent measurements of the rate of formation of helium from radium salt, specially purified by Sir T. Edward Thorpe for his recent atomic weight determination, have provided exact molecular data, throwing light on the nature of the spontaneous disintegration of that very remarkable substance.

Hughes Medal.

The Hughes medal falls this year to Richard Tetley Glazebrook, F.R.S.

Dr. Glazebrook has for many years been closely identified with the construction, testing, and evaluation of electrical standards. Not only has he published important memoirs on these subjects, but, as secretary for a very long period of the Electrical Standards Committee of the British Association, and more recently as director of the National Physical Laboratory, he has taken a leading and responsible part in this type of scientific work and in conferences of international importance. It is thus specially fitting that he should be the recipient of the Hughes medal.

The anniversary dinner was held at the Hotel Metropole on Tuesday evening. Sir Archibald Geikie occupied the chair, and a large number of fellows and distinguished guests was present. In proposing the toast of "The Royal Society," Mr. Butcher, M.P., remarked that organised science presents the most signal example of cooperative enterprise in the things of the mind. Modern scientific research demands a host of humble labourers in every field. The hewers of wood and the drawers of water are as necessary as the men of genius. Like the builder of a mediæval cathedral, the obscure worker in the laboratory adds his stone to the fabric, and passes from sight; the individual is effaced, and the structure that slowly rises is the collective achievement of many forgotten workers and even of many generations, guided, however, by a few master minds. While art and literature bear the stamp of permanence, the movement of the sciences produces another kind of effect—that of progressiveness and limitless expansion. Yet, in spite of this irresistible forward movement, the man of science, like the artist, is aware that the ideal may still escape his grasp, and that the quest of truth still remains the search for something that must ever be pursued, that ever recedes, and never can be wholly attainable.

Replying to the toast, the president said that at its foundation every side of intellectual life seems to have been represented in the society. The non-scientific elements which so preponderated at the start were gradually reduced as years went on, but a wide and liberal view of the claims of admission continued to be taken, and the more distinguished in each generation in affairs, in literature, and in art were elected as fellows. This custom is still kept up, but with increasing stringency, until now the number of such persons is limited to two in every two years. There are some fellows who believe that the general interests of the society would be promoted by the introduction of a larger leaven of culture which is not scientific.

The Japanese Ambassador, responding to the toast of "The Guests," said it is barely forty years since Western science was transplanted into Japan on anything like an adequate scale. For the progress being made Japan owes an immense debt of gratitude to the scientific men of the West, and particularly to scientific men of Great Britain.

NOTES.

THE meeting of the Royal Irish Academy on Tuesday, November 30, was occupied by a commemoration of Charles Darwin, the date nearly coinciding with that of the publication of "The Origin of Species" fifty years before. The president, Dr. F. Tarleton, opened the proceedings, and the following short addresses were given on the influence of Darwin's work:—geology, Prof. G. A. J. Cole; geographical distribution of animals and plants, Dr. R. F. Scharff; zoology, Prof. G. H. Carpenter; botany, Prof. T. Johnson; anthropology, Prof. A. F. Dixon.

THE Washington correspondent of the *Times* announces that a recommendation is to be submitted to the Department of Commerce and Labour by the Bureau of Fisheries that the Government should bring about an international conference for the formulation of an international marine game law to protect from extinction seals, whales, walruses, and other sea mammals. The countries which would be invited by the United States to send representatives to the proposed conference are Great Britain, Russia, and Japan.

THE council of the Child-study Society has approached Prof. Karl Pearson, F.R.S., to assist its efforts to advance scientifically our knowledge of child-life. Prof. Pearson has drafted a schedule for studying the factors influencing the social life of the child, which he desires to have filled in by heads of families or by teachers intimate with families. The number in the family need not be large, but particulars of father, mother, and at least two children are required. The schedules are being distributed through branch secretaries of the Child-study Society, but it may be difficult in a short time to secure the number requisite

to make the subsequent investigation by Prof. Pearson worth while. The society appeals to members of learned societies and to professional men and women to assist the scheme by applying for a copy of the schedule and filling in the particulars. Copies can be obtained from the secretary of the Child-study Society, London, 90 Buckingham Palace Road, London, S.W.

PROF. SORLEY, in his paper on "The Interpretation of Evolution" communicated to a meeting of the British Academy on the fiftieth anniversary of the publication of the "Origin of Species," drew a distinction between inorganic and organic evolution which appears to belong rather to the material forming the subject of the process than to the process itself. It is perhaps true that, as he says, physiologists are on the whole less satisfied now than formerly with the adequacy of the physico-chemical explanation of vital activities; but they have not all abandoned the idea of gaining a more profound insight than at present into the nature of life, nor do they anticipate that any increase of knowledge will tend to exclude vital phenomena from the domain of natural law. That the history of vital activity is in a true sense teleological may be readily conceded, and it is possible that Prof. Sorley is right in holding that the whole course of evolution can only be interpreted "by means of the conception of conscious purpose." Such contentions, however, belong to a domain which is outside that of science.

MR. BALFOUR'S Romanes lecture, delivered at Oxford on November 24, was couched in his happiest vein of genial scepticism. The chief function of literary and artistic critics in all ages has been, he said, to sweep away the rubbish of their critical predecessors. No standard of æsthetic excellence has been found to be permanent; attempts to find an ethical or religious end to art, though not valueless, are independent of the critical question. It is true that in the present age there is a superficial appearance of unanimity as to what is and what is not a successful work of art, though a man of genius like Matthew Arnold or Ruskin will occasionally kick over the traces; but in the history of artistic criticism this unanimity is not to be found. The great Gothic builders were only restrained by considerations of time and money from demolishing the work of their predecessors. Training and study are undoubtedly sources of subsidiary æsthetic pleasure, but the increase of powers of discrimination may be accompanied by a waning of æsthetic sensibility. Are we not, then, obliged to regard æsthetic emotion as a mere accidental by-product of evolutionary process? No assistance is afforded by the instinctive efforts of the popular philosophy to press morals, religion, utility, or progress into the service, nor can satisfaction be obtained out of the metaphysical treatment of the subject; but there remains the consideration that, besides the class of emotions to which the æsthetic sense belongs, there is another class, practical rather than contemplative, at the head of which are the loftiest feelings—love and devotion—of which human nature is capable. These practical emotions, Mr. Balfour thinks, are recalcitrant at present to any logical or philosophical treatment. Why, then, should we quarrel because we can at present find no adequate philosophy of the æsthetic emotions?

THE eighth International Zoological Congress is to be held at Graz (Austria) on August 15–20, 1910, under the presidency of Prof. Ludwig von Graff. The first general meeting of the congress will be held in the afternoon of August 15 in the great Stephaniensaal of the Steiermärkische Sparkasse, and further similar meetings the next and every morning up to and including August 19. Sectional meetings will be held on each of the four afternoons from August 16–19 in the Natural History Institute of the University. A meeting of the nomenclature committee and the committee for the Concilium Bibliographicum has been arranged for August 16 in the Zoological Institute, and the permanent committee of the congress will meet at the same place on August 17 to consider the place of meeting for 1911. Two lantern lectures will be given during the evenings of August 16 and 17 on "Die Steiermark" (Styria), and "The Austrian Riviera, Bosnia, Herzegovina." In addition to short excursions during the late afternoon of the earlier days of the congress, longer journeys have also been arranged. Among the more ambitious excursions may be mentioned:—to the Erzberg and the Leopoldstein See on August 20, to Triest on August 21, and to Dalmatia by special steamer from August 22–27. A banquet will be given by the congress on August 19 to the honorary members, members, and participants. Not only professional zoologists, but all persons interested in zoology, may take part in the congress, which covers the whole field of biology in the widest sense, including, for instance, palæozoology, hydrography, and marine biology. All inquiries relative to the congress should be sent to the Präsidium des VIII. Internationalen Zoologen-Kongresses, Universitätsplatz 2, Graz (Österreich).

WE have to acknowledge the receipt of a copy of No. 62 of the Hull Museum Publications, in which various additions to that museum are recorded; also of vol. v., No. 2, of the *Museum News*, the first article in which is devoted to an account of an exhibition of mediæval architecture in the Brooklyn Museum.

ACCORDING to the October number of the *Victorian Naturalist*, it is proposed to erect in Sydney a statue or some other appropriate memorial to Sir Joseph Banks, who has been called the "father of Australia." In order to awaken interest in the matter, Mr. J. H. Maiden, the Government botanist of New South Wales, has written a full and elaborate life of Banks, and has generously promised to hand over the profits on the sale of the volume to the memorial fund.

IN discussing a new digger-toad from Manchuria in the September issue of the Proceedings of the Academy of Natural Sciences of Philadelphia, Mr. T. Barbour takes exception to the emendation of the barbarous generic name Kaloula to the more classical Callula. Seeing that the emendation was made by Dr. Günther and accepted by the late Prof. Cope, and subsequently by Mr. Boulenger (in the official British Museum Catalogue), it is surely a little strong to write that "*Callula*, a more recent emendation, has no standing in nomenclature." Günther, Blanford, and Boulenger have all seen fit to amend (or accept amendments of) ill-spelt or ill-formed zoological names, and it scarcely becomes their juniors to say they were not justified in so doing.

IN the first portion of an article on the nuptial habits of the black-cock in Scandinavia and England, published in the November number of the *Zoologist*, Mr. Edmund Selous alludes to certain very definite statements made by a Swedish forester to the effect that these birds are in the habit of making burrows for themselves beneath the snow, in which they remain for considerable periods during severe weather. Although each bird makes its own tunnel, it seems probable that the tunnels may often open into a common chamber, where several black-cock may remain in company for the sake of warmth. The capercaillie, on

the other hand, has no need for such shelters—and perhaps food-supplies—as the pine needles which form its food are always obtainable in abundance.

THE November number of the *American Naturalist* opens with the first part of an instructive article, by Mr. Newton Miller, on the life-history and habits of the American toad, this article being written to illustrate the proper way of studying common American animals from the point of view of their position as active forces in the economy of nature. After devoting a considerable amount of space to the breeding-habits and development of the species, the author makes the (to us) novel observation that "toads are more numerous in and about towns than elsewhere. Very rarely is a toad seen in a large field under cultivation. Only fifty toads were seen during a whole season on one thousand acres of farming land in central Indiana. This scarcity may be accounted for by two factors, *i.e.*, first that pasturage and tillage kill the toads, or, secondly, that the extensive drainage has exterminated the toad by depriving it of breeding places."

MUTATION in Ceratium, a protozoan common to fresh and salt water, forms the subject of No. 13 of vol. lii. of the Bulletin of the Museum of Comparative Zoology at Harvard College. After describing the mutations observed, the author, Mr. C. A. Kofoid, states that the most important fact in the phenomena is the abrupt and complete change in form in a line of descent in a single generation, or at most in two generations, of organisms asexually produced. The change is recorded in fixed skeletal parts which clearly show the transmutation in shape, while the accessory phenomenon of chain-formation enables the line of descent to be accurately traced. These changes do not give rise to new types, "but old well-known types give rise suddenly to others old and well known, or at least previously known. The particular category to which these types are referred, species, subspecies, varieties, or forms, is a subordinate matter. . . . The fact remains that like gives rise to unlike, that the descendants differ profoundly from the ancestral type."

PROF. HICKSON and Mr. Wadsworth give an interesting account in the *Quarterly Journal of Microscopical Science* (vol. liv., part ii.) of their observations on *Dendrosoma radians*. This remarkable Acinetarian occurs in abundance on the stems of Cordylophora in the Bridgewater Canal near Altrincham, and supplies were also obtained from Birmingham. The authors give a detailed account of the minute structure of the adult and the formation and development of the ciliated gemmule. They find that the so-called "external buds" described by Saville Kent are really epizoic Acinetarians of the genus Urnula. The phenomena of conjugation have not yet been observed.

THE *Quarterly Journal of Microscopical Science* (vol. liv., part ii.) contains a continuation of Mr. Goodrich's well-known researches on the structure of the excretory organs in Amphioxus. Mr. Goodrich brings forward what appears to be very conclusive evidence in favour of his view that the nephridia of Amphioxus do not open, as Boveri has supposed, into the cœlom, but end blindly at their inner extremities. He maintains the homology of these organs with the nephridia of Annelids and Platyhelminths, and not with the kidney tubules of the Craniata, and gives a partial, but very interesting, account of their development. He has examined the sections upon which M. Legros based his conclusions as to the origin of the nephridia from the cœlomic epithelium, but does not agree with this author on this important point. We are left to conclude that the nephridia of Amphioxus are probably ectodermal in origin, although the question is not discussed in detail at present. The paper also deals with the structure known as Hatschek's nephridium, and the discovery of solenocytes in this organ by Goldschmidt is confirmed. It appears to be a true nephridium, homologous with the posterior nephridia, but the fact that it opens into the alimentary canal (externally; it has no internal opening) remains unexplained. We must also direct attention to the valuable criticism of Prof. Hubrecht's views on the early ontogenetic phenomena in mammals, by Mr. Richard Assheton, which concludes the number.

IN a pamphlet recently published at Athens under the title of "Ἰωάννης Λαμὰρκ καὶ τὸ ἔργον αὐτοῦ," the author, M. Athanasios E. Tsakalotes, gives a very clear and impartial account of Lamarck's life and work. Passing in brief review the facts and dates of the famous French naturalist's scientific career, he enumerates the various systematic treatises that came from his pen, and enlarges on the evolutionary views which found expression in the "Philosophie Zoologique," published just one hundred years ago. The main points in Lamarck's theory of descent are well brought out—his belief in the continuity of the process, his consequent rejection of Cuvier's theory of successive catastrophes, his doctrine of the inherited effects of use and disuse, and of the direct action of the environment on plants and on the lower animals. The author shows how intimately in Lamarck's mind the facts of adaptation were connected with the problem of evolution; the passage in the "Philosophie Zoologique" on the relation of structure to habit and function in the three-toed sloth might, he asserts, have been written by Darwin himself. That Lamarck's views failed to commend themselves to his scientific contemporaries was, the author thinks, partly his own fault; for the reasons that he was in too great a hurry in reducing his speculations to a complete system, and that he weighted his theory with improbable psychic elements, for example, the alleged influence of individual volition. The author might have added that Lamarck lacked the touch of genius that led Darwin and Wallace to find in natural selection the key to the problem of adaptation.

MR. CARUS-WILSON informs us that he has sent to the Kew Museum the specimen of oak in which stones are embedded, referred to in his recent paper on "The Natural Inclusion of Stones in Woody Tissue," described in NATURE of November 25 (p. 117).

THE development of the embryo-sac of *Datisca cannabina* forms the subject of an article by Dr. W. Himmelbaur in the *Sitzungsberichte der Kaiserlichen Academie der Wissenschaften*, Vienna (vol. cxviii., part ii.). One division of the embryo-sac mother cell is the rule; otherwise, except for the early disappearance of the antipodal cells, development is normal. The author refutes the possibility of parthenogenesis, but finds that parthenocarpy, *i.e.* the maturation of the fruit without fertilisation of the ovule, may occur.

A STUDY of trichomes as hereditary characters in a few pure and hybrid species of Juglans, Œnothera, Papaver, and Solanum, is described by Dr. W. A. Cannon in Publication No. 117 of the Carnegie Institute of Washington. It is apparent that the trichomes in these cases are not allelomorphs; in fact, they vary in size as much according to their position on the leaves as they do for different species. The development of the hairs on the leaves was also investigated for the species of Juglans, and found to be consistently uniform except in a single type observed in an F_2, or second hybrid generation.

THE current number of *Irish Gardening* (November) opens with an account, by the Hon. Vicary Gibbs, of a few of the shrubs collected by Mr. E. H. Wilson during his last visit to China. About forty species of Rubus have been introduced, chiefly on account of their decorative foliage and stem colouring; also a number of new species of Hydrangea, Ribes, and Vitis. New climbers are furnished by the genera Clematis and Lonicera, of which *Clematis Pratti* and *Clematis souleana* receive special mention. A short report is given of a meeting held in Dublin by the Irish Forestry Society with the object of promoting an annual November "Arbor" week; the economic importance of forestry and the former extent of Irish forests formed the subject of addresses. A novel plan is mentioned in a note of etherising the roots of fruit trees to retard the blossom and so save it from being destroyed by spring frosts; the experiment is said to have been successful.

OWING to the custom which prevails so largely in Germany of making presents of plants at Christmas and on other auspicious occasions, there is a great industry in forcing plants, notably lilacs and cyclamen. As a consequence of this unnatural treatment diseases appear, or become more malignant, and in this connection a brochure by Dr. H. Klebahm, dealing with diseases in lilacs, has been recently published. A bacterial disease of the branches or leaves caused by *Pseudomonas Syringae*, and other leaf diseases due to a Heterosporium and Botrytis, are referred to, but the main purpose is to give the details of a new disease, traced after considerable trouble to a Phytophthora. Full details of the life-history, which is similar to that of *Phytophthora omnivora*, have been worked out.

WE have received from the Michigan State Agricultural College Experiment Station several bulletins dealing with subjects of practical interest. The construction of silos of wood and of cement is described, the latter material being found especially satisfactory. The number of silos in Michigan is steadily increasing; green maize is generally used, either alone or mixed with field peas, cow peas, or soy beans, &c. A description is given of the methods used in treating pigs for the prevention of hog cholera by injection of the appropriate serum; good results are said to be obtained. Another bulletin deals with the feeding of farm horses during winter time, a highly important economical problem. Several rations are suggested, and the cost is worked out in each case.

THE report of the Botanic Station Agricultural School and Experiment Plots, St. Lucia, is a record of continued progress. The soil under cultivation is generally very fertile, and as the population is not large the means of subsistence is easily gained by the natives. In consequence, the methods of cultivation are not very advanced, and there is abundant scope for the work of the agricultural instructors. Attempts are being made to develop the cultivation of Sea Island cotton, and also to assist the sugar industry. Improved methods of dealing with cacao and limes are being worked out, and the various pests submitted to examination. A number of rubber trees and mangoes have been distributed among the planters from the station.

THE bird problem in relation to agriculture is discussed in a recent number of the *Journal of Agriculture of South Australia*. Among insectivorous birds recommended to be encouraged are the wrens (*Malurus cyaneus*), the fly-catchers (*Rhipidura tricolor*, *Sisura inquieta*, *Micraeca fascinans*), the robin (Petrœca, sp.), the swallows, the thrush (*Collyriocincla harmonica*), the pipit (*Anthus australis*), the catbird (*Pomatorhinus superciliosus*), and the yellow-rumped tit (*Acanthiza chrysorrhoa*). On the other hand, the sparrow and the starling do great damage, and the advisory Board of Agriculture has recommended that stringent methods of dealing with them should be made compulsory.

IN continuation of his general discussion on the earthquakes of the Philippines, noticed in NATURE of October 28 (vol. lxxxi., p. 527), the Rev. M. Saderro Masó has undertaken the study of the different seismic regions of the archipelago. His first paper deals with the earthquakes of the Batanes Islands, a group in the extreme north, and only about 200 kilometres from Formosa. In the central island of Batan forty-nine earthquakes were recorded in the six years 1903–8, May and June being the months of greatest frequency. None of these shocks exceeded the degree of intensity 5 of the Rossi-Forel scale. Father Saderro Masó discusses the interesting question whether the Batanes Islands are more closely related seismologically with Formosa or Luzon, and, though the evidence is not very complete, concludes in favour of their connection with the latter and more distant island.

MR. T. SHEPPARD, the curator of the Hull Museum, continues his useful series of catalogues of the collections under his charge, which are issued at the nominal price of one penny each. The last numbers are devoted to an account of a large collection of Roman antiquities from South Ferriby, in North Lincolnshire, and of a number of Anglo-Saxon vases. These publications are issued in cooperation with the Hull Scientific Field Naturalists' Club, which is doing excellent work in cataloguing the fauna and flora of Yorkshire. The second part of its Proceedings for the current year is largely devoted to an account, by Mr. T. Stainforth, of the spiders, harvestmen, and pseudo-scorpions of East Yorkshire.

THE common horseradish (*Cochlearia armoracia*, L.) has been described by Darwin and others as a plant which practically never produces seeds. M. J. Brezezinski contributes to the Bulletin of the Cracow Academy of Sciences, No. 7 (1909), some interesting experiments on this point. He adopted two plans of favouring the production of seeds—grafting and an annular incision round the root. The former plan was a failure, but the latter led to the production of a good number of seeds, some of which germinated and have grown up. These seedling plants belong to two widely differing types, of which illustrations and descriptions are given.

A PAPER on the decimal system of numbers is contributed to the *Popular Science Monthly* for November by Dr. L. C. Karpinski. It contains a historical account of the Babylonian, Roman, Greek, Hindoo, and Arabic systems. A necessary conclusion is that improvements in the system of numeration have been slow to obtain adoption. Even at the present day France does not possess a decimal system of numeration, the use of 20 as a base being still preserved in numbers above 60, a system which, we are told, is of Semitic origin, and exists also among certain Pacific Coast tribes. It exists also in Wales. As a further illustration, the author refers to the slowness of the United States and England to adopt the metric system.

THE principal of the Belfast Municipal Technical Institute has drawn up a valuable series of notes on the method of conducting experiments set in laboratory courses of experimental science. The guidance offered is intended to secure a desirable amount of uniformity in the conduct of the

various laboratory classes in the institute. It is, we notice, made clear that the teachers in charge of the laboratories concerned are at liberty to modify the suggested scheme to meet their special needs. The notes should be of assistance to young demonstrators who are gaining experience as indicating what a successful teacher has found to be a good plan of procedure, but any slavish copying of a hard and fast routine would be undesirable in most cases. The notes have been printed for distribution among the staff at Belfast.

THE *Physikalische Zeitschrift* for November 10, and part xx. of the *Berichte der deutschen physikalischen Gesellschaft*, are both devoted to reports of the physical papers read at the Versammlung deutscher Naturforscher held at Salzburg in September. The former periodical gives, in addition, reports of the discussions following the reading of the papers. An afternoon sitting was devoted almost entirely to papers on the problems which arise in the treatment of radiation and in the building up of electrodynamics on the principle of relativity. Prof. Sommerfeld discussed the composition of velocities, and Dr. M. Born the dynamics of electrons on the theory of relativity. Prof. Einstein gave an interesting account of the development of our views of the origin and constitution of radiation, an account which will be of special value to those who are looking forward to the appearance of Sir Joseph Larmor's recent Bakerian lecture.

MESSRS. ELLIOT BROTHERS are making an accelerometer and gradient measurer, devised by Mr. H. E. Wimperis, which is both ingenious and simple and is free from disturbance by motions of any kind, except that of acceleration in one direction or of tilting in the same direction. Two vertical spindles are geared together so as to run in opposite directions, and they are each eccentrically weighted, and the weights are so placed that their motions in the direction marked upon the instrument are the same and conspire in their effect, while those transverse to this direction are opposite and neutralise each other's effect. One of the spindles carries a copper disc damped by a permanent magnet, an index moving over the scales of acceleration and gradient, and a controlling hair-spring. Such a combination is unaffected by rotational movement or by rotational acceleration of the instrument about any axis whatever; it is also unaffected by transverse or vertical motion or acceleration, or by longitudinal steady motion. It is therefore affected by longitudinal acceleration or by fore and aft gradient alone. As either fore and aft tilting and fore and aft acceleration are of necessity both operative, it is impossible merely by taking a reading to tell how much of the deflection is due to each if the two causes act simultaneously. The user is therefore instructed how to arrange that one of the effects is zero, or, if they both act together, to determine one by an independent observation. A large number of illustrations of the utility of the instrument are described, including power of engine, efficiency of brakes, friction when running idle, and measurement of gradients.

WE have received the first part of Dr. Ludwig Koch's "Pharmakognostischer Atlas" (Leipzig: Gebruder Borntraeger), which is intended to form a supplement to the recently completed work by the same author on the microscopical analysis of drug powders. The atlas will deal mainly with the crude drugs of the German Pharmacopœia, and will contain illustrations and descriptions of sections cut in various directions, the illustrations being sufficiently extensive to show, not only the nature of the elements that occur, but also their relative quantity. Judging from the first part, the figures, so important in a work treating of structural details, will leave nothing to be desired in clearness or accuracy, and the descriptions, though minutely detailed, will be readily intelligible. The work promises to be one of the most valuable of its kind, and to be indispensable to everyone interested in the anatomical structure of drugs.

MESSRS. J. J. GRIFFIN AND SONS have issued their list of chemicals manufactured by C. A. F. Kahlbaum, of Berlin. In comparison with their previous list there has been an expansion from 79 to 95 pages. As compared with the German price-lists of Kahlbaum and Schuchardt, the present list shows an increase of price amounting, in the case of typical materials, to about 35 per cent., but as the English prices include cost of freight, bottles, and packing, the difference on small orders is not excessive, and there can be no difference of opinion as to the advantages gained by having a stock of these materials available in London for immediate use.

THE Journal of the Chemical Society for October contains an interesting paper by Mr. R. W. Gray and Mr. F. P. Burt on the atomic weight of chlorine. The work is divided into three parts—a revision of the density of hydrogen chloride, a re-determination of its volumetric composition, and a study of its compressibility at 0° between the limits 780 mm. and 150 mm. The density was measured by an ingenious application of the condensing action of charcoal cooled by liquid air, as suggested and used by Dewar and Jones. The gas to be examined was condensed by liquid air, carefully purified by fractional distillation, and transferred for measurement of volume to a flask of 460 c.c. capacity surrounded by ice and distilled water, and connected to a manometer; for measurement of weight it was connected to a charcoal bulb having a capacity of only about 20 c.c.; when cooled with liquid air the charcoal absorbed the whole of the hydrogen chloride, leaving a vacuum both in the weighing and measuring bulbs, and by closing the bulb by a stop-cock its weight could be determined at atmospheric temperatures. The average density, after correcting for adsorption of gas by the walls of the measuring bulb, was found to be 1·63915 grams per litre. The volumetric analysis, carried out by measuring the volume of hydrogen set free by the action of aluminium on the gas, gave a mean volume of 1·00790 vols. hydrogen from 2 vols. hydrogen chloride. Combined with Morley's value for the density of hydrogen, the authors' own value for the density of hydrogen chloride, and Morley's value for the ratio of oxygen to hydrogen, this gave the atomic weight 35·459. A comparison of the densities of hydrogen chloride and oxygen, both corrected for deviations from Boyle's law, gave Cl=35·461. The mean value Cl=35·460 coincides exactly with the mean of seven recent determinations ranging from 35·452 to 35·466, and there can be little doubt that the figure is substantially correct.

THE firm of Gauthier-Villars, of Paris, has published the first of a series of volumes projected under the general title "Savants du Jour." The present book deals very appropriately with M. Henri Poincaré, whose work is known to men of science everywhere. The frontispiece to the volume is an admirable portrait of M. Poincaré. The text is divided into seven sections; the first is in the form of a biography, which comprises the discourse by M. Frédéric Masson last January in response to an oration by M. Poincaré when received by the Académie Française, a chronological list of the distinctions conferred upon the subject of the work, and a list of the appreciative articles upon his career which appeared in the French Press. The succeeding six sections are concerned, respectively, with

M. Poincaré's works in mathematical analysis, analytical and celestial mechanics, mathematical physics, and scientific philosophy; his obituary notices of numerous men of science, including the late Lord Kelvin; and his more various writings. Each of the sections dealing with M. Poincaré's scientific work is prefaced by an appreciation by some great authority; thus, that on celestial mechanics is preceded by a translation of Sir George Darwin's address in presenting the gold medal of our Royal Astronomical Society last February. The price of this interesting volume is 7 francs.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN DECEMBER:—

Dec. 2. 6h. Venus at greatest elongation, 47° 18′ E.
,, 18h. Mercury in superior conjunction with the Sun.
6. 10h. 35m. Jupiter in conjunction with the Moon (Jupiter 3° 35′ S.).
12. 7h. 45m. Sun eclipsed, invisible at Greenwich.
,, 19h. 27m. Mercury in conjunction with the Moon (Mercury 0° 3′ S.).
14. 13h. 51m. Uranus in conjunction with the Moon (Uranus 3° 5′ N.).
16. 3h. 10m. Venus in conjunction with the Moon (Venus 2° 50′ N.).
18. 9h. Mercury in conjunction with λ Sagittarii (Mercury 0° 3′ N.).
20. 10h. Saturn stationary.
,, 11h. 56m. Mars in conjunction with the Moon (Mars 5° 0′ N.).
,, 21h. 2m. Saturn in conjunction with the Moon (Saturn 1° 40′ N.).
27. 8h. 30m. Neptune in conjunction with the Moon (Neptune 4° 9′ S.).
,, 20h. 1m. Mercury in conjunction with Uranus (Mercury 1° 43′ S.).

HALLEY'S COMET, 1909*c*.—The following is a further extract from Mr. Crommelin's revised ephemeris for Halley's comet as given in No. 4359 of the *Astronomische Nachrichten*:—

Ephemeris.

1909 (Berlin M.T.)	R.A. (1910·0) h. m. s.	Decl. (1910·0) ° ′	log *r*	log Δ	Magnitude
Dec. 1·4	4 26·9	+15 52			
6·4	4 6·2	+15 23	0·3775	0·1505	12·4
11·4	3 44·4	+14 45			
16·4	3 22·3	+14 4	0·3527	0·1340	12·0
21·4	3 0·6	+13 18			
26·4	2 40·2	+12 28	0·3259	0·1381	11·8

From this we see that the comet is now a little to the west, and south of, Aldebaran, and on December 4 will pass very near to γ Tauri.

According to a note by Mrs. Maunder in the *Daily Chronicle*, Mr. Hollis found the comet a conspicuous object in a 10-inch telescope on November 22, and the Rev. T. E. R. Phillips observed it the same evening, and was still able to see it when the aperture was reduced to 3 inches. Photographs taken at Greenwich on that date showed the comet to be somewhat brighter than the tenth magnitude, *i.e.* about eight times as bright as computed.

OBSERVATIONS OF MARS.—Seven new canals, bringing the total found at the Hem Observatory up to twenty-three, are announced by Mr. Jonckheere in No. 4371 of the *Astronomische Nachrichten*. For two of them, leaving the Cyclopum Lucus and going to Hephæstus and Amenthes respectively, Mr. Jonckheere proposes the names Cepheus and Cassiopeia.

The *Comptes rendus* for November 15 (No. 20) contains three notes dealing with the planet. In the first M. Idrac describes the visual and photographic observations made by him at Meudon during the recent opposition. The photographs were taken in the focus of the 24-inch photographic equatorial, and show a fair number of details, some of which were not visible, or very faint, to the naked eye; the plates used were sensitive to the blue and ultra-violet radiations. On September 20 the edge of the north polar cap was shown clearly on the photograph, and on September 25 extended down to about latitude 55°.

In the second note M. Antoniadi describes the results of thirteen nights' observations made between September 20 and November 9. The most remarkable changes, since the opposition of 1907, appear to be the return of Syrtis Major to the form it had in 1864 and 1877, the re-apparition of Lac Mœris, and the formation of a multiple "island" in the eastern part of the Mare Cimmerium. About fifty "canals" were seen, but M. Antoniadi discusses the meaning of this term before applying it definitely to the features seen. He defines eight types of markings which may be called "canals," and finds that there is no geometrical *réseau* of straight lines intercrossing on the surface of Mars; but across the continental areas there is a structure like a grey marbling, which is too evanescent and intricate to be drawn. A useful chart (Mercator) accompanying the note embodies the features seen at Meudon.

MM. de la Baume Pluvinel and F. Baldet contribute the third note, which describes the photographic researches carried out on the Pic du Midi during September and October. Ordinary plates were used at first, with exposures of 0·1s., but these showed only the polar caps. Later exposures, with Lumière colour filters and various bathed plates, took 6s. to 12s., and show nearly all the details observed visually; the geometrical *réseaux* of fine canals are not, however, to be found on the photographs.

During the recent opposition, M. Kostinsky, using the Pulkowa astrographic telescope, succeeded in obtaining photographs of the two satellites Phobos and Deimos, and now publishes the measures in No. 4369 of the *Astronomische Nachrichten*. The accordance with the ephemeris (based on Struve's elements) is satisfactory, and the photographic magnitudes of the satellites are 11·6 and 12·3 respectively.

PERRINE'S COMET, 1909*b*.—An observation of Perrine's comet, made at Heidelberg on November 20, gave the position at 13h. 0·2m. (Königstuhl M.T.) as 7h. 6m. 20·33s., +15° 31′ 28″ (1909·0), and the magnitude as 14·0 (*Astronomische Nachrichten*, No. 4371).

In No. 4369 of the *Astronomische Nachrichten* Prof. Wolf directs attention to an abnormal decline of the brightness of this object about November 9. On October 11 it was seen with difficulty in the reflector, and on November 6 could not be found visually, although since September 5 it has been observed visually with a 6-inch telescope. A photograph taken with the Bruce telescope on November 9 failed to show any trace of the comet, which must therefore have become enormously fainter.

THE DESIGN OF SPECTROGRAPHS.—All those who are interested in the design and performance of spectrographs, more especially such as are used for radial-velocity determinations, will welcome a paper by Mr. J. Plaskett which appears in No. 4, vol. iii., of the Journal of the Royal Astronomical Society of Canada. As is now generally known, Mr. Plaskett has, since 1905, devoted a great deal of labour to the design of a generally effective instrument, and he has now succeeded in producing a single-prism spectrograph which has proved beautifully effective. Rigidity, temperature control, and optical efficiency have all been provided for, and the instrument can be changed from a one- to a three-prism spectrograph in two minutes without affecting the temperature conditions. Mr. Plaskett gives illustrations and full details of the numerous minor devices and accessories, which it is impossible to reproduce here.

THE ASTRONOMICAL SOCIETY OF WALES.—No. 3, vol. xi., of the *Cambrian Natural Observer*, the quarterly record of the Astronomical Society of Wales, contains several useful notes for amateur observers. Miss Hagerty contributes an interesting article on solar energy, and Mr. Mee asks all Welsh observers to forward to him accounts of any astronomical phenomena they may observe; he gives some useful hints as to what the naked-eye observer may see and should record.

BRITISH ASTRONOMICAL ASSOCIATION.—Messrs. Neill and Co., Edinburgh, have just published, for the British Astronomical Association, a general index of the Journal from vol. i. to vol. xviii. The index has been compiled by Mr. F. W. Levander.

RESEARCHES IN RADIO-TELEGRAPHY.[1]

RADIO-TELEGRAPHY, popularly called wireless telegraphy, has outlived the tentative achievements of its precocious infancy and obtained for itself a settled but important position amongst our means of communication.

This stage, however, has only been reached after a long struggle with experimental difficulties and much labour in analysing the processes involved. As many of these matters are of general scientific interest, it is proposed, during the present hour, briefly to summarise the results of some recent research.

It is well known that the nature of the earth's soil or surface between the sending and receiving stations has a great effect upon electric waves passing over it. If the surface is a very good conductor the wave hardly penetrates into it, but glides over the surface. If it is a poor conductor the wave penetrates into it to a greater extent, and the worse the conductivity the deeper the penetration.

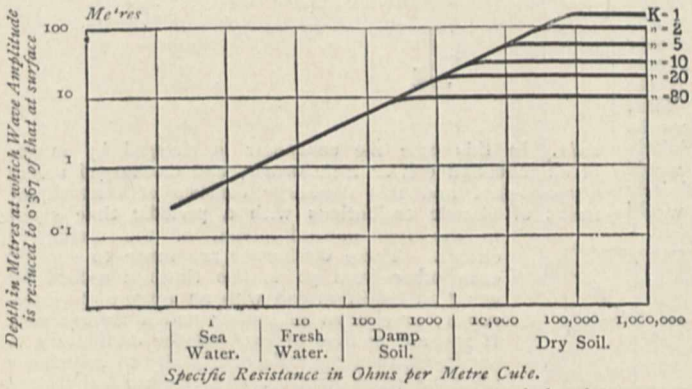

FIG. 1.—Depth of Penetration of Waves 1000 feet in length. (Dr. Zenneck.)

The materials of which the earth's crust is composed, with some exceptions, owe their electric conductivity chiefly to the presence of water in them. They are called electrolytic conductors. Substances like marble and slate, when free from iron oxide, are fairly good insulators. Dry sand or hard dry rocks are poor conductors, but wet sand and moist earth are fairly good conductors. Sea water, owing to the salt in it, is a much better conductor than fresh water. The following table gives some figures, which, however, are only approximate, for the specific resistance of various terrestrial materials in ohms per metre cube. It will be seen that dry sand or soils are of very high specific resistance, and damp or wet sand or clay fairly low.

TABLE I.—*Approximate Conductivity and Dielectric Constant of various Terrestrial Materials.*

Material	Specific resistance in ohms per metre cube	Dielectric constant. Air = 1
Sea water	1	80
Fresh water... ...	100 to 1000	80
Moist earth... ...	10 to 1000	5 to 15
Dry earth	10,000 and upwards	2 to 6
Wet sand	1 to 1000	9
Dry river sand ...	very large	2 to 3
Wet clay	10 to 100	—
Dry clay	10,000 and upwards	2 to 5
Slate	10,000 to 100,000	—
Marble	5,000,000	6
Mercury	0·000001	infinity

If our earth's surface had a conductivity equal, say, to that of copper, then the electric radiation from an antenna would glide over the surface without penetration. In the case of the actual earth there is, however, considerable penetration of the wave into the surface, and therefore absorption of energy by it.

Brylinski, and also Zenneck, have calculated the depth to which electric waves of such frequency as are used in radio-telegraphy penetrate into the sea or terrestrial strata of various conductivities. For mathematical reasons, it is customary to define it by stating the depth in metres or centimetres at which the wave amplitude is reduced to $1/\epsilon = 0.367$ of its amplitude at the surface. I have represented in a diagram some of Zenneck's results calculated for waves of 1000 feet in length, and for terrestrial surface materials of various kinds, conductivities, and dielectric constants (see Fig. 1). You will see that in the case of sea water an electric wave travelling over it penetrates only to the depth of a metre or two, whereas in the case of very dry soil it would penetrate much deeper. Owing to the conductivity of the soil, this movement of lines of magnetic force through it sets up currents of electricity which expend their energy in heat. This energy must come from the original store imparted to the sending antenna, and therefore the wave is robbed of its energy as it travels over the surface.

Dr. Zenneck has discussed mathematically, in a very interesting paper, the effect of the conductivity and dielectric constant of the terrestrial surface, soil or sea, on the propagation of a plain electric wave over it, assuming the radiation to be from an ordinary vertical antenna, and the electric force therefore normal to the earth, and magnetic force parallel to it. The result is to show that there are, broadly speaking, three cases to consider. First, supposing the surface material to be a good conductor, then the wave moves over the surface and penetrates a very little way into it. The electric force in the air over the surface is a purely alternating force vertical to the earth's surface, and the magnetic force is an alternating force parallel to it, and there is very little subterranean electric or magnetic force (Fig. 2, A). This is realised approximately or most nearly in the case of radio-telegraphy over sea water. Secondly, let the earth be assumed to have a very poor conductivity and not a very large dielectric constant, then analysis shows that the electric force in the air has two components, one perpendicular to the earth's surface and one parallel to it, and the resultant is an alternating and a rotating force, the direction of its maximum value being inclined to the surface and leaning forward (Fig. 2, B). The wave-front therefore slopes forward. Also there is a subterranean electric force, showing that the wave is penetrating into the soil, and there is therefore dissipation of energy owing to the conductivity of the soil as the wave travels over the surface. This case is realised when the wave travels over land composed of dry soil having a small dielectric constant. Thirdly, let the earth be a very poor conductor, having a small dielectric constant from 2 to 3, and a specific resistance of about 10,000 ohms per metre cube. For example, very dry earth or sand. Then the investigation shows that the electric force in the air has two components, one parallel to the earth's surface and one perpendicular to it differing in phase, and the resultant is represented by the rotating radius of an ellipse, the maximum value or major axis of which is inclined forward in the direction of the wave motion (Fig. 2, C). At the

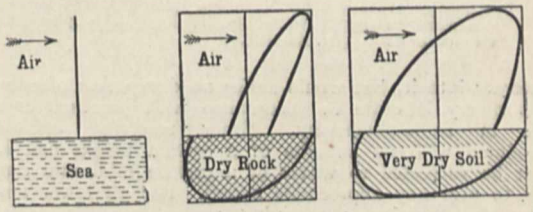

FIG. 2.

[1] From a discourse delivered at the Royal Institution, on Friday, June 4, by Prof. J. A. Fleming, F.R.S.

same time there is some penetration of the wave into the earth, and consequent dissipation of energy.

Dr. Zenneck has considered the case of electric waves 1000 feet in wave-length, and has represented the final result by some interesting curves. He defines the effect of the absorption of energy by the soil by stating the distance in kilometres at which the wave amplitude would be reduced by the effect of this absorption to $0{\cdot}367 = 1/\epsilon$ of its amplitude at the sending station, altogether apart from the weakening due to the spreading of the waves out in a hemisphere, which we may call the spherical or space decrease. These curves are plotted to abscissæ representing the specific resistance of the soil (Fig. 3). You will see from this diagram that when a plane electric wave having the above wave-length is propagated over sea water, it would have to travel 10,000 kilometres before its amplitude would be reduced in the assigned ratio, and over fairly dry soil about 100 to 1000 kilometres; but over very dry soil, having a small dielectric constant, only about 1 to 10 kilometres. Also you will notice that the curves rise up again for still higher resistivities. This, of course, is as it should be. All the practical cases lie between two ideal extremes: the case of an infinitely perfectly conducting earth, in which case the waves would not penetrate into it at all, and the other case, an infinitely perfect non-conducting earth, in which the wave would penetrate into it, but would suffer no dissipation of energy. This theory is quite in accordance with practical experience in radio-telegraphy. Every receiving apparatus associated with an antenna of a certain height and kind must be subjected to waves of a certain minimum amplitude to give any appreciable signal. For all lower amplitudes that particular receiving arrangement is perfectly deaf. Now it is a matter of common experience that with a given radio-telegraphic apparatus and antenna it is possible to receive signals for greater distances over sea water than over dry land, and that if the soil is very dry the distance may be cut down very considerably indeed. This is not due merely to the difficulty of making what the telegraphists call a good earth at the sending station, it is due to the absorption of the wave by the earth for the whole distance which extends between the two stations. Hence, also, it is a common experience that when particularly dry weather is succeeded by wet weather the radio-telegraphic communication between two stations on land is considerably improved.

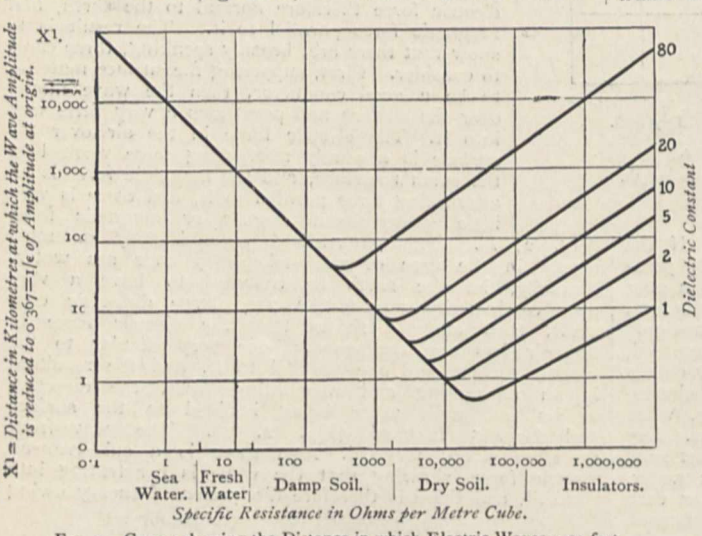

FIG. 3.—Curves showing the Distance in which Electric Waves 1000 feet (300 metres) in length have Amplitude reduced to $1/\epsilon$ by travelling over various surfaces. (Dr. Zenneck.)

The next point in connection with the antenna to be noticed is the means adopted of setting up the oscillations in it. The universal custom at present is to excite oscillations in a reservoir circuit consisting of a condenser and an inductance by means of the spark or arc. If the spark method is used, then the condenser is one of relatively large capacity, and the inductance is kept small. If the capacity is measured in electrostatic units, and the inductance in electromagnetic units, the ratio of capacity to inductance may be something of the order of 5/1 or even

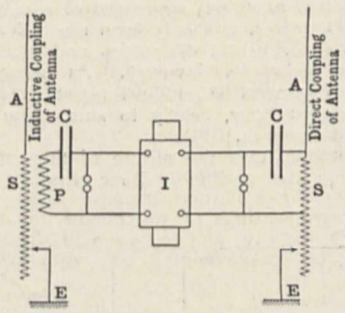

FIG. 4.

20/1. In this case the condenser is charged by means of an induction coil or transformer, and discharged across a spark-gap, and this discharge consists of intermittent trains of electric oscillations with a periodic time equal to the free natural period of the oscillatory circuit. These discharges are made to succeed each other from 50 to 600 times a second by using an induction coil with an appropriate interrupter, or else an alternator and a transformer. If the arc method of exciting the oscillations is employed, then the ratio of capacity to inductance must be much smaller, and the oscillations are excited in this circuit by a continuous current arc worked with a voltage from 200 to 400 volts or more, the arc being traversed by a strong magnetic field, and generally being placed in a chamber kept free from oxygen. The oscillations set up in the condenser circuit are then persistent or unbroken. The oscillations are excited in the antenna by coupling it inductively or directly with the condenser circuit (Fig. 4). If the former method is employed, then an oscillation transformer is used consisting of two coils of wire, one coil being inserted in the condenser circuit and one in the antenna circuit, and according as these coils are near or far apart they are said to be closely or loosely coupled. These two circuits have, then, each their own natural period of electric vibration, like tuning-forks, and they have to be adjusted to syntony. It is well known that under these conditions oscillations set up in one circuit immediately create oscillations of two frequencies in both circuits. This action can be easily illustrated by two pendulums, which are of the same length and are hung side by side on a loose string distinguished by red and blue bobs. If one pendulum is set swinging it imparts little jerks to the other and sets the latter in motion, but to do this the first must part with its own energy, and hence is gradually brought to rest. Then the operation is repeated in the reverse direction. The motion of each pendulum may then be represented by the ordinates of a curve such as those in Fig. 5. This kind of motion can,

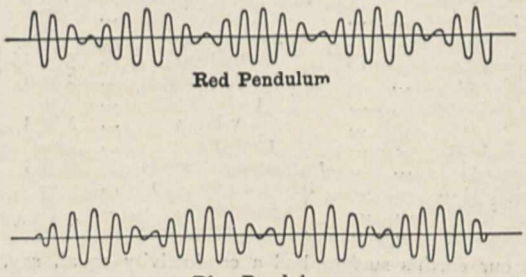

FIG. 5.

by a well-known theorem, be resolved into the sum of two oscillations of different frequencies. Hence each pendulum may be said to possess two rates of vibration. The same thing happens in the case of two closely coupled syntonic electric currents. If one circuit has free oscillations set up in it, the action and reaction of the circuits generates oscillations of two frequencies. Accordingly, when an antenna circuit is coupled to a condenser circuit we have oscillations of two frequencies set up in it, and waves of two wave-lengths radiated from the antenna. The presence of these two waves can be detected either by measurements made with the cymometer or by an oscillograph vacuum tube. In the first case, all that is necessary is to place a cymometer in proximity to the antenna and vary its oscillation constant. It will be found that there are two settings of the handle for which the neon tube glows brightly, and the scale of the instrument will indicate the wave-lengths of the two waves respectively.

Some instructive measurements of this kind have been made by Prof. W. G. Pierce in a recent research, and he has shown that the wave-length given by the formulæ which can be deduced from the theory of the operations are in agreement with actual measurements (Fig. 6). Another striking confirmation can be obtained by the oscillograph vacuum tube, invented by Dr. Gehrcke, of the Reichsanstalt, Berlin. This consists of a glass tube having

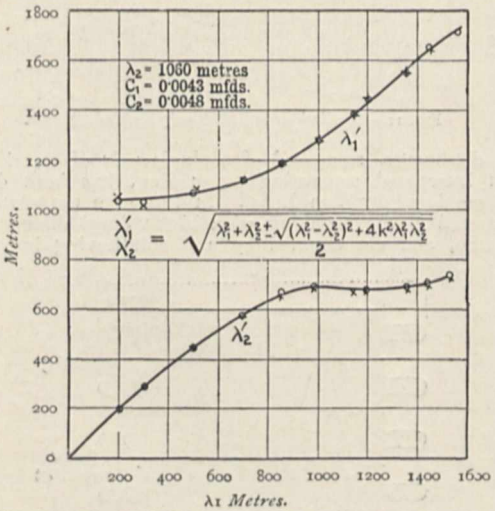

FIG. 6.—Pierce's Experiments on Inductive Coupling.

two strip electrodes in it nearly touching, which are made of nickel or aluminium. The tube is filled with pure nitrogen and exhausted to a pressure of about 10 to 20 mm. If such a tube has a high voltage applied to its terminals a glow light extends along the electrodes, the length of which varies with the electromotive force. Hence, if the tube is connected to a circuit in which an oscillatory discharge is taking place, the glow light along the tube will rapidly extend and contract. If the electrodes are examined in a revolving mirror, making from fifty to a hundred turns a second, the images of the glowing electrodes corresponding to each oscillation will be separated out, and if the oscillations are persistent or undamped we see a series of short bright lines alternately above and below a central line. If, however, the oscillations are damped, then we see in the mirror a train of images each decreasing in length (Fig. 7). On applying such an oscillograph vacuum tube to the circuit of an inductively coupled antenna, and examining in a revolving mirror the image of the electrodes, they will be seen to present an appearance as in Fig. 8, taken from photographs kindly given me by Herr Hans Boas, of Berlin. These oscillograms indicate that there are two oscillations present of different frequency, producing an effect similar to beats in music. Owing to the difference in frequency, the oscillations alternately reinforce and extinguish each other throughout the period, and as this type of oscillogram is only obtained with an inductively coupled antenna, it is a proof that in such a case there are two oscillations present of different frequencies. A similar result has been obtained by Prof. E. Taylor-Jones with low-frequency oscillations in coupled inductive circuits by means of an electrostatic oscillogram of his own invention. Looking at these photographs, it will be seen that each represents a single train of damped oscillations gradually dying away,

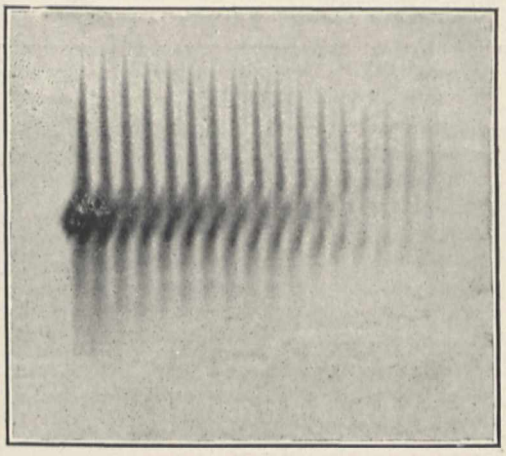

FIG. 7.—Oscillogram of Damped Oscillation (Antenna not connected) taken with the Gehrcke Oscillograph Vacuum Tube.

but that in each train of oscillations there is an alternate waxing and waning of the amplitude, which indicates that it may be considered to be composed of two superimposed oscillations of different frequency (Fig. 9).

Accordingly, in the case of wireless telegraph antennæ inductively coupled, we have in general two waves radiated of different lengths, and either of these can be made to affect suitably tuned receiving circuits. These waves have different damping and different maximum amplitudes.

One of the disadvantages of close inductive coupling is,

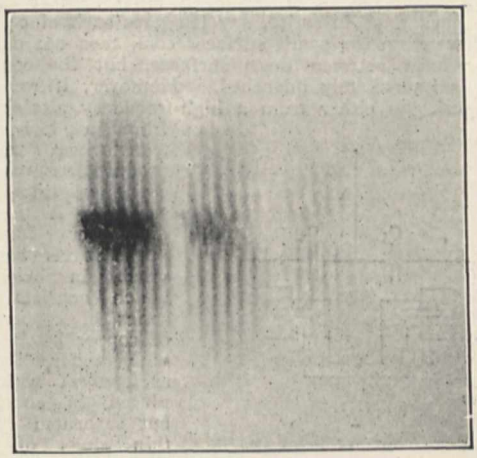

FIG. 8.—Oscillogram of Secondary Oscillation (Antenna connected) taken with Gehrcke Vacuum Tube.

therefore, that we must divide the energy given to the antenna between two waves of different length. As the receiving antenna is generally only tuned to one of these wave-lengths, we then capture and absorb only the energy conveyed by the waves of that wave-length. To meet this difficulty it has been the custom to employ a feeble coupling between the circuits of the oscillation transformer, so as to generate waves of only one wave-length. The objection then arises that the energy conveyed to the antenna is

much reduced. It is, however, possible, as I have shown, to duplicate the receiving circuits so as to capture the energy of both the waves even with close coupling of the transmitter transformer [1] (Fig. 10).

A method of creating feebly damped oscillations has, on the other hand, recently been developed, generally known in Germany as Wien's method, or the method of quenched sparks, which is based on the fact that if we can quench or stop the spark in the condenser circuit after the first few oscillations, the oscillations of the antenna then take place freely and with a single frequency (Fig. 11).

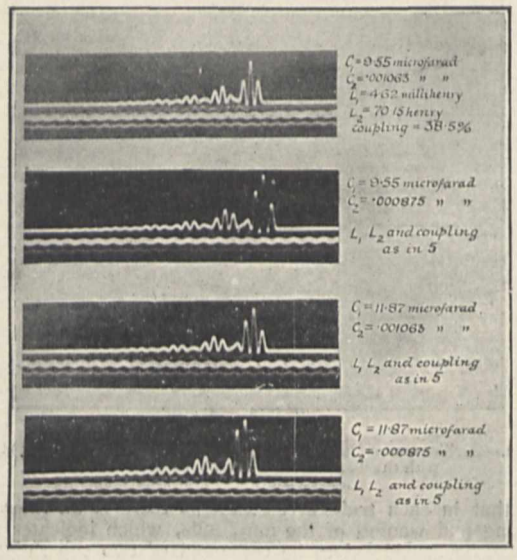

FIG. 9.—Oscillograms of Oscillations in Coupled Circuits by Prof. E. Taylor-Jones.

The principle which underlies this method is the well-known fact, to which particular attention was directed by Prof. M. Wien, of Danzig, in 1906, that the damping effect of very short sparks is extremely large. Hence if we form a spark-gap consisting of a large number of very small spark gaps in series, say ten gaps each of 0·3 mm., and if we keep the spark surfaces cool, then not only can no arc form between these surfaces, but the condenser spark is immediately quenched. Moreover, if we supply this spark-gap either from a high-frequency alternator or from a low-pressure transformer we can produce as many as 2000 sparks per second. A form of discharger for this purpose has been devised in Germany, which consists of a series of copper discs or copper boxes cooled with water, the flat surfaces of which are placed in contiguity, but separated by very thin rings of mica. The interspace between the boxes is not more than 1/125th part of an inch, and ten or twelve of these discs or boxes are placed in series (Fig. 12). The row of boxes takes the place of the ordinary spark balls, and is connected to the secondary terminals of a transformer, fed by a high-frequency alternator, and also connected to an oscillatory circuit. When the transformer is in action it produces a very large number, 1000 or more, oscillatory discharges of the condenser per second, each of which has a large initial amplitude, but quickly dies out. The inductively or directly coupled antenna hence receives a very large number of impulses per second, each of which sets up in it free electrical oscillations of one definite period.

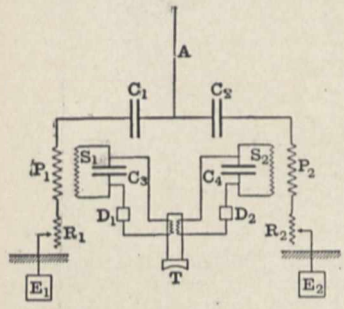

FIG. 10.—Method of utilising waves of both frequencies emitted by inductively-coupled Transmitting Antenna.

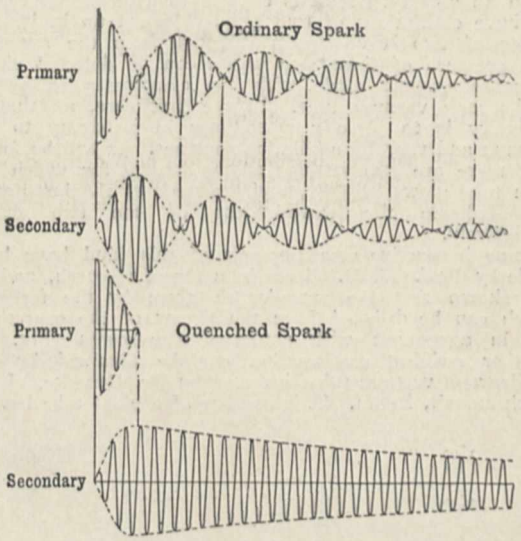

FIG. 11.—Oscillations in Inductively-coupled Circuits.

A discharger, composed of a single pair of metal plates with interposed separating paper ring, has been devised and employed by Von Lepel. In this case the plates are connected to the terminals of a high-voltage direct-current dynamo, and are shunted by a circuit having inductance and capacity, one of the plates being also connected to an antenna and the other to a balancing capacity.

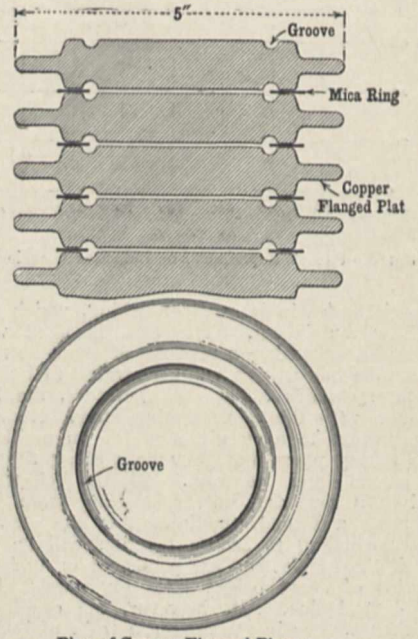

FIG. 12.—Plan and Section showing portion of Discharger.

These discharges, however, have not stood the test of prolonged practical use, and we cannot say, therefore, that they are comparable in value for telegraphic purposes with the well-proved inventions of Mr. Marconi.

(To be continued.)

[1] Since the delivery of this lecture, my attention has been drawn by Mr. J. Hettinger to an article by himself in the *Electrical Engineer* of October 26, 1906, in which he describes an almost identical arrangement devised by him for capturing both the waves of an inductively-coupled transmitter, and refers to a prior invention for the same purpose by Dr. Seibt.

TWO REPORTS ON MARINE INVESTIGATIONS.[1]

THE staff responsible for scientific investigations and administration of fisheries under the Department of Agriculture and Technical Instruction for Ireland is attacking its problems with insight and energy, and is laying up a store of information of permanent value and interest. It is somewhat startling at this stage to note that Mr. Holt finds it necessary in his report on international investigations to expound the wherefore of hydrographical and plankton investigations and their bearing upon practical fishery problems. He states the case clearly and well, pointing out the necessity of studying the variations in the "annual ocean tide," of investigating the relation between salinity and plankton distribution, and of determining how far plankton conditions the abundance or absence of pelagic fishes, and hence may be taken as a guide in practical fishery pursuits. The ultimate end is the foretelling of physical conditions—favourable or unfavourable—from knowledge of prior causative factors, and thus preventing blindly tentative and unremunerative fishing operations. This research is of primary importance to Ireland, the staple fisheries of which are for the pelagic and plankton-eating mackerel and herring. The report further deals with the trawling survey of the deep-water grounds off the south-west coast, with mackerel and herring fisheries, oyster and other bivalve fisheries, and their artificial culture by the Department.

In connection with inland fisheries, a valuable fund of information is afforded by the publication of a summary of reports from many different local observers as to the migrations, abundance, and condition of salmon, grilse, and smolts. Local observations relating to the movements of eel fry up the Irish rivers are similarly collated.

Among the papers comprising the appendix is a second report on the Copepoda of the Irish Atlantic slope, by Mr. G. P. Farran, which deals with a total of 164 species, thirty of them being new and three being made types of new genera. The same naturalist writes on the distribution of the Thaliacea and Pyrosoma in Irish waters, discussing their occurrence in relation to hydrographical factors.

In collaboration with Mr. L. W. Byrne, the scientific adviser to the Department contributes a second report on the fishes of the Irish Atlantic slope, containing detailed descriptions and figures of Scorpænidæ and Alepocephalidæ, and a further list of recent additions to the British-Irish fish fauna. Two further appendices are the result of pioneer work under the auspices of the Ulster Fisheries and Biological Association: one by Mr. Geo. C. Gough on the bottom deposits of Larne Lough, and the other by Mr. H. J. Buchanan-Wollaston on the simple ascidians of the Larne district.

The volume on marine investigations in South Africa is a continuation of the reports on South African marine biology published by the Cape Department of Agriculture under the editorship of Dr. J. D. F. Gilchrist, Government biologist of the colony. Various groups of marine animals containing several new species of great interest form the subject of eight papers written by authorities, and well illustrated with thirty-five plates. Dr. Gilchrist's paper on new South African fishes adds to our knowledge of the deep-water forms two genera of Zeidæ and a new species of a genus already described for these waters, viz. Cyttosoma, which may be the adult of Cuvier and Valencienne's Oreosoma. A third new genus and five new species from the same locality are also described. Among notes on other deep-sea forms, perhaps the most interesting observations are in reference to sexual dimorphism in *Scopelus coccoi*, the males of which bear luminous scales on the upper side of the caudal region and the females on the lower side of it. Of shallow-water forms new species are described in the families of Scorpænidæ, Mugilidæ, Pleuronectidæ, and Clupeidæ. The Pelecypoda are dealt with by Mr. G. B. Sowerby, who describes thirty-three species new to science. A continuation of the report on Crustacea, by the Rev. Thos. R. R. Stebbing, contains accounts of further species—some showing remarkable characters as regards pigmentation and luminous organs—of Macrura, Brachyura, Schizopoda, and the interesting parasitic copepod *Penella orthagorisci*. Mr. P. T. Cleve adds to his plankton contributions a report on the Halocypridæ, Cypridinæ, and pelagic Annelida and Chætognatha. A new Cephalodiscus is described in minute detail by Dr. W. G. Ridewood, who includes in his paper a key to the identification of the seven species of this genus now known. A short paper by Prof. F. Jeffrey Bell describing three new crinoids is marred by three different renderings of the specific name of a new Antedon (presumably *A. magnicirra*). Still a fourth variation of spelling appears in the index!

[1] Report on the Sea and Inland Fisheries of Ireland for 1906. Part ii., Scientific Investigations. Pp. xiv+274. [Cd. 4405.] (1909.)
Marine Investigations in South Africa. Vol. iv. Pp. 196. (Cape Town, 1908.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The syndicate appointed to consider the steps to be taken for the erection of a building for the Department of Agriculture reports that the erection of the building is now practically completed, and the fittings sanctioned are in a forward state. The syndicate anticipates that the building will be ready for occupation by the department at the beginning of the Lent term of 1910.

At a Congregation to be held on Thursday, December 9, at 2 p.m., it is proposed to confer the degree of Doctor of Science, *honoris causa*, upon Mark Aurel Stein.

A short address will be given at the Cavendish Laboratory on Monday, December 6, at 5 p.m., by Mr. G. F. C. Searle, on a course of experimental lectures on geometrical optics specially designed for candidates for the mathematical tripos, which has been arranged for the Lent term, 1910. A number of experiments, with very simple apparatus, illustrating the principles of geometrical optics will be shown. The attendance of mathematical teachers and others interested in the subject is invited.

MR. B. N. WALE, senior lecturer in agriculture at the South-eastern Agricultural College, Wye, has been appointed principal of the Seale-Hayne Agricultural College in Devonshire.

THE London University College Committee will shortly proceed to appoint a Derby scholar in zoology. The value of the scholarship is 60*l*. per annum, tenable for two years. Candidates must have been students of University College in zoology. Full particulars can be obtained from the secretary.

THE Lord Mayor has arranged a conference at the Mansion House on December 3, at 3 p.m., for the discussion of the question of industrial training in education, the development of trade schools, the position of apprenticeship and of the apprenticeship charities, and the establishment of employment bureaux to bring children leaving school into touch with employers of labour. The chairman and members of the London County Council are expected to be present.

A SUMMARY of the returns made to the Education Committee of the London County Council of attendances for the four weeks ended October 30 last at the polytechnics, technical institutes, and schools of art aided by the Council gives some striking results. The returns deal with ten polytechnics and twenty other institutions. In the polytechnics by October 30 last 20,820 individual students were enrolled since the beginning of the session, as compared with 26,410 in attendance for February last. The average number of student attendances a week was, for October, 61,158, and for February, 51,919. In the technical institutes and schools of art together, the grand total of individual students enrolled since the beginning of the session was, for October, 28,558, and for February, 35,911; the average number of student attendances a week were 73,482 and 62,357 respectively. It would appear from these numbers that the interest and enthusiasm of the students flag as the session advances, or else that the counter attractions of the winter prove too strong for a number of students.

THE October number of the Journal of the Association of Teachers in Technical Institutions contains the report

of the council of the association for the year 1908–9. From this report we note that the association has applied to the Royal Commission on University and Higher Education in London to be allowed to lay its views on the subject before the commission, in the belief that the work of the commission will deal to a considerable extent with the polytechnics and technical schools of London. We also gather from an editorial note that the association, while anxious to secure coordination of the work of the polytechnics, looks on the scheme which has been put forward by the Education Committee of the London County Council as a curtailment of the powers of these institutions to do work of a university character, and is therefore opposed to the scheme. The association has also drawn up a scale of salaries for teachers in technical institutions in order to counteract the present tendency towards lower salaries. They propose that salaries of assistants begin at 150*l.* and go to 250*l.*, or 350*l.* for chief assistants in London polytechnics, and that heads of departments in the larger institutions have salaries from 350*l.* to 500*l.* per annum.

At the meeting on November 24 of the Education Committee of the London County Council an important application from the Imperial College of Science and Technology was considered. The governing body desires the Council to make a grant of 8000*l.* to the college in respect of the financial year ending August 31, 1910, as compared with a grant of 5000*l.* for the previous financial year. Application was also made for a special grant of 350*l.* in respect of the teaching of aëronautics. The committee decided that, without in any way committing the Council to the payment of an annual grant, and subject to twenty-five free places being reserved for the Council's scholars, 8000*l.* should be allowed to the governing body of the Imperial College for the year named, that 5000*l.* of the amount should be paid during the current financial year, and the remaining 3000*l.* between April 1 and July 31 next. It was further agreed that the Council, in considering any future application for grant, should ask to be informed what steps had been taken by the governing body "to prevent overlapping and secure coordination of the work already carried on by university colleges, polytechnics, and other science and technological institutions, and the proper connection of the whole with the university," and also what further provision for maintenance is to be obtained from funds of a national character. The special grant for the teaching of aëronautics will not be made.

We have received a copy of the annual report on the 113th session's work of the Glasgow and West of Scotland Technical College, adopted by the governors of the college at their meeting last September. The record of the year shows continued development in the work of the college; full advantage has been taken of the new departures enumerated in the report of last year, and these have had a satisfactory influence upon the standard as well as upon the volume of the work of the session. An important modification has been made in the general curriculum for the diploma awarded by the college, having especial reference to the examination tests to which candidates have been subjected hitherto. It has been the practice in the college to hold special sessional examinations in which it was necessary that a candidate for the diploma should show the attainment of a certain standard of proficiency. Although the examiners were in the habit of taking some note of the class-work before coming to a decision on the merits of a candidate, it was inevitable that the greatest weight should be attached to the results of these special examinations. The departure referred to consists in a reorganisation of the work for the diploma which will permit of the special being combined with the class examinations, and of a student's position each session being determined by the examiners after a review of his whole work for that, and, if need be, for the previous sessions. This review will take account of examinations, drawings, practical work as shown by laboratory books, and other class-work. Part of the work for the final year will be the preparation of a design, the composition of a thesis, or the like, done, not under examination conditions, but as nearly as possible under those which obtain in everyday professional life. It is interesting in this connection to note that Prof. Perry, F.R.S., who was appointed by the Scotch Education Department to make the special inspection of the college for this session, does not think it possible "for the college to take its proper position until it can confer the B.Sc. degree upon all its students who pass satisfactorily through courses of study which satisfy its own council of professors." His report has been brought before the notice of the Court of the University of Glasgow, and of a committee appointed by them to consider the question of future relations with the Glasgow and West of Scotland College.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, November 12.—Dr. C. Chree, F.R.S., president, in the chair.—P. V. **Bevan**: The absorption spectrum of potassium vapour. The method of studying the absorption spectrum was that used first by Roscoe and Schuster, and of late years elaborated by Prof. R. W. Wood. That the optically dense vapour has small density makes it possible to heat the metal in a tube, and to have enough vapour to show strong absorption of light with little distillation to the colder parts of the tube. A tube with quartz plate ends can be used, and the absorption spectrum studied with a quartz spectrograph. The most evident feature of the spectrum obtained is the appearance of the lines of the principal series. None of the lines of the two associated series appear, but additional channelled space spectra unrepresented in the emission spectra. Fifteen new lines have been obtained in the principal series by this method. In the invisible region there appears a channelled space spectrum in the red. This shows definite edges of bands towards the violet end of the spectrum. The wave-lengths of the edges of these bands were measured. When the ratios of these wave-lengths to that of the first member of the principal series are found, the values are found to be in the same range as the corresponding ratios as deduced from Wood's measurements on sodium absorption. This the author regards as evidence of connection between the channelled space spectrum and the principal series of lines. The remarkable feature of this absorption spectrum is the difference in the properties of the principal series lines from those of other lines in the emission spectrum. Some other lines are in emission spectra far stronger than the higher members of the principal series, yet do not appear at all in the absorption spectrum. This fact may indicate that the metallic vapour at the low temperature of these experiments is in a different molecular state from its state in a spark or flame, or that in these latter cases chemical action is going on and the emission spectrum is not a simple elementary spectrum.—J. S. **Dow**: Some further notes on the physiological principles underlying the flicker photometer. The author suggests that something may be learned regarding the physiological phenomena governing the flicker photometer by observing whether it is subject to certain physiological effects, such as the "yellow spot" and "Purkinje" phenomena. Experiments show that the effects referred to do occur, but are apparently much less marked. The author suggests an explanation based on the assumption that the rod-elements on the retina, in addition to the peculiarities attributed to these organs as regards the perception of light and colour, also differ from the "cones" in the fact that they seem to receive a luminous impression more slowly, and retain it longer than these organs. This peculiarity is of little consequence in an ordinary photometer of the equality of brightness type, but may play a part in the flicker instrument; it seems to explain why certain effects should be perceived more clearly in one case than in the other. According to this theory, we may imagine the flicker effect to be due to two distinct portions, received by the agency of the rods and cones respectively. Under certain conditions the speed of a flicker photometer may be supposed to be suitable for the use of "cone-flicker" but too high for the "rod-flicker," which becomes fused into a steady luminous impression, and thus does not affect the readings of the instrument. The author regards his experiments as being essentially of a suggestive character, requiring more detailed examination. One must be cautious in seeking to draw deductions from cases of colour-blindness, as many different varieties of this affliction

exist.—Dr. Edridge **Green**: Colour-perception spectrometer. This consists of an ordinary spectrometer with a single prism, fitted with two wave-length drums, which work two shutters placed in the focal plane of the eye-piece. By means of the shutters any part of the spectrum can be viewed at will, and the wave-lengths of the edges of the patch under observation can be read off from the drums. Dr. Green described how the instrument is used for testing colour-blindness, and referred to the superiority of the method over those usually adopted.—H. G. **Savidge**: Tables of the ber and bei and ker and kei functions, with further formulæ for their computation.

Mineralogical Society, November 16.—Prof. W. J. Lewis, F.R.S., president, in the chair.—J. B. **Scrivenor**: An occurrence of native copper with tin ore in the Federated Malay States. In concentrates obtained in the final washing of the tin ore from the Rotan Dahan mine in the district of Kinta, Perak, the cassiterite was found to be mixed with a reddish mineral, which could not be separated from it. This proved to be native copper in minute and beautifully sharp crystals. The tin ore is obtained from a mass of partially decomposed soft schists overlying limestone, and the copper was probably the result of reduction *in situ* of a copper salt held in solution by water percolating through the schists.—Dr. G. T. **Prior**: A meteoric stone from Simondium, Cape Colony. Two or three masses of a meteoric stone were discovered in 1907, 100 yards apart and a foot below the surface, in gravel near Simondium Station, on the Paarl to French Hoek line, in Cape Colony. The masses, of which the largest was not more than a foot in diameter, were broken up by the finders, who supposed the particles of nickel-iron seen on the fractured surfaces to be native silver. Six of these fragments, which were preserved, have been presented to the British Museum collection by Mr. R. T. Hancock and Mr. R. H. Stanley, one of the prospectors who discovered the masses. The meteorite belongs to the less common class of aërolites which show no chondritic structure; it consists of enstatite, olivine, and felspar, with nickel-iron, magnetite, and some troilite.—L. J. **Spencer**: The occurrence of alstonite and ullmannite (a species new to Britain) in a barytes-witherite vein in the New Brancepeth Colliery, near Durham. A large vein of barytes, coinciding with a fault, in the New Brancepeth Colliery is worked commercially on a large scale for barytes, and has yielded many finely crystallised mineral specimens. These include barytes and witherite in large crystals, and the rare species alstonite and ullmannite (NiSbS, with 28 per cent. of nickel), the latter of which has not been previously recorded in the British Isles. Galena, blende, copper-pyrites, iron-pyrites, and melanterite are also present in small amount. The order of formation of the non-metallic minerals is (1) barytes, (2) witherite, and (3) alstonite, the two last having been derived from the barytes. The ullmannite is found as cubes of considerable size and as octahedra, and it sometimes forms a parallel intergrowth with galena.—Prof. W. J. **Lewis**: Sartorite and other minerals from the Binnenthal. A crystal of sartorite showing twin lamellæ was described.

Royal Anthropological Institute, November 16.—Prof. W. Ridgeway, president, in the chair.—F. G. **Parsons**: The Rothwell crania. The church of Rothwell is situated in the north of Northamptonshire. About 200 years ago some workmen discovered the existence of a crypt, in which was stored a large number of human skulls and other remains. The date *circa* 1700 is the latest, therefore, to which the skulls can be assigned. As, however, at the time of their discovery all knowledge of their existence had been lost, it is safe to consider 1600 as the latest possible date for them. On the other hand, they can hardly be earlier than 1180, which is the earliest date to which can be assigned the vault in which they are stored. There are probably some five or six thousand individuals represented in the vault, and it is practically certain that, as at Hythe, the bones represent the burials of a very considerable number of years, removed at various times to the vault when the graveyard became overcrowded. It seems justifiable, therefore, to consider the bones as being the remains of English men, women, and children, most of whom lived in the fourteenth and fifteenth centuries. It is interesting to notice that, except for a greater breadth of forehead, these Rothwell crania are almost identical with those of the students at St. Thomas's Hospital, measured by the author. On the whole, however, the Rothwell crania are slightly larger. The bones are in a very bad condition owing to the damp.

Royal Meteorological Society, November 17.—Mr. H. Mellish, president, in the chair.—C. J. P. **Cave**: Methods employed for observing pilot balloons used for investigating the currents of the upper atmosphere. Two theodolites are used, each at the end of a measured base-line, and observations of the balloon are taken each minute from its start. The readings are subsequently worked out and plotted graphically, when the height, direction, and rate of travel of the balloon during its course are determined. The best time for observing balloons is shortly before sunset, as the sky will be becoming dark when the balloon reaches its greatest height, and, being illuminated by direct sunlight, will shine like a star. The author has seen a balloon burst at a distance of forty miles under these conditions. The rate of ascent of balloons is found to vary considerably near the ground, and in cloudy weather, particularly when there is cumulus cloud, but higher up the rate of ascent remains fairly uniform up to great heights.—W. **Marriott**: Registering balloon ascents at Gloucester, June 23 and 24, 1909. During the Royal Agricultural Society's recent show the author sent up *ballons-sondes* with recording instruments on three consecutive days. Two of the meteorographs were found and returned. The balloon on June 23 fell thirty-seven miles south-east, and that on June 24 fell forty-three miles north of Gloucester. The records showed that the temperature decreased pretty uniformly up to between five and six miles; above that height the temperature increased somewhat, and then kept nearly stationary up to the highest point reached by the balloons, about twelve miles. The temperature recorded on June 23 was higher than that recorded on June 24, and the point of change, or the so-called "isothermal layer," was about half a mile lower in altitude. This was probably due to the balloon on June 23 having ascended on the eastern side of the centre of a cyclone, while that on June 24 ascended on the western side of the centre.—W. P. **Brown**: Winter temperatures on mountain heights. In 1867 the author placed a minimum thermometer on the summit of Y Glyder-fach, a mountain near Snowdon, and 3262 feet above sea-level, and this has been regularly observed and the lowest winter readings recorded each year. The author gives the readings in full.—E. **Gold**: The semi-diurnal variation of rainfall. The results of the author's investigation seem to indicate that the upward motion associated with the semi-diurnal variation of pressure is the probable cause of the semi-diurnal variation of rainfall.

Geological Society, November 17.—Prof. W. J. Sollas, F.R.S., president, in the chair.—A. R. **Andrew** and T. E. G. **Bailey**: The geology of Nyasaland. E. A. N. **Arber**: Description of the fossil flora. R. B. **Newton**: Notes on the non-marine fossil Mollusca. Dr. R. H. **Traquair**, F.R.S.: Description of the fish-scales of Colobodus, &c. The greater part of Nyasaland consists of crystalline rocks, which comprise:—(*a*) metamorphosed sedimentary beds, including graphitic gneisses with limestones, and muscovite-schists; (*b*) foliated igneous rocks, especially augen-gneiss; (*c*) plutonic intrusions, usually granite or syenite, more rarely gabbro. In the N.W. corner of Nyasaland is an altered sedimentary series, which forms the Mafingi Hills. It consists of accumulations of quartzites, grits, and sandstones of pre-Karoo age. The Karoo system is represented both in the north and in the south of Nyasaland; in the north it occurs in patches. It has afforded remains of fresh-water lamellibranchs (Palæomutela), fish-scales (Colobodus), and species of Glossopteris. Recent lacustrine marls and sands are found at great heights above the present level of the lake, and as much as fifteen miles away from its margin. Pumiceous tuffs are found in the north of the country; across the border, in German East Africa, Tertiary and recent lavas and tuffs are distributed widely. Nyasaland consists of high plateaux rising irregularly one above the other.—S. **Smith**: The

faunal succession of the Upper Bernician. The Bernician series forms the upper division of the Lower Carboniferous sequence of Northumberland. Below the Bernician lie the Tuedian beds. The Northumberland succession, together with the Lower Carboniferous rocks north of the Tweed, occupies the northern extremity of the Pennine province of the Carboniferous Limestone series. The Carboniferous strata in Northumberland encircle the Cheviots on the south, east, and north, and dip from the volcanic inlier. The Bernician is mainly built up of sandstones and shales, but intercalated are beds of limestone and numerous seams of coal. In the Upper Bernician the limestones are fairly thick, constant, and truly marine. The calcareous beds of Lower Bernician age are thin, impure, and frequently contain Stigmaria. There are a few good marine limestones of local occurrence. The Upper Bernician answers to Tate's calcareous group, while the Lower Bernician is equivalent to Tate's carbonaceous group. It is with the Upper Bernician only that the present paper is concerned. The whole of the Upper Bernician Limestones belong to the Dibunophyllum zone, but they are capable of palæontological subdivision, as is given in the paper.—M. K. **Heslop** and Dr. J. A. **Smythe**: Notes on the dyke at Crookdene (Northumberland), and its relations to the Collywell, Morpeth, and Tynemouth dykes. The dyke at Crookdene is exposed in the bed and banks of the Wansbeck above Morpeth. It is intruded along a fault-fissure in beds of Bernician age. The basalt contains narrow lath-shaped felspars and curved augites. Large inclusions of a felspar, closely allied to anorthite, occur. The exterior of the inclusions in contact with the ground-mass is zoned; the individual crystals are intergrown, cracked, faulted, and in places shattered. These phenomena point to a plutonic origin of the felspathic inclusions, and connect them with the porphyritic felspars of the Tynemouth Dyke, for which a similar origin has been suggested by Dr. Teall. The dyke, which comes to a head in the coast-section at Collywell, shows the same peculiarities. The two basalts are practically identical. It appears probable that they belong to the same intrusion. The work of Dr. Teall has been amplified by further observations. The resemblances among the four dykes are so strong as to render it probable that they are derived from a common source.

Royal Microscopical Society November 17.—Mr. F. J. Cheshire, vice-president, in the chair.—E. **Heron-Allen** and A. **Earland**: The recent and fossil Foraminifera of the shore-sands of Selsey Bill, Sussex, part iv. This paper covered the genera Cycloloculina to Nummulites inclusive, and included many rare and interesting forms, but no new species. Of the genus Cycloloculina, first described by the authors in 1908 from this locality, a few additional details were mentioned, but the original source of the specimens still remains doubtful, although its distribution has now been worked out over an extensive area of the peninsula. The evidence, however, points to the Eocene beds of Bracklesham Bay as the source from which the specimens were derived, although none have been found *in situ*. The paper was illustrated by a series of lantern-slides, photographed from specimens specially mounted for the purpose.

Linnean Society, November 18.—Dr. D. H. Scott, F.R.S., in the chair.—W. **Weschè**: A new Tipulid subfamily. The flies which form this well-marked subfamily were brought to the author's notice by Lieut.-Colonel Winne Sampson, who collected them in S. Nigeria. The striking proboscis, more like the mouth-parts of the Culicidæ than of the Tipulidæ, marks them off from all other genera of the latter family, except Geranomyia; but though Geranomyia has greatly developed mouth-parts, they are quite different in type, the paraglossæ being cleft, and the palpi, though single-jointed, being situated at the base of the labium instead of at the tip, as is the case in the Ceratochilinæ. Colonel Winne Sampson's specimens were all mounted as preparations for the microscope, but the author found five pinned, unnamed insects in the British Museum which had been collected by Dr. Graham in Ashanti, and which agreed with the Nigerian species as regards the trophi and peculiar antennæ, but presented generic differences in the wing venation. This genus he has called Neoceratochilys, as the venation is less archaic in type than that of the other genus, which the author names Ceratochilus, or horned or palped lip.—J. M. **Brown**: Fresh-water rhizopods from the Lake District. The author stated that between forty and fifty species had been obtained from Sphagnum and sediment from tarns and lakes, amongst them some which had not been previously recorded as occurring in Britain, with one species new to science. After enumerating the forms found at certain localities, the author gives some critical remarks on some of the species obtained.

Zoological Society, November 23.—Dr. A. Smith Woodward, F.R.S., vice-president, in the chair.—G. C. **Shortridge**: An account of the geographical distribution of the Marsupials and Monotremes of South-west Australia, having special reference to the specimens collected during the Balston Expedition of 1904–7.—Mrs. E. W. **Sexton**: Notes on some Amphipoda from the north side of the Bay of Biscay. The paper contained notes on the development of the females of certain Amphipoda, showing that structural modification continues even after sexual maturity is reached, and this may give rise to differences of so striking a character that earlier and later stages might easily be mistaken for distinct species. This was illustrated by examples from the families Pleustidæ and Eusiridæ.—Lieut.-Colonel J. M. **Fawcett**: Aberrations in Nymphalinæ from the Andaman Islands, and of *Papilio clytia* from Burma.—R. **Lydekker**: Note on the cetacean *Sotalia borneënsis*. A correction of the author's description of this species published in the society's Proceedings for 1901 (p. 88, pl. viii.).

DUBLIN.

Royal Dublin Society, November 23.—Prof. H. H. Dixon, F.R.S., in the chair.—J. **Adams** and Prof. T. **Johnson**: Bacterial rot in the turnip and other brassicas. Three different bacterial diseases are referred to:—(1) brown rot of turnips caused by *Pseudomonas campestris*, Smith; (2) white rot of turnips caused by *Pseudomonas destructans*, Potter; (3) black rot of cabbages caused by *Bacillus oleraceae*, Harrison. The characters of each are described, and an outline of their distribution in Ireland is given. A comparison of the characters of the organisms responsible for numbers (2) and (3) is given in parallel columns, and the inference is drawn that they are the same species. Further confirmation of this conclusion is afforded by infection experiments.—Prof. Henry H. **Dixon** and W. R. G. **Atkins**: Osmotic pressure in plants and on a thermo-electric method of determining freezing points. In this paper the authors describe a thermo-electric method of cryoscopy, and arrangements by which the freezing point of small quantities of liquids (about 2·5 c.c.) may be determined with considerable accuracy to 0·01° C. The method was devised for determining the freezing points of the cell-sap of plants, and by that means to obtain the value of the osmotic pressure in the tissues. More than a hundred determinations were made, and these showed pressures in the leaves of plants ranging from 3·7 to 27 atmospheres. So far as the observations have gone, assimilation appears to be the most important external factor controlling the osmotic pressure of the leaves, which may vary widely in the same plant. Exposure to conditions favouring the fixation of carbon may cause the upper leaves to have a higher osmotic pressure than the lower, or *vice versa*. The determinations of the osmotic pressure are in most cases accompanied with determinations of the mean molecular weight of the substances giving rise to the pressure, so that some idea of the nature of these substances may be formed. The roots examined showed a lower osmotic pressure than the leaves.—Dr. J. R. **Sutton**: Some observations of dew at Kimberley (South Africa). This paper gives the results of some routine observations of dew. The author concludes that, contrary to the usual statements of the text-books, a clear sky is by no means essential to the formation of dew. A clear sky will, as a rule, hasten the beginning of the condensation of moisture from the air, but in the long run as much dew may be deposited when there are clouds as when there are none. When the air is very near the saturation point, the radiation of heat from the earth's surface is not much more intense under a clear sky than it is under clouds. Dew-making is not so much a function of the clearness of the sky as of the dampness of the air and the length of the night.

EDINBURGH.

Royal Society, November 22.—Sir William Turner, K.C.B., president, in the chair.—Prof. Alex. **Smith** and Prof. A. W. C. **Menzies**: A new hydrate of orthophosphoric acid. The new hydrate has the composition $10H_3PO_4,H_2O$. It was obtained in quantity by concentrating orthophosphoric acid to 96 per cent., and keeping it at 24·38°. Mechanical stirring for a few hours brought about crystallisation, the crystals being large transparent prisms similar to those of Joly's hydrate.—Dr. J. A. **Gunn**: The pharmacological action of harmaline. Harmaline is one of two alkaloids found in the seeds of *Peganum harmala*. These seeds have been used medicinally, especially in India, for a variety of purposes, but the nature of their pharmacological action has not been thoroughly investigated. The present investigation shows that harmaline belongs to the group of general protoplasmic poisons, and resembles quinine in its pharmacological actions.—Dr. D. Berry **Hart**: Mendelism and zygotic segregation in the production of anomalous sex, i., the Free-Martin. John Hunter first described the anomalous sterile twin, known as the Free-Martin, found chiefly in black cattle. The Free-Martin is a sterile animal like a heifer, the co-twin of which is a potent bull. John Hunter described three specimens, and, on naked-eye examination, stated that the sexual gland was an ovary in one, a testis in a second, and that in the third both ovary and testis were present. Spiegelberg, of Breslau, examined a Free-Martin calf the co-twin of which was a bull, and described the organs in detail, concluding that the Free-Martin was a sterile bull with very rudimentary Müllerian relics. Numan, of Utrecht, published a memoir on sterile cattle, and figured several specimens comparable with John Hunter's. Although in error in some of his conclusions, he established a most important fact, which Dr. Berry Hart had anticipated theoretically, viz. that there may be a Free-Martin with rudimentary external male genitals the co-twin of which is a potent female. This Free-Martin (Stier-Kween of the Dutch) is thus a sterile female. The conclusion arrived at in the paper was that the Free-Martin and its twin were derived from a single zygote, the potent organs being segregated in the potent twin, the non-potent in the sterile animal. Thus a male zygote gave rise to a potent bull and a sterile bull, the ordinary Free-Martin, while a female zygote gave a potent female and a sterile female. The potent and non-potent elements in each sex behave usually as a complete unit, but in black cattle they segregate in twinning. This explains the puzzling anomaly. The potent and sterile twins may thus be described as an extracted dominant and an extracted recessive respectively, and placed in F^2 of the ordinary Mendelian scheme.—Dr. Thomas **Muir**, F.R.S.: The theory of orthogonants in the historical order of development up to 1860.

PARIS.

Academy of Sciences, November 22.—M. Bouchard in the chair.—G. **Darboux**: Congruences of curves.—Yves **Delage**: The true causes of the supposed electrical parthenogenesis. A repetition, under more stringent conditions, of the experiments described in an earlier paper has shown that the conclusions given were not well founded. Electric charges, as such, do not produce parthenogenesis. Electrolysis produces a slight effect, solely on account of the formation of acid and alkali at the electrodes.—A. **Lacroix**: The existence of rhodizite in Madagascar pegmatites. This mineral is a boroaluminate of beryllium, lithium, sodium, and potassium, of the composition

$$6B_2O_3.4Al_2O_3.4BeO,4(Li,K,Na,H)_2O.$$

—Lecoq **de Boisbaudran**: The band spectra of barium and aluminium.—M. Simon was elected correspondant for the section of anatomy and zoology, in the place of the late M. Bergh.—M. **Borrelly**: Observations of Halley's comet made at the Observatory of Marseilles with the comet finder. The positions of the comet and comparison stars are given for November 19 and 20.—J. **Haag**: Certain groups of families of Lamé.—S. **Carrus**: The integration of partial differential equations.—Marcel **Riesz**: Dirichlet's series and integral series.—B. **Szilard**: An apparatus for radio-active measurements. An instrument based on the principle of the electroscope, but in which the gold leaf is replaced by a rigid index, a magnetised steel needle.—Georges **Claude**: The desiccation of air before liquefaction. A small quantity of alcohol, nearly equal to the weight of water vapour in the air, is added to the air on its way to the compressor; this does not solidify, and can be readily separated in liquid form in the course of the cooling process.—A. **Dufour**: Asymmetry of certain emission bands of vapours in the Zeeman phenomenon.—E. **Caudrelier**: The function of the capacity of the electrodes in the discharge of inductors.—MM. **de Broglie** and **Brizard**: Chemical reactions and ionisation of gases. A criticism of work of M. Reboul on the same subject.—Jean **Meunier**: The conditions necessary for platinum to remain in a state of incandescence in a Bunsen burner. Experiments are detailed tending to show that the property of remaining incandescent in an air-gas mixture is not due to the platinum alone, but to minute traces of saline substances of the order of 0·001 milligram carried by the wire.—H. **Dautriche**: The working of safety explosives containing ammonium nitrate in presence of coal, paper, and paraffin. Coal-dust surrounding the cartridge is burnt to carbon monoxide during the explosion.—A. **Guyot** and A. **Gry**: Some new syntheses of vanillin. Mesoxalic ether and an $\alpha\beta$-diketonic ester are condensed by chloride of zinc in glacial acetic acid, and the product converted into a vanilloyl-carboxylic acid by heating with an aqueous solution of copper acetate.—Marcel **Guerbet**: Some condensation products of camphor.—Henri **Lecomte**: Floral pedicels.—M. **Marage**: Studies of laryngeal vibrations.—J. **Comandon**: The kinematography of living micro-organisms and mobile particles with the aid of the ultra-microscope.—M. **Baudran**: A tuberculous endotoxine of albumose nature. The separation of the albumose from the bacilli is described in detail; it proved to exert toxic effects on guinea-pigs.—L. **Bull**: Researches on the flight of insects.—C. **Gerber**: The ferment of the Basidiomycetes.—A. **Goris** and M. **Mascré**: The existence in *Primula officinalis* of two new glucosides hydrolysable by a ferment. The glucosides are named primeverine and primulaverine; both are unacted upon by emulsin, but are hydrolysed by boiling dilute sulphuric acid.—E. L. **Trouessart**: A new insectivorous type (*Neotetracus sinensis*) from western China.—Jean **Boussac**: The Nummulitic of the eastern Alps.

NEW SOUTH WALES.

Royal Society, August 4.—Mr. H. Deane, vice-president, in the chair.—J. H. **Maiden** and R. H. **Cambage**: Botanical, topographical, and geological notes on some routes of Allan Cunningham.

September 1.—Dr. Walter Spencer, vice-president, in the chair.—T. H. **Johnston**: A new genus of bird-cestodes.—S. G. **Walton**: A complete analysis of Sydney water.—J. H. **Maiden**: A plea for the study of phenological phenomena in Australia.

CAPE TOWN.

Royal Society of South Africa, October 20—Mr. S. S. Hough, F.R.S., president, in the chair.—Dr. M. **Wilson**: Nutmeg poisoning. The symptoms were described and attention directed to the small number of cases recorded. As the condiment was used practically throughout the whole world, the explanation must be that a few nutmegs had gone into circulation after germination had begun and then been arrested. In support of this the author directed attention to the fir seed (dana pitje), which was greatly relished and largely eaten by children near Cape Town without any bad results; but when one seed which had started to germinate was eaten, the results were very serious and dangerous.—Dr. R. **Broom**: Observations on some specimens of South African fossil reptiles preserved in the British Museum. The following are some of the conclusions come to by the author:—All the later specimens which have been referred to Galesaurus are held to belong to a different genus and species, and must take Owen's name *Nythosaurus larvatus*. Gorgonops is held to be closely allied to Titanosuchus, and to be really a dinocephalian. Theriognathus is believed to be very distinct from Endothiodon, and to be really a therocephalian. Anthodon is held to include at present two entirely distinct forms. The type is a small pareiasaurian from the Permian beds of Styl-Krantz. The teeth from the

Cretaceous bed of the Bushman's River, which have hitherto been placed under Anthodon, are held to be dinosaurian, and for them the new name *Palacoscincus africanus* is proposed.—L. **Péringuey** and E. J. **Phillips**: Notes on a zoological and botanical collections from the group of islands of Tristan d'Acunha, made by Mr. J. C. Keytel, 1908–1909. The botanical specimens came from Tristan only, while a few birds were obtained from Nightingale Island; the remainder, however, was collected at Tristan itself. Mr. Keytel collected seven of the twenty species endemic to the island, as well as sixteen plants that have been introduced within the last thirty years, as no mention is made of them by Moseley, of the *Challenger* expedition; among the birds was found a cuckoo, a native of South America, *Coccyzus melanocoryphus*. Among the insects, all but one are introductions, mainly from the Cape, but also from extreme South America. The Cape crawfish, *Jasus lalandei*, occurs also at Tristan, as well as several fishes found on the Cape Colony coast.—A. W. **Roberts**: Absorption of light by the atmosphere. The investigation was undertaken for the purpose of obtaining a value of the coefficient of absorption for South Africa. Taking the means of all the results, Dr. Roberts obtains as the value of the coefficient of atmospheric absorption o^m20, which, interpreted into other terms, means that 17 per cent. of all rays that strike the atmosphere perpendicularly are absorbed by the atmosphere.—L. **Péringuey**: The age of Stone (Palæolithic) in the Drakenstein Valley and the manner in which the implements were made. A large collection of implements of a huge size were exhibited. It was found possible from the material found in that valley to reconstruct the artificial working of those implements from the fractured, water-worn quartzite boulder to implements of a finish equal to the best Acheulean. The division of Chellean, Acheulean, Mousterian, cannot be adopted in South Africa, as the three typical forms were found together and in all stages of finish. The extreme antiquity of the implements shown was demonstrated by the well-nigh disintegrating sandstone of which they are made, as well as by the abraded edges of many of these palæoliths. In fact, some that had been long exposed seem to be preserved by the patina they acquired through the exposure.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 2.

RÖNTGEN SOCIETY, at 8.15.—Some Effects of Electrical Discharges on Photographic Plates: Prof. A. W. Porter.

LINNEAN SOCIETY, at 8.—Nudibranchs from the Indian Ocean: Sir Chas. Eliot, K.C.M.G.—Trichoptera von Mr. Hugh Scott, auf den Seychellen gesammelt: Dr. Georg Ulmer.—Report on the Brachiopoda obtained from the Indian Ocean by the *Sealark* Expedition, 1905: Dr. W. H. Dall.—Narrative of the *Sealark* Expedition, Part III.: Prof. J. Stanley Gardiner, F.R.S., and others.

SOCIETY OF DYERS AND COLOURISTS, at 8.—The Testing of Tanning Materials from a Dyer's Standpoint: W. P. Dreaper.—Methods of Testing Dyes for Fastness: Dr. E. Feilmann.—Some Problems in Leather Dyeing: M. C. Lamb.—The Purchase and Testing of Dyestuffs: H. P. Pearson.

FRIDAY, DECEMBER 3.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Design of Generating Stations: G. Ingram.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—*Resumed discussion*: An Internal-combustion Pump, and other Applications of a New Principle: H. A. Humphrey.

GEOLOGISTS' ASSOCIATION, at 8.—The Volcanic and Alpine Regions of New Zealand: A. E. Kitson.

SATURDAY, DECEMBER 4.

ESSEX FIELD CLUB, at 6 (at Essex Museum of Natural History, Stratford).—Surface Tension and its Relation to Life at the Surface of Water: S. G. Starling and D. J. Scourfield.

MONDAY, DECEMBER 6.

ARISTOTELIAN SOCIETY, at 8.—The Subject-matter of Psychology: G. E. Moore and G. Dawes Hicks.

ROYAL SOCIETY OF ARTS, at 8.—Aëronautics: C. C. Turner.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Artificial Silk Industry: W. P. Dreaper.

VICTORIA INSTITUTE, at 4.30.—The Ivory Islands of the Arctic Ocean: Rev. D. Gath Whitley.

TUESDAY, DECEMBER 7.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Marine Propulsion by Electric Motors H. A. Mavor.

WEDNESDAY, DECEMBER 8.

ROYAL SOCIETY OF ARTS, at 8.—The Destruction of Plumage Birds: J. Buckland.

THURSDAY, DECEMBER 9.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Hexosephosphate formed by Yeast-juice from Hexose and Phosphate: W. J. Young.—On the Presence of Hæmagglutinins, Hæm-opsonins, and Hæmolysins in the Blood obtained from Infectious and Non-infectious Diseases in Man (Third Report): L. S. Dudgeon and H. A. F. Wilson.—Gametogenesis of the Gall-fly *Neuroterus lenticularis* (*Spathegaster baccarum*): L. Doncaster.—Preliminary Note upon the Cell Lamination of the Cerebral Cortex of Echidna, with an Examination of the Fibres in the Cranial Nerves: Dr. E. Schuster.—Cortical Lamination and Localisation in the Brain of the Marmoset: Dr. F. W. Mott, F.R.S., Dr. E. Schuster, and Prof. W. D. Halliburton, F.R.S.—The Caudal Fin of Fishes (Preliminary Paper): R. H. Whitehouse.—Some Experiments with the Venom of *Causus rhombeatus*: H. E. Arbuckle.—On the Comparative Action of Stovaine and Cocaine as measured by their Direct Effects upon the Contractivity of Isolated Muscle: Dr. V. H. Veley, F.R.S., and Dr. A. D. Waller, F.R.S.—A Critical Study of Spectral Series. Part I., The Alkalies, H and He: Prof. W. M. Hicks, F.R.S.—On the Distribution of the Röntgen Rays from a Focus Bulb: G. W. C. Kaye.—On the Nature of the Ionisation of a Molecule by an α Particle: R. D. Kleeman.—Conduction of Heat through Rarefied Gases: F. Soddy and A. J. Berry.—Harmonic Tidal Constants for Certain Chinese and New Zealand Ports: T. Wright.

MATHEMATICAL SOCIETY, at 5.30.—Exhibition of an Instrument for Solving Cubic Equations: T. H. Blakesley.—The Connection between the Theories of the Singularities of Surfaces and Double Refraction: A. B. Basset.—On the Representation of a Group of Finite Order as a Group of Linear Substitutions with Rational Coefficients: Prof. W. Burnside.—The Eliminant of the Equations of Four Quadric Surfaces: A. L. Dixon.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Notes on Methods and Practice in the German Electrical Industry: L. J. Lepine and A. R. Stelling.

ROYAL SOCIETY OF ARTS, at 4.30.—The Punjab: Sir James Wilson, K.C.S.I.

FRIDAY, DECEMBER 10.

PHYSICAL SOCIETY, at 8.—Annual Exhibition.

ROYAL ASTRONOMICAL SOCIETY, at 5.

MALACOLOGICAL SOCIETY, at 8.—Note on the very young Stage of the Genus Humphreyia: G. A. Smith.—A Further Note on the Anatomical Differences between the Genera Cypræa and Trivia: H. O. N. Shaw.—A New Mexican Genus of Pleuroceratidæ: Prof. H. A. Pilsbry.—Notes on a Collection of Terrestrial Land Shells from Angola, with Description of New Species: H. B. Preston.—Notes on the Genus Libera: J. H. Ponsonby.

CONTENTS.