THURSDAY, FEBRUARY 6, 1902.

RELIGION AS A SCIENTIFIC STUDY.

The Study of Religion. By Morris Jastrow, jun., Ph.D. Contemporary Science Series. Pp. xiv + 451. (London: Walter Scott, 1901.) Price 6*s*.

PROF. JASTROW is chiefly known on this side of the Atlantic as an exponent of the ancient religion of the Euphrates valley. The work now before us exhibits its author not merely as an Oriental scholar, but as a scholar of wide and original thought, of keen and sympathetic insight. It is a notable book in a series which has included many notable books.

Beginning with an excellent sketch of the history of the study, Prof. Jastrow proceeds to discuss the classification of religions, the various definitions proposed for religion, and, finally, the origin of religion. These form a preliminary division, which is followed by a consideration of special aspects of the study, namely, the relation of religion to ethics, philosophy, mythology, history and culture. Four chapters devoted to certain practical aspects of the study then bring the work to a conclusion.

Anthropological students will naturally turn with the greatest interest to the chapter in which the author discusses the question of origin. They will agree with much of his criticism on the various theories put forward to account for the phenomena which we class together under the name of religion. An original revelation is now everywhere discredited. Modern science and a larger and more sympathetic view of human nature equally reject the crude theories of the philosophers of the eighteenth century. When, however, Prof. Jastrow leaves these behind and reaches Dr. Tylor and Mr. Herbert Spencer, he seems to be confounding in his criticisms two distinct things—the earliest form of religion and the origin of religion. Little consideration is required to show that the earliest form and the origin are not identical conceptions. Either the animistic theory of the former thinker or the ghost-theory of the latter may correctly present the earliest form assumed by religion, and yet the origin of religion itself may remain undiscovered. In other words, there must be behind the earliest form the possibility of life, the inchoate material ready to take shape. Religion is not a simple phenomenon, as the author rightly points out; it is a complex of thought and emotion. What we want to ascertain is what are, reduced to their lowest terms, the components of this complex, and how did they come together to make the germ of that universal characteristic of mankind—religion.

To these questions Prof. Jastrow adopts the answer of Max Müller which ascribes the origin of religion to "the perception of the infinite." Now Max Müller is a very dangerous guide to follow. He knew little of savage belief and savage custom. He derided the efforts of anthropologists to account for myth and custom, whether of the Greeks or of the Hottentots. He himself built up an elaborate system based on a study of the Vedas and philological comparisons. After it had been riddled with shell and rendered completely untenable he was still dwelling in a fool's paradise, despising his antagonists because they were not Sanskrit scholars. And so he continued to the end. One of the last things he did was to publish a reply which exhibited his utter unconsciousness of many of the real problems about religion considered as a human phenomenon. In his solution of the origin of religion as "the perception of the infinite" he was acting like his fellow-countryman in the camel-story. He was evolving the idea of the origin of religion from the depths of his inner consciousness. He had not gone to the nearest representatives accessible to our inquiry of the primitive human being. He had not questioned them. He had not examined their modes of thought, their customs, their beliefs, with the hope of obtaining a clue to those of their hypothetical ancestor. He would no more have thought of doing so than Hobbes or Rousseau. Hence his answer to the question of the origin of religion is not the result of induction, it is "a shot." It is a shot by a very acute and accomplished man, and so perhaps in the right direction. It may miss its mark by excess, rather than by falling short, or by misdirection. But it misses its mark all the same.

The general course of human evolution is upward, not downward. We may therefore assume that the hypothetical ancestor with whom religion originated was a less developed being as to mental and moral characteristics than his descendant, the modern savage. Has any traveller or missionary ever found a modern savage with a perception of the infinite? Perception of the vague, the indefinite, the mysterious, the awful is common to the race; but perception of the infinite is beyond the power of any but the cultivated intellect of a philosopher, if even he can attain to it. Prof. Tiele, whom Prof. Jastrow quotes, tries to avoid the difficulty, while giving the weight of his distinguished authority to the general theory, by speaking of "man's original, unconscious, innate sense of infinity." And Prof. Jastrow himself admits that "such a concept as infinity is a self-contradiction on the part of a finite intellect." Yet he thinks this "need not deter us from according to it a strong influence over primitive man, and all the stronger because of his failure to grasp it clearly." Does the phrase, then, mean anything more from the pen of Prof. Jastrow (whatever Max Müller may have meant by it) than the sense of the mysterious, the awful? If it be simply a pompous way of saying this, it harmonises with what we know of the savage mind and is sufficient to satisfy Prof. Jastrow's own requirements when he says that in seeking for the origin of religion

"we must look for something which could stir [primitive man's] emotions deeply and permanently, which could arouse thoughts that would henceforth never desert him and would prompt him to certain expressions of his emotions and thoughts, so definite and striking as to become part and parcel of family or tribal tradition."

If it mean more than this it goes beyond those requirements and imputes to primitive man powers of thought and ideas incomparably beyond any yet discovered among savage races, while it ignores the practical considerations which must have immediately and profoundly influenced him.

I have dwelt upon this point because it is obviously cardinal in a work on the scientific study of religion.

And I regret that a writer ordinarily so clear-sighted and judicious has been misled by one whose services to the study of Hindu religion and literature can hardly be overrated, and whose contributions to philology and, indeed, the science of religion it would be the veriest ingratitude not to recognise. The rest of my task is more pleasant. To discuss a subject so vast as religion in a little volume of some four hundred pages is no mean undertaking. It cannot be expected that the writer will satisfy his critics on all points. No fulness of treatment would probably enable him to do this, and where so much has to be compressed or entirely passed over it is hopeless to think of it. Besides, the questions dealt with are such that at every point he encounters prejudice and runs the risk of wounding the innermost and most sacred feelings. Among these difficulties Prof. Jastrow has tried to find his way. Owing to his charity and sympathy with the most diverse manifestations of the religious spirit, to his circumspection, to his large views of history and to his dispassionate judgment, he has, on the whole, succeeded admirably. His opening chapter on the history of the study, and those on religion and history and religion and culture, display in full measure all the qualities referred to. The practical suggestions contained in the final section deserve careful consideration. In the chapter on the study of the sources the standard is fixed very high. It is well that it should be so. But it is to be observed that the exhaustive study demanded for the religion to which the student proposes to dedicate himself will, in the case of most students, leave but little time for that acquaintance which the writer demands, and rightly demands, with other religions.

"In order to understand one religion," he says, "we must be acquainted with more than one. Religions with literatures differ far more from one another than those which possess none. Hence it is not sufficient to study merely one religion direct from the sources."

By this expression the author means the study of the religious literature in the original tongue. He does not mention, though his illustration of the Hebrew word *goel* evidently implies, a study of the history and culture of the people concerned outside their religion. To continue the quotation :—

"Studying two in this way may be set down as a minimum for acquiring that firmness of method and keenness of judgment needed for the chief problem of religious research—the interpretation of facts. This does not imply that the two are to be cultivated with equal intensity, or that the entire field of both must be covered, but only that in addition to the one religion which forms one's special object of research, one should be able to acquire a sufficient knowledge of a second religion, direct from its sources, as to be able to penetrate into the spirit of that religion."

The ideal is excellent. And yet I am not sure that a more important service may not sometimes be rendered to the study of a religion by one who is ignorant even of the original language, if he be able to bring to bear upon a study of first-rate translations a wide ethnographical knowledge, and therefore to compare the practices of totally different races and cultures. How, for example, would a study of the sources of Hebrew and Egyptian religions, or Hebrew and Hindu religions, even if we add Mohammedanism and Zoroastrianism, enable us to solve the origin and meaning of the rite of circumcision? Robertson Smith could never have written his "Religion of the Semites" if he had been *simply* a student, from the sources, of the Hebrew and Arab religions. A general acquaintance with the results of anthropological study of savage peoples was of more value to him than the study of the literatures of half-a-dozen civilised religions would have been.

I have no space to do more than refer to the cogent arguments with which the author enforces the need for the scientific study of religion in higher education generally, and especially in mission-colleges; or to his exposition of the utility of museums in the study. These chapters, not less than the earlier parts of the book, deserve to be carefully read. The appendices illustrate them by showing actual courses of lectures delivered at the École des Hautes Études at Paris, and the arrangement of the Musée Guimet, which was specially formed to aid the study of religion. To guide the student, a bibliography is added of a remarkably catholic character.

E. SIDNEY HARTLAND.

CHEMISTRY FOR COLLEGES.

A College Text-Book of Chemistry. By Ira Remsen. Pp. xx+689. (London: Macmillan and Co., Ltd., 1901.) Price 8*s.* 6*d.* net.

THIS book is intended to fill a place between the "Introduction to the Study of Chemistry" and the "Inorganic Chemistry" by the same author. The style and plan of the book may be estimated from the author's remark in the preface, where he expresses the opinion that "The time has not yet come for the abandonment of the study of elements and their compounds in what some are pleased to call the old-fashioned way." Intended, as its name implies, for the use of colleges, the book differs in no essential particulars from other text-books of the same scope. The arrangement adopted for the treatment of the subject is one that has in more recent years repeatedly appeared, a few typical elements and their compounds being studied in some detail in the earlier chapters, and the main bulk of the subject subsequently dealt with from the standpoint of the periodic law. Each descriptive chapter is followed by a number of experiments to be carried out by the student, whose power of observation is aided and developed by the manner in which many suggestive questions are asked concerning each experiment. A number of chapters throughout the book are devoted to a discussion of the principles of theoretical chemistry, and it is in reading these that we are more particularly struck with the loose and inaccurate expressions that are more or less characteristic of the book. Thus it is not the best definition of energy to say that it is "that which causes change in matter." Again, in discussing chemical changes, the student is told to "consider the changes included under the head of fire." Is not fire rather a phenomenon accompanying these changes? In discussing the law of conservation of energy the incomplete statement is made that "from a certain amount of heat we can get a certain amount of motion, and that for a

certain amount of motion we can get a certain amount of heat." In the first place this form of statement is likely to give the impression that heat is something entirely different from motion, and in the second place it implies that heat and motion are quantitatively convertible, which is not strictly true. Further on the statement is made that in order to bring about chemical change "high heat must be used to aid the reaction."

A great number of similar expressions are to be found scattered throughout the book, and it seems a very short-sighted policy to sacrifice accuracy and the use of scientific modes of expression, even in attempting to make matters more intelligible to beginners, as it is far more difficult to get rid of early false impressions than to acquire correct ones in the first place. This sort of treatment is especially to be noticed in the author's account of the ionic theory. On p. 90, ions are first introduced very briefly to the notice of the student, and throughout the succeeding pages many reactions are represented as due to action between the ions; and equations are printed in which the ions are represented as atoms. This must be exceedingly confusing to the student who has been told in another place that atoms, generally speaking, cannot exist in the free state; and it is not until p. 417 that this difficulty is overcome for the student by the true explanation of the nature of an ion. Another serious misstatement occurs in the account of the phenomena of osmotic pressure, where, after quoting the extension of Avogadro's law to solutions, the following passage appears: "Notwithstanding the simplicity of this law, no practical method for determining molecular weight based upon it has yet been devised."

The more descriptive part of the book is also not free from inaccuracies. For example, in one portion of the table on p. 15 the atomic weights are referred to H = 1, in another part of the same table to O = 16. The term combining weight is itself used in two different senses in different parts of the book; in the earlier portion it is used as synonymous with atomic weight, and in the later portion as a simple submultiple of the latter. Another discrepancy is that which ascribes to krypton on p. 19 the atomic weight 81·8 and on p. 262 58·67. It is disappointing to find the author of so excellent a work as the admirable little book on organic chemistry failing to come up to the standard of accuracy which is now demanded of teachers.

HYDRAULICS.

A Treatise on Hydraulics. By Henry T. Bovey, M.Inst.C.E. Second edition, rewritten. Pp. xviii + 583. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1901.)

THE author of this treatise, in his position of professor of civil engineering and applied mechanics at McGill University, Montreal, has exceptional opportunities for conducting experimental investigations on the flow of water, owing to the remarkably complete equipment of the hydraulic laboratory under his charge, which the University owes, in addition to many other endowments, to the munificent liberality of Sir William C. McDonald, a well-known merchant residing in Montreal. It is very satisfactory to note that Prof. Bovey has made full use of his opportunities in advancing the study of hydraulics, as indicated, in the first instance, by the publication of the first edition of this book in 1895; whilst this second edition, with its rearrangement, its large quantity of new matter, and its additional tables of experimental results, marks the progress which has been made in the interval towards raising the subject of hydraulics, so long based on empirical formulæ, into the position of an exact science.

The subject is divided into eight chapters, to each of which, in addition to examples worked out in the text, is appended a number of problems for the student, relating to the questions dealt with in the chapter, together with their answers. The book begins with a chapter on general principles and the flow through orifices and over weirs, followed by one on fluid-friction and pipe-flow, and another on the flow of water in open channels; and these three chapters, each extending over more than a hundred pages, complete the portion relating to the flow of water, and occupy more than half the book. They furnish a fairly exhaustive treatment of the subject; but though, owing to the large print, the widely-spaced formulæ, the numerous diagrams, and the tables, the actual contents of these chapters are not so great as might be inferred from the number of pages they occupy, the chapters are inconveniently long, and might with advantage have been subdivided. This is undoubtedly the portion of the book to which civil engineers engaged in water-works, irrigation, and river improvement will mainly refer for an elucidation of the difficulties involved in the correct determination of the flow of water through orifices, over weirs, along pipes, and in open channels. A chapter is devoted to the important subject of hydraulic machinery, including rams, presses, accumulators, and water-pressure engines. Three chapters relate to water-motors, dealing successively with impact, reaction, and the principles of impact and tangential turbines, vertical water-wheels, and turbines; and the final chapter deals with centrifugal pumps. The book is illustrated by three hundred and thirty figures in the text, mainly diagrams for elucidating the various theories and principles dealt with, together with a few drawings of machines referred to; whilst a very convenient paged list of the various headings of subjects throughout the book is given in the table of contents at the commencement, and a concise but useful index concludes the volume.

The mathematical treatment adopted right through, with the four hundred and forty-six examples given for working out, render the book more especially suitable for students in hydraulics who have had a previous mathematical training, the book having, indeed, been originally the outcome of a series of lectures to such students; and it will be doubtless of interest to hydraulicians, particularly in view of the advance it manifests in hydraulic science. A less elaborate and less educational method would probably have more favourably commended the book to the notice of practical engineers interested in hydraulic problems; and, in its present shape, the book seems likely, irrespective of its value to hydraulic students, to be mainly advantageous to those engineers

in practice who possess adequate mathematical knowledge and leisure to select from the numerous formulæ, and especially from the tables, those portions which are best adapted for practical application. It appears really almost impossible to produce a treatise on such a subject as hydraulics, so that, whilst furnishing an exhaustive treatment of the subject and being of considerable educational value for the advanced mathematical student, this book should, according to the author's hopes, at the same time prove specially adapted to the requirements of busy practical engineers; for in proportion as it realises its main object, it tends to become unsuited for its secondary purpose. Nevertheless, as a book tending largely to advance the science of hydraulics and promote the thorough training of future hydraulic engineers, it deserves to be very cordially welcomed.

OUR BOOK SHELF.

Erlebtes und Erstrebtes. Von Carl Gegenbaur. Mit einem Bildniss des Verfassers. Pp. 114. (Leipzig: Wilhelm Engelmann, 1901.) Price 2*s*.

THERE must be many who have hailed with delight the announcement of "Erlebtes und Erstrebtes," the authentic account of the long and assiduous life of the founder and elaborator of modern comparative anatomy. However, the readers of the little brochure will be sadly disappointed, since it contains not much Erlebtes, and the author is more than reluctant about telling us what he has "Erstrebt," *i.e.* striven for and reached. Most of the reminiscences can be of interest only to his own family. Born at Würzburg August 21, 1826, sprung from a family of mostly Governmental officials, mainly of Bavarian descent, Gegenbaur went through his schooling at Würzburg and spent the vacations roaming about with his gun, dissecting his spoil. He is emphatic about the value of the studies of the classics; "to ignore the classical languages means to resign part of our education, and those who say that these languages are dead, ought to remember that the letter killeth, but the spirit giveth life." Würzburg was also his university, where, after eighteen months of preliminary philosophical and historical studies, he was inscribed as a medical student. In the same year, 1847, Albert Koelliker was called to the university. F. Leydig was privat docent for microscopical anatomy, and for him our author has high praise. Another of his teachers was R. Virchow, "whose great merit is that he gave a new, very fertile, direction not only to pathology, but to the whole of anatomy, by imparting to it the notion of evolution."

Gegenbaur studied with a view to following natural sciences, not to devote himself to medicine, which latter he could not bring himself to consider a true science. Still, he became third assistant at the Julius hospital. In 1851 he took his degree, one of his theses dealing with the changes and variations of plants. Then followed his "Wanderjahre," visits to the chief German towns, and in Berlin he made the personal acquaintance of Joh. Mueller. In 1852 he went with Koelliker and Heinrich Mueller, of retina renown, to Messina, bent upon zoological research, and he wandered through Sicily, in which island he spent nearly a year.

In 1854 Gegenbaur established himself as privat docent for zoology at Würzburg, soon to leave this place for Jena as professor extraordinarius. At the death of Huschke he became the latter's successor as professor of anatomy. This was the first university in which henceforth anatomy was separated from physiology, a science for which he has not many kind words to say. Berlin followed suit in the same direction after the decease of Joh. Mueller, then Würzburg, &c.

In 1856 he married his first wife, whom he was to lose soon after; we are not told that she was a daughter of Huschke. From this time dates the intimate friendship with Haeckel. The author speaks with warmth of quiet little Jena as the place where practically all his fundamental ideas were conceived and grew. He set himself to rescue anatomy from the state of mere description; the term morphology in opposition to physiology "was intended mainly to express the difference of treatment," and anatomy itself was to be elevated to a higher position by the comparative method.

In 1873 Gegenbaur went to Heidelberg as the successor of Fr. Arnold, his second father-in-law. The following twenty-nine years, so full of activity and world-wide influence, are dealt with in ten small pages—the writing of the text-book of the anatomy of man (now in its seventh edition), based upon the results of comparative anatomy; the starting of the long series of the "Morphologische Jahrbuch," and scanty reminiscences concerning, and of interest to, but a few intimate friends.

The book is prefaced with an excellent likeness of the author. H. G.

Beautiful Birds. By Edmund Selous. Pp. ix + 224. (London: Dent and Co., 1901.)

MR. SELOUS' volume, in spite of its pleasant-looking green cover, numerous though indifferent plates, and text cheerfully varied with italics, is in reality no more than an unduly swollen tract. It is necessary to say this at once, and with emphasis, lest the unwary buyer of bird books should add this volume to his library under the impression that he was adding a useful and chatty account of humming-birds and birds of paradise. The volume is, in fact, an example of what is known in the animal world as "aggressive mimicry." Under the guise of a pleasing discourse upon some of the more striking among many beautiful birds, the author really provides the public with not much more than a simple attack upon the wearing of birds' plumes by ladies. We have not the least objection to Mr. Selous' views in this matter, or to the expression of them. But he might surely have found one of those numerous journals which delight in denunciatory declamation rather than in adherence to frigid fact, and into its sympathetic columns have poured his feelings of horror at feminine inhumanity. Then no one would have been deceived about the matter, as some possibly may be. Mr. Selous builds upon a minimum of zoological fact a large superstructure of curiously agitated, almost hysterical, ethics. The book is, in its form, addressed to a hypothetical and female infant of tender years who is urged to persecute her mother and female relatives generally until they promise never to wear birds' feathers in their hats, as, for instance—"You must remind her of it from time to time ('remember mother you promised'), when you hear her talking about getting a new hat. And when you have made her promise about herself then you must make her promise never to let you wear a hat of that sort. . . . And if you have a sister very much older than yourself, &c., &c." With such observations the chapters are liberally sown and nearly invariably conclude; it is, moreover, at least once added that the mother and sisters in question had better read this particular volume. We sincerely hope that they won't take this broad and business-like hint; for even from the point of view of a "humanitarian" (we must use inverted commas as there is no necessary connection between the use and meaning of this term) Mr. Selous is unworthy of praise. Why should he select the "beautiful birds" only, and by implication condone the massacre of birds that have not that advantage? F. E. B.

Lehrbuch der Chemie und Mineralogie. By Prof. G. Siebert. 3 vols. Pp. viii + 101, vi + 144, vi + 110; figs. 100, 91, 32. (Braunschweig: Friedrich Vieweg und Sohn, 1901.) Price Mk. 4·25.

THIS text-book, which is intended for use in higher schools, does not differ to any very remarkable extent from numerous other elementary treatises on the same subject. Perhaps the first volume, described as an introduction to chemistry and mineralogy, shows the most originality in treatment. In this part the beginner is made acquainted with the most important chemical processes, such as oxidation and reduction, and is taught something of the more common chemical compounds, mainly by means of experiments, of which a hundred are fully described. These experiments are in most cases quantitative, and involve the weighing of gases as well as of solids and liquids. The laws of chemical combination which receive their expression in the atomic theory are thus impressed on the student by his own actual quantitative results. The treatment of the mineralogy is of a somewhat perfunctory character. The six systems of crystals receive the usual brief and inadequate exposition common to chemical text-books, and the Naumann system of notation for the crystal-faces is explained, but no mention is made of Miller's system. A review of the most important minerals appears at the end of the volume, and brief descriptions, with figures of the crystals, of natural phosphates, sulphates, &c., are given in their appropriate places in the text. The second volume is devoted to inorganic chemistry, and the elements with their principal compounds are treated in turn, the non-metals in the order of their valencies, and the metals in the usual groups. The third part deals with organic chemistry. Structural formulæ are explained, but the treatment is sufficiently elementary, as is evident from the fact that the whole subject of both fatty and aromatic compounds occupies less than a hundred pages. In an appendix are given the descriptions of a number of simple experiments illustrating the methods of production and properties of some of the most important organic compounds. A very brief introduction to organic and volumetric analysis completes the volume.

Knowledge. Vol. xxiv., January to December, 1901. Pp. xii + 288. (London: *Knowledge* Office.) Price 8*s.* 6*d.*

SOME of the full-page photographic plates in this volume of *Knowledge* are very fine. Among the subjects are several brilliant photographs of star clusters and nebulæ, taken by Dr. Isaac Roberts, constellation figures on Greek coins, lunar photographs, life-history of a sun-spot group, spectra of Nova Persei, and the solar corona of May 18, 1901. Mr. E. W. Maunder has a series of articles on constellation studies, in which he deals largely with the poetical aspects of the sky; Dr. Vaughan Cornish has four articles on the sizes of ocean waves; Mr. G. H. Carpenter describes insects of the sea; Mr. R. Lydekker writes on a number of subjects of zoological interest; Mr. H. F. Witherby on ornithological experiences in the Soudan; and Mr. R. Lloyd Praeger on flowering plants. There are numerous other articles of an instructive character.

A Geography of Wales. By A. E. L. Hudson, B.A. Pp. xii+164. (London: Macmillan and Co., Ltd., 1902.)

THIS book is intended chiefly for use in Welsh schools, and the general idea borne in mind in its preparation is that the best foundation for a knowledge of geography is the study of the land and the people of the district and country in which the pupils live. The attention given to physical geography and to civic affairs, such as local and national government, and population and its distribution, is noteworthy. There are many attractive illustrations, which, with the instructive text, will serve to commend the book to the attention of teachers.

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.*]

Fall of Mud or Dust.

MY men here noticed on Thursday last the 23rd inst. that the leaves, glasses of the frames and iron work of the gates were smeared with a reddish mud; one hedge in particular they described as almost covered with the substance; and the pinafores of a cottager's children which were hanging out to dry were so stained with the deposit that they had to be rewashed. When the substance fell no one here knows, nor is it clear whether it fell as dust or mud; from the firm way in which it has attached itself to the iron work I should think that it fell as mud.

Unfortunately, I did not hear of the event till some days afterwards, and I first saw the deposit yesterday. It was still, notwithstanding a good deal of rain, to be seen on the iron work, the glasses of the frames and on leaves. I send for your inspection herewith a laurel leaf, down the sides of the midrib of which you will find some of the deposit in question. Possibly some expert may be able to determine the nature of the deposit. It does not appear to me to be silica.

I append cuttings from local papers, showing that the phenomenon was observed elsewhere. Lawrence Weston is some five miles north-east from hence, Chewton Priory some fifteen miles south-east, and Barry Island some twenty miles west-by-south and on the other side of the Bristol Channel.

Failand, January 28. EDW. FRY.

From the *Bristol Times and Mirror*, January 21.

A CURIOUS STORM.

SIR,—I thought the readers of your valuable paper would be interested to know that on Thursday morning we had what I think a rather strange storm, about a quarter past seven, of about 15 minutes' duration. After it got light I found quite a covering of dust on the glass on the garden frames, about the colour of Bath brick dust. Not having seen any account of it in your paper, I thought I should like to hear if anyone else had noticed it. Yours truly,

Lawrence Weston, Henbury, January 24. A. DENHAM.

From the *Western Daily Press*, January 28.

SINGULAR PHENOMENON.

SIR,—Seeing in your paper of yesterday's date a paragraph about a mysterious red substance which fell at Barry Island on Wednesday last, I write to say that a somewhat similar phenomenon occurred here.

Wednesday the 22nd was with us very warm, with wet mist only measuring 0·02 of rain. Afterwards the glass and woodwork of the greenhouses and frames were covered with a rust-coloured dust, which has left stains on the paint.

Yours faithfully,

Chewton Priory, Bath, January 26. WALDEGRAVE.

Change of Pitch of Sound with Distance.

I HAVE read with considerable interest the letter by Mr. Paul R. Heyl on this subject in your issue for January 23. Speaking off-hand, I should have agreed with Mr. West, that pitch rises with distance; but, in view of the experience of your later correspondent's grandfather, I am inclined to adopt the contrary view. Many years ago I was sitting with an organist friend listening to a fugue on an organ—I think the player was the late Mr. Thomas Adams, and the fugue one of the immortal "Forty-eight" of Bach. At any rate, it was in a minor key; but I noticed that the last chord was *major*. "Why," I asked my friend, "does he end with a major chord?" "Because," was the reply, "sound has a tendency to rise in a long building like a church, and therefore the writer anticipated this by writing his final chord with a major third." But was this the reason? If the late Mr. Knauff was right, it was probably to allow for the third dropping, and the chord reaching the listeners as a minor chord, in keeping with the rest of the piece.

Of course, everybody knows that the practice above alluded to of ending a minor piece with a major chord is by no means uncommon with Bach. For example, in his "Grosse-Passions-Musik," the chorus which follows the duet, "My Saviour Jesus now is taken," ends (according to the English version by Miss Johnston) with the words, "the treach'rous betrayer, the murderous throng." Bach has reiterated them—the first time with a minor chord (E), with G natural, on the word "throng"; the second time with a chord on the same key-note, but with a *major* third (G sharp) and a pause. The effect is thrilling. Surely there could have been no allowance for drop here. Handel, on the contrary, begins and ends his chorus, "And He shall purify," in the "Messiah," in G minor, although the two succeeding pieces are in D major, with which key the previous piece would have been brought into relationship by the raising of the third.

This is a digression from the subject of your correspondents' letters, which probably never entered the minds of the great masters named. R. FREEMAN.

London, February 3.

A Lunar Romance.

Is not Mr. Wells right in the description of the effect referred to by the reviewer of his "First Men in the Moon" (p. 218)? The *sphere* itself, as a whole, is *not* attracted by gravity. The action of gravity has effect only in the line (?) through the open window, and, *quâ* the sphere, would only affect that part which would be directly in a straight line from the moon through the window. F. C. CONSTABLE.

Wick Court, near Bristol.

In answer to Mr. Constable, I think we cannot allow that the sphere is not attracted by gravity. I understand it to be a sphere of solid glass, PQ, inside a cavorite covering, RS (Fig. 1).

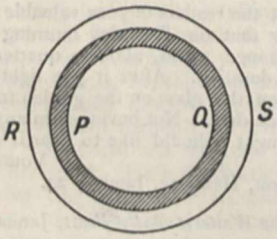

Fig. 1.

In the case considered, the covering is removed through a wide angle AB, thus described (p. 62): "Four windows were open in order that the gravitation of the moon might act upon all the substances in our sphere." Hence the gravitational beam

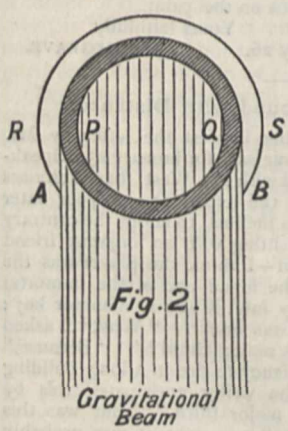

Fig. 2.

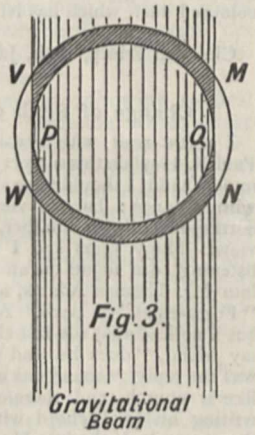

Fig. 3.

reaches the whole of the glass sphere itself (Fig. 2); unless (Fig. 3) Mr. Wells means to reserve little pieces, VW and MN, at the sides outside the beam. In this case the total mass of the sphere remains the same, but is not all acted on by gravity; so that the acceleration of the whole would be *less* than *g* (in the ratio of mass acted on to total mass), *i.e.* less than that of objects within, which would promptly settle to the "floor."

If Mr. Wells was thinking in this subtle fashion I withdraw my criticism, and Mr. Constable will see that I have left an open door for myself in the review for withdrawal. I may say it was left open expressly in view of this possibility. But the context does not suit this view at all well.

THE REVIEWER.

Cherry Leaf Disease.

THE question raised by Sir W. T. Thiselton-Dyer's letter is a very important one, and I venture to offer a few observations on it.

It is impossible that Mr. Bennett—still more Mr. Carruthers—could have intended to suggest that the experts at Kew and the British Museum are not competent to investigate such diseases as the above when they are submitted to them. They probably meant that an organised system is wanted in every county, by means of which an outbreak of any such disease should be at once brought under their notice. This could only be satisfactorily done by local inspectors, who would be in touch with the farmers on the one hand and the experts on the other. It should be part of their duties to keep accurate records of temperature and rainfall in order to show the connection, if possible, between these and the disease. These officials would naturally be appointed and paid by the County Council.

As regards the outbreak of Gnomonia mentioned by Sir W. T. Thiselton-Dyer, it is a curious fact that in most of the orchards about here affected by it in 1900 the disease has almost disappeared, though no preventive measures such as stripping the leaves were taken. It would, however, be very unfair to blame the advisers of the Royal Agricultural Society for raising a false alarm; in the case of a disease not known to have occurred in this country before, they were clearly bound to act upon the best information they could get—that of Frank—and warn the farmers. The more equable climate of England, as compared with Germany, is probably the cause of the different result, the effects of comparatively small differences of temperature and moisture being vastly more important than is generally believed.

ALFRED O. WALKER.

Ulcombe Place, near Maidstone, February 2.

Extremes of Climate in the British Empire.

YOUR correspondent (p. 299) who writes under this head in the current number of NATURE would make the labours of an editor as super-Herculean as those of the Highland minister who was called upon to incorporate the whole body of divinity in every sermon lest his flock should be misled.

That it would be wrong to generalise on the climates of the British Empire from eighteen stations, or to claim any one of them as the hottest or the wettest point, is obvious; but even in the few lines of your abstract you have not done this, and in my original summary (*Symons's Meteorological Magazine*, November, 1901, p. 167) I said:—

"It is true that neither the hottest, the coldest, the wettest nor the driest points in the Empire are dealt with; and the reader is warned, as on each previous occasion of presenting this annual summary, not to take the figures as meaning more than they profess to convey."

In order to secure continuity in the records, which are published monthly, it is necessary to obtain them from regular observatories: these are, unfortunately, few; but, fortunately for the student of climatology, they are usually situated in districts of normal rather than of extreme climate. Additional observations would certainly be welcome, and I hope during the present year to be able to publish monthly records from at least twenty-five stations in all the Britains.

HUGH ROBERT MILL.

62 Camden Square, London, N.W., January 31.

Elementary School Mathematics.

IN connection with the present discussion on the teaching of elementary mathematics in schools, and the recommendation made by many experienced teachers that much use should be made in geometry—at any rate in the earlier stages of actual

measurements of lengths of lines, may I suggest that such measurements should always be made in centimetres? A handy steel rule, six inches long, graduated both in inches and tenths, and in centimetres and millimetres, can be bought for a few pence, and is easily carried in that almost omnivorous receptacle—the pocket of a schoolboy. The use of such a rule would beget familiarity with the metric scale, in itself an advantage for any boy whose education includes some knowledge of elementary physics. But more—the schools of the country would soon be sending out each year a body of educated men acquainted more or less with the advantages of the metric system, and their influence can scarcely fail to be helpful in hastening the general adoption of the metric system—a change so much to be desired both in education and in practical life.

Fettes College, Edinburgh. JOHN S. YEO.

Electrification of Glass.

REFERENCE is commonly made, in text-books of electricity, to the uncertainty of kind of the electrification produced on glass when it is rubbed with fur or flannel, opposite results being obtained with different specimens.

The following is a variation which I have not seen mentioned. A strong positive charge may be given to a smooth rod of soda-glass, by rubbing it gently with a certain piece of fur. Vigorous rubbing, on the other hand, produces an equally good negative electrification. Thus the two sorts may be produced in quantity at one stroke, by making the friction small at first and finishing with a vigorous pull. The half-way region of zero electrification may be displaced at will.

A piece of lead glass seems to be always positively electrified by this particular piece of fur. F. HODSON.

North Eastern County School, Barnard Castle, January 28.

THE DANGEROUS SIDE OF INDIA.[1]

AT the present time much interest attaches to the North-West Frontier of India, and to Afghanistan, the Beluch country and the Persian Gulf. Sir Thomas Holdich's book, therefore, is opportune as well as of remarkable value. It must be carefully studied by everyone desirous of forming an intelligent opinion about our Indian frontier policy. The politician, the military expert, the dilettante student, the thoughtful citizen of the Empire, all will gain much from its well-written pages. Moreover, although the chief and permanent value of this admirable work is topographical, the general reader merely in search of mental enjoyment will find a peculiar pleasure in the vivid descriptions of stirring incident and picturesque countries. The style is always easy and graceful, while it rises frequently to singular eloquence and poetry. Rarely are sound knowledge and expert opinions offered to the public in a form at once so simple and attractive.

A cultured survey officer of the Indian Service has clearly very enviable opportunities for varied experiences; but it requires a quiet observant mind, sanitary with humour, to vitalise scenes and peoples as they appear in this record of twenty years' work on the restless Indian frontier. Of the various districts and wild folk shown to us, some are more especially in one's thoughts at the present moment. The political temperature of parts of the Punjab frontier is just now simmering or even ebullient. In Swat there is the outward aspect of peace without cheerfulness. How much this is due to the dominance of our big battalions in that historic valley and how much it is due to the vast number of strong fighting men, fierce of heart and light of foot, who were killed there during the 1897-98 uprising it is hard to decide. No one, however, seems to assert that the people like our presence among them. When the sullen youths shall be grown enough to strike another blow for Islam, we may expect more trouble in that sickly district, especially if the garrison is diminished. The less fanatical Orakzais and Afridis sit complacent, but watchful. Satisfied with their last display of fighting prowess, they are ready, on the instant, to rush to the rally if their freedom of rascality is threatened or their subsidies are reduced. Further south, in Waziristan, we have gone back to the old plan, the ancient way, of surprise and counter raid, the burning of homestead and tower. Also in the organisation of the new frontier province, of which so much has been written, Lord Curzon has reverted to more primitive methods. Complex forms of administration have been replaced by a rougher, not necessarily less efficient system. The mere lawyer and the pleader are beggared in importance, and the "political officer," raised aloft in power, is to be mantled with responsibility. It is admittedly a putting back of the clock. Curious, not always friendly, eyes watch the experiment. Its success mainly depends upon the attractions dangled before the eyes of able officials to draw them from easier days, and domestic joys, to rugged solitary work in desolate places. Beluchistan is placid and peaceful. It is the more primitive type of frontier management. To this simple pattern the new frontier province is to be retrograded by the forcible suppression of many functions and recent developments, which until now were gloried in as triumphs of British rule in India. But not only are the political and ethnological conditions of Beluchistan and the new frontier province dissimilar, but a Sir Robert Sandeman is not the product of every day.

Then behind all these borderland experiments stands dubious Afghanistan watching curiously its new Amir, full of conjecture, moreover, about the refugee pretender in the hands of the Russians, and that other refugee pretender, the honoured guest of the British at Rawalpindi. It is no easy task to rule the turbulent, faithless Afghan tribes, and the peaceful succession of the present ruler of Kabul may be followed at any moment by some wild upheaval of ambition or of revenge on the son for the savage repressions of his father. Herat, and the Russians peering wistfully at that coveted if somewhat corroded "Key of India," must always be of anxious interest to all students of the Afghan frontier and to all lovers of peace.

To understand the real value to India of all these differing countries, and to estimate accurately their relative importance, a thorough comprehension of Sir Thomas Holdich's facts and geographical opinions is an essential precedent condition. He has something important to say on all the pressing questions concerning the north-west limits of India, some solid physical basis to disclose or to explain, ignorance of which must make reasonable conclusions impossible. That strange diplomatic instrument the "Durand" treaty has a chapter to itself. Surely no more curious or less sincere arrangement was ever concluded between the Government of India and an adjoining Power. By it a definite frontier line has been laid down and actually demarcated. On one side of this line the Amir is to maintain order and never again to throw covetous glances beyond the boundary pillars which define its course. We, on our part, accept responsibility for all the independent tribes which intervene between the pillars and our Punjab territory. The Amir can fulfil his promises, while obviously we can only keep to our agreement by first subjugating this wild mountain land. Misdemeanours against Afghanistan by the tribes nominally under our responsibility, but actually uncontrolled by us, can only be punished by the Amir sending raiding parties into the very country he has promised not to enter. We have to wink at these flagrant violations of a solemn treaty because we ourselves never had any intention of obeying its terms.

Such loose acceptances of frontier responsibility are,

[1] "The Indian Borderland, 1880-1900." By Colonel Sir T. Hungerford Holdich, K.C.I.E., C.B., F.S.A., late of the Indian Survey Department. Pp. xii + 397. (London: Methuen and Co., 1901.)

in a political sense, immoral as well as practically mischievous. Already terrible evils have followed. The independent tribes, on our side of the limit, believe that in 1893 we annexed their hills, and only now refrain from a military occupation because of the martial prowess of the clansmen. All the frontier wars and the exacerbation of fanaticism all along the line since 1893 are traceable directly or indirectly to this unlucky treaty. Implacable suspicion and armed watchfulness on the part of the highlanders, as well as those violent outbreaks which have cost us so dearly, are part of the price which we have already paid for a false policy, not justified even by the seeming expediency of a critical time.

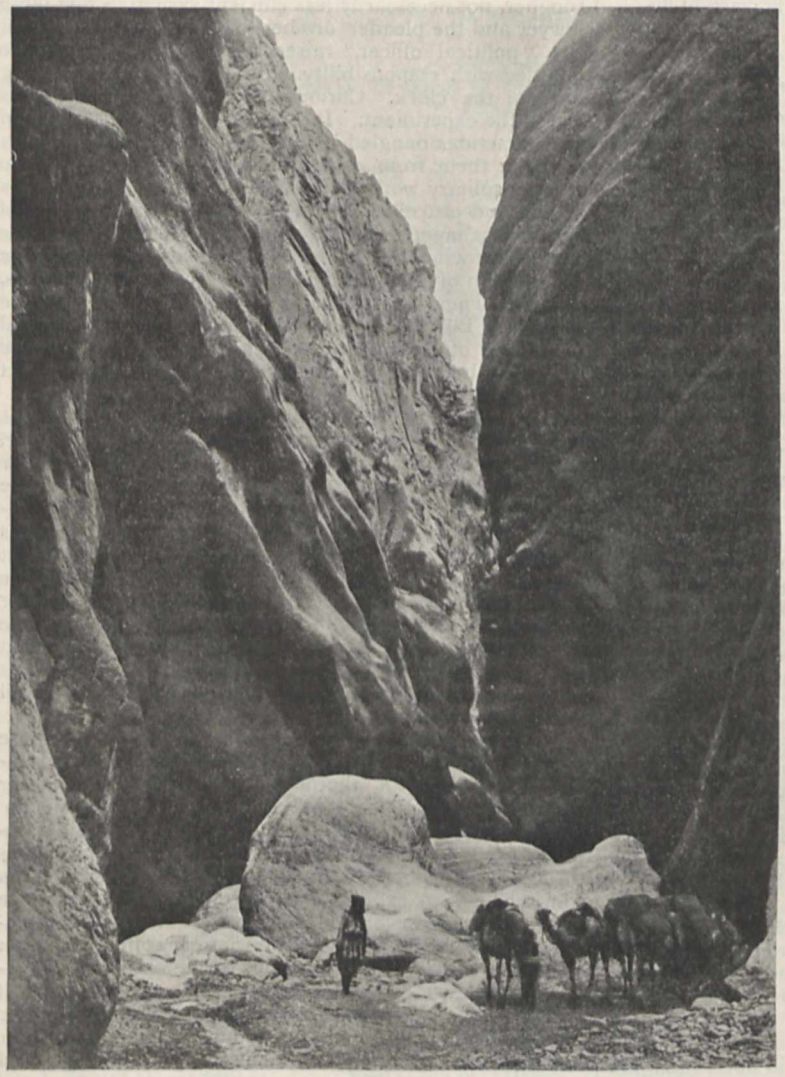

FIG. 1.—The road to the Takht-i-Suliman. (From "The Indian Borderland, 1880–1900.")

Of Makran, the Persian Gulf, and that place of contention, Koweit, Sir Thomas Holdich has very pleasant and instructive pages. Quite apart from the "professional" value of his judgments and his historical summaries, there is a graphic power in his descriptions which stamps the strange scenes deeply in the mind. Here, as in all his other wanderings, this genial, able Royal Engineer officer displays his love of nature's beauty. This makes his book, not only the most important publication of the time on the Indian frontier, but also the most agreeable to read. The illustrations are excellent, the map trustworthy and very useful.

REPORT OF THE INDIAN PLAGUE COMMISSION.

THIS report, consisting of five big volumes, is a record of the work of the Commission appointed by the Governor-General in Council, with the approval of the Secretary of State for India. The questions submitted to the Commission were four: (1) the origin of the different outbreaks of plague (in India); (2) the manner in which the disease is communicated; (3) the effects of curative serum; and (4) the effects of preventive inoculation.

The Commission, with Prof. Fraser, F.R.S., as president, has collected in seventy meetings in different parts of India and in two additional meetings after their return in London, the stupendous amount of evidence embodied in three closely-printed large volumes in twenty-seven thousand questions and answers.

The summary of the conclusions arrived at by the Commission, after having examined a host of competent witnesses and after having carried out itself or directed a considerable amount of work concerning plague, is contained in vol. v. on more than 500 folio pages. From this it will be understood that the work of the Commission was carried out in a thorough manner. Add to this the fact that the Commission had prepared a large amount of work in the form of charts, tables, statistical summaries, &c., and that after repeated and lengthy discussions amongst themselves the commissioners remained divided on several important points. We mention this to prepare the reader of the report for the surprise of not finding specific answers to the specific questions put to the Commission. This surprise is to a certain extent justified if we remember that various foreign commissions—Russian, German, Austrian, French—who have been sent out to India or Oporto respectively to study plague have in their reports given their Governments to understand that they have satisfactorily solved all and every problem concerning every point of the disease plague.

One has only to look through vol. v. of the report to feel convinced that the Commission has striven assiduously to find the specific answers; every page of this volume testifies to the desire to arrive at the correct conclusion; every assertion of fact brought before it was judicially and critically examined, compared and adjusted to its proper place and bearing. There can be, therefore, no question as to the thoroughness of the work itself. The cause of the deficiency of the answers must be sought elsewhere. In looking at the evidence of the witnesses and at the observations of

the commissioners themselves, it will be seen that the answers were not found, partly because the data to hand were insufficient and partly because the problem of plague in India is of far greater complexity than we were led to expect, and because there were too many unexpected difficulties encountered by the Commission.

If one reads some of the self-sufficient conclusions of some modern writers on plague (including the above-mentioned reports of the foreign commissions), one is met by the apparent simplicity and seemingly satisfactory solution of the problem concerning the etiology, epidemiology, prophylaxis, treatment, &c., of plague; and yet here we have a commission, consisting of a number of the most able and highly qualified experts, examining, experimenting, criticising and discussing, and at the end of their labours they either fail to give a specific answer to the specific questions asked, or they are able to do so only in a fragmentary manner and under certain restrictions. The commissioners have not been able to trace when, whence and how plague came into Bombay; the commissioners are not able to state the manner in which plague was imported and how it spread in many localities in India; the commissioners are not able either to condemn or to recommend the use for therapeutic purposes of either Lustig's serum or Yersin's serum; and the commissioners express a not markedly decided, although on the whole a favourable, opinion about Haffkine's plague prophylactic. Although definite answers by the Commission to the four specific questions could not be given, many valuable opinions and facts concerning plague in India have been placed on record.

In the first place, the Commission distinguished the mild (or ambulating) form of true bubonic plague from the severe form, the former as "pestis minor," the latter as "pestis major." This is a timely and important statement, because recently some "plague experts" have tried to raise some febrile disease associated with glandular swelling, but which, according to their own showing, is not plague, that is to say, is not caused by the *Bacillus pestis*, to the position of "pestis minor," thereby creating and fostering misunderstanding.

Another important point is the confirmation by the Commission concerning the great importance of "locality" in the dissemination of plague (vol. v. p. 101). "The universal experience of plague in India proves . . . that houses into which the infection of plague has been imported, whether by man or by rats, are infective, this infectivity being so marked that many of the officers who have had most experience of the disease have come to the conclusion that the principal source of infection is . . . to be found in the houses into which the infection of plague has been introduced."

Unfortunately, the Commission did not find sufficient data to explain the nature of this factor. Equally unsatisfactory results attended the discussion as to the importance of rats in the dissemination of plague amongst human beings. But as regards the reality of the danger of clothes and personal effects of plague-infected persons in transmitting plague to new "localities," the Commission is very emphatic.

Not the least valuable part of the report consists in the indication of the nature of further work required for elucidating many of the points at present unsolved. Amongst these is the encouragement of further experimental work in the more accurate study of the blood of animals which furnish curative serum, and the importance of such work in obtaining a uniform strength and accurate standard of Haffkine's plague prophylactic.

E. KLEIN.

A. W. BENNETT.

ALFRED WILLIAM BENNETT, M.A., B.Sc., F.L.S., the well-known lecturer on botany at St. Thomas's Hospital, and for many years a prominent figure in botanical circles, died suddenly from heart disease on January 23. Born at Clapham in 1833, Mr. Bennett took the degree of B.A. (Lond.) in 1854, and afterwards spent ten years in business as a publisher. During this period he employed photography in the illustration of books, and was one of the first, if not the first, to do so. Shortly after taking his M.A. degree he had the misfortune to fall from a horse, an accident that somewhat seriously affected his health throughout his subsequent life. When the publication of NATURE was commenced, Mr. Bennett was appointed as the first sub-editor, and he occupied that postion for several years. He received the appointment of lecturer on botany at St. Thomas's Hospital nearly thirty years ago. Botanical students will remember Mr. Bennett as the translator of the third edition of Sachs's classical "Lehrbuch der Botanik" and of Thomé's Lehrbuch. His enthusiastic study of the flora of the Swiss Alps found expression in some important works for the use of students of Alpine botany. His translation of Dalla-Torre's "Tourist's Guide to the Flora of the Alps" was issued in 1886, and previously he edited Séboth's "Alpine Plants Painted from Nature," a work in four volumes. His useful "Flora of the Alps," in two octavo volumes, accompanied by 120 coloured plates, appeared in 1897. He devoted much attention to the Cryptogams, as witnessed by the excellent "Handbook of Cryptogamic Botany," a work executed in conjunction with Mr. George Murray and published in 1889. With regard to the systematic study of the Phanerogams, Mr. Bennett confined his labours chiefly to the Polygalaceæ, which he monographed for the "Flora of British India" and the "Flora Brasiliensis," dealing with the order also in some important papers contributed to the *Journal of Botany*. In the Royal Society's Catalogue of Scientific Papers he appears as the sole author of forty-six papers, many of which are based on his observations respecting the fertilisation of flowers. Elected a fellow of the Linnean Society in 1868, he served for some years on the council of that society, and was one of the vice-presidents for 1891–92. He was also a fellow of the Royal Microscopical Society, of which he was a vice-president in 1899–1900, and the editor of its *Journal* since 1897.

S. A. S.

NOTES.

AN influential committee has been formed with the object of establishing a memorial tower and meteorological station in honour of Dr. J. P. Joule, F.R.S., at Sale, Cheshire, where he lived from 1872 down to the time of his death in 1889. Sir W. H. Bailey has offered to the Sale District Council an automatic recording meteorological and public clock made from designs which are the result of his investigations and inquiries with regard to similar instruments in this country and abroad. The instrument will be unique in its details; will indicate the time as a public clock on large dials, produce automatic graphic records of the various changes of temperature and the fluctuations of atmospheric pressure, and also changes of the wind and the rainfall of the district. In addition to this gift, which will cost about 250*l*., Mr. F. Armstrong has offered to the Council a set of instruments to equip a meteorological station, and the only condition attached to these gifts is that they shall be suitably housed. Designs for a building to be called "The Joule Memorial Tower," to contain the recording and other instruments, have been prepared, and the Council is willing to

permit the erection of such a building in the public park and recreation ground. In a room at the base of the building the meteorological instruments will be placed, and on one side of the exterior a tablet will be fixed on which there will be set a medallion portrait of Dr. Joule and a short record of his titles to fame. The cost of this tower will probably be 1000*l.*, which sum the District Council would have been willing to provide had its funds been applicable for such a purpose. As this course was not practicable, a committee has been formed at the instance of the District Council for the purpose of obtaining subscriptions to raise the amount required. Subscriptions should be sent to the hon. treasurer (Mr. A. H. Megson, The Priory, Sale), or the hon. secretary (Mr. J. W. Robson, Selbourne Lodge, Sale).

THE Royal Institution has received the following relics of Michael Faraday, bequeathed to it by the late Mr. Thomas J. F. Deacon, of Newcastle-on-Tyne:—Medals of silver and bronze (numbering twenty in all), and including the Fuller medal of 1828, two Copley medals of 1832 and 1838, two Newton medals of the Royal Society, 1833 and 1838, and the Rumford medal of 1846; and two foreign Orders, contained in a small mahogany box; a book of portraits and autographs, including original letters from the Prince of Wales and Prince Alfred (written in 1856), Louis Napoleon, Emperor of the French; Humphry Davy, Thomas Young, Humboldt, John Dalton, Whewell, Mary Somerville, and many others; a daguerreotype of a consultation of Faraday with Prof. Daniell; a drawing in colours of the laboratory of the Royal Institution, by a niece of Sir John Moore; and a manuscript book entitled "A Class Book for the Reception of Mental Exercises instituted July 1818," containing contributions by Faraday.

THE Council of the Society of Arts is prepared to award, under the terms of the Benjamin Shaw trust, a gold medal or a prize of 20*l.* "for any discovery, invention, or newly-devised method for obviating or materially diminishing any risk to life, limb or health incidental to any industrial occupation, and not previously capable of being so obviated or diminished by any known or practically available means." Intending competitors should send in descriptions of their inventions not later than May 1, 1902, to the secretary of the Society of Arts, Adelphi, London, W.C.

THE Royal College of Physicians of London has appointed Dr. D. Ferrier, F.R.S., as Harveian orator for this year, Dr. Cullingworth as Bradshaw lecturer, and Dr. H. T. Bulstrode as Milroy lecturer.

THE manuscript of a French translation of Viete's works has been presented to the Paris Academy of Sciences by the family of the late M. F. Ritter, who devoted many years of his life in translating the Latin text and adding explanatory notes. The documents also include a history of the great geometrician's life and times.

ON Saturday, February 15, Lord Rayleigh will begin a course of six lectures at the Royal Institution on "Some Electrical Developments." The Friday evening discourse on Friday, February 7, will be delivered by Prof. E. Ray Lankester, his subject being "The New Mammal from Central Africa and other Giraffe-like Animals."

THE London County Council has appointed Prof. A. C. Haddon, F.R.S., advising curator in connection with the Horniman Museum at Forest Hill. It will be remembered that this museum was presented by its founder, Mr. E. J. Horniman, M.P., to the Council last year. It contains a fine collection of anthropological, art and natural history objects.

THE sixty-third anniversary meeting of the Royal Agricultural Society will be held on Thursday, May 22. The Society's annual exhibition of live stock, implements, poultry and produce will be held at Carlisle in the week commencing Monday, July 7. An appeal has been issued by the Society for funds for the purchase and preparation of the site in the metropolis which has been selected for the future permanent showyard of the Society.

PROF. E. MILLOSEVICH has succeeded Prof. P. Tacchini as director of the Astronomical Observatory of the Roman College and of the astronomical museum connected with it. Prof. Tacchini has resigned his office of administrator in the Reale Accademia dei Lincei, and Prof. Volterra has been appointed as his successor. Prof. P. Villari having been unable to accept the office as president, an election to the presidential chair will be made early in June.

THE executive committee of the Jenner Society has resolved that, in view of the provisional character of the Vaccination Act of 1898, and as a preliminary to the further legislation which must be adopted next year in fulfilment of the promise made by the Government in regard to revaccination and of the termination of the experimental period for which the Act was passed, a comprehensive and careful inquiry should be made into the working of the administrative machinery by which vaccination is promoted as well as of the results of the Act itself.

AT the annual general meeting of the Royal Scottish Arboricultural Society, held in Edinburgh on Friday last, Lord Mansfield said he was authorised to state that it was Mr. Hanbury's intention to appoint a departmental committee to inquire into and report upon the present position and future prospects of forestry and the planting and management of woodlands in the United Kingdom, and to consider whether any further measures might be taken with advantage, either by the provision of further educational facilities or otherwise, for their promotion and encouragement. Mr. Munro-Ferguson, M.P., has been invited and has consented to act as chairman of the committee.

MR. S. HARBERT HAMILTON has started on a scientific exploring and collecting trip of several months' duration in the vicinity of Santiago, Cuba. Collections will be made in all branches of natural history, the bulk of which will go to the New York Botanical Gardens, the American Museum of Natural History and the Academy of Natural Sciences of Philadelphia. Specialists or institutions desiring material in any branches direct from the locality are invited to correspond with Mr. Hamilton at Santiago, Cuba.

THE meeting of the British Ornithologists' Club on March 19 is to be specially devoted to an exhibition of photographic slides, illustrating bird-life of all kinds, taken by members of the Club and their friends in various parts of the world. It is expected that a large number of very interesting light-pictures will be shown on this occasion.

FROM the *American Field* we learn that a young female specimen of that rare Arctic mammal, the musk-ox (*Ovibos moschatus*), reached Chicago alive at the beginning of January last. It is said to have been captured by hunters employed for the purpose by Captain H. H. Bodfish, of the steam-whaler *Beluga* (of San Francisco), near Cape Bathurst in the Arctic Ocean. A figure is given of this animal, which is stated to be the only living musk-ox ever brought alive to the United States. The only specimen of the musk-ox in England is that belonging to the Duke of Bedford at Woburn. There are, however, said to be also examples of this animal in the Zoological Gardens of Copenhagen and Berlin.

WE are glad to be able to record the formation of an Acetylene Association, which is similar in character to the associations which have existed for some time in several countries abroad. The object of the Association, as stated in the articles thereof, is "To promote the advancement of acetylene gas engineering and manufacture, and to facilitate the interchange of information amongst the members of the Association." An attempt was made in 1898 to found such an association, largely on the initiation of Sir David Salomons, but the trade did not then show sufficient general interest in the matter to make this possible. In reviewing this attempt a note of bitterness is sounded as to the opposition which every new industry started in this country has to encounter. Perhaps we may hope that the functions of the National Physical Laboratory will be wide enough in scope to make such repinings unnecessary, by giving new industries a helping hand in the future. The chairman of the Association is Mr. F. G. Worth, manager of the Acetylene Illuminating Company, who, as one of the prime movers in the formation of the Association, has devoted much time and care to bringing matters to a successful issue. The members of the council as at present constituted are nearly all members of well-known firms interested in acetylene, but several vacancies have yet to be filled up at the first annual general meeting, to be held on February 27. Subsequent to this, meetings will be arranged at which papers will be read and discussed. The official organ of the Association is, for the present, the *Journal of Acetylene Gas Lighting*, and the present secretary is Mr. Lacey Downes, of 11, Ironmonger Lane, Cheapside.

DURING the past week this country, in common with the greater part of western Europe, has been visited with inclement weather and very keen north-east winds. In Scotland the temperature in the screen has fallen 20° and more below the freezing point, the minimum reading during Friday night being 7° at Nairn. In the south the thermometer has not been much below the freezing point, but the north-east wind has been stronger than in the north, and this has greatly added to the sensation of cold. The barometer has risen above 31 inches in the north of Scotland, the reading at Aberdeen being 31·11 inches at 10 p.m. on Friday, which is as high as the very exceptional reading in our islands in January, 1896. Barometrical gradients have been very steep over the south of England and in France and Germany, which have given rise to fierce north-easterly gales in the Channel and over the southern portion of the North Sea. The gales have been unusually prolonged, continuing without interruption for about three days.

IN one of the important articles contained in vol. xxiii. of *Aus dem Archiv der Deutschen Seewarte*, Dr. Grossmann discusses the results of the maximum and minimum temperatures at Hamburg during the last quarter of a century (1876-1900). During this period the highest readings were 89°·6 in July 1883, and 89°·1 in May 1892. The lowest were −3°·6 in December 1876, and −1°·1 in January 1893. Temperatures of 86°·0 and upwards were recorded seventeen times between May and August, and 3°·0 and below also seventeen times between December and February. If we denote as summer days those on which the highest temperature reached or exceeded 77°, and as wintry days those on which the temperature remained below the freezing point, we find that the latter were twice as frequent as the former. The distribution shows that the so-called wintry days occurred as late as March and as early as November, and that the summer days occurred as early as May and as late as September. April and October were the most temperate months; the highest reading did not exceed 77°, and the lowest did not fall below the freezing point.

AN interesting paper by Herr Hofrath J. Hann appears in a January number (No. 1, 1902) of the *Transactions* of the section of mathematics and natural sciences of the Vienna Academy o Sciences, entitled "The Variations of Rainfall during long Periods of Time." Herr Hann discusses the monthly and yearly means of the values of the rainfall for the stations Padua (1725-1900), Klagenfurt (1813-1900) and Mailand (1764-1900), and finds that they all conform to a period of definite length. In the investigation he first of all obtains the extreme yearly sums of the rainfall expressed in per cent. of the total mean, and finds the following values for the past century (1801-1900):—

Driest year....	Padua 58	Klagenfurt 42	Mailand 62 per cent.
Wettest ,, ...	,, 152	,, 151	,, 152 ,,

Using the earlier observations of Padua so far back as 1725, the extremes for this station became 56 per cent. and 181 per cent. Taking the frequency of similar yearly totals during the last hundred years, he groups the wet and dry years as shown in the following summary:—

Character	Very dry	Dry	About normal	Wet	Very wet	Extra-ordinarily wet
Per cent...	51-70	71-90	91-110	111-130	131-150	over 150
Number...	8	26	37	22	6	1

These figures show that the dry years predominate, 34 per cent. being dry and 29 per cent. wet, but the wet years exceed to a greater extent the mean yearly value of rainfall than the dry years. Herr Hann then determines the mean epochs of these wet and dry periods and finds that they satisfy a thirty-five-year period, with their maxima (wet) and minima (dry) in the following years:—

Wet.....	1738	1773	1808	1843	1878	(1913)
Dry	1753	1788	1823	1859	1893	(1928).

This period of thirty-five years and the above epochs are in complete harmony with the secular variation of rainfall indicated by Brückner in his "Klima-schwankungen," and agree with the long-period variation of sunspots recently shown to exist by Dr. Lockyer.

THE Report of the museum committee of the Bristol Museum for 1901 shows that many desirable improvements were effected by the curator, Mr. H. Bolton. The condition of the specimens has been greatly improved; in particular, the cases of birds have been thoroughly worked over, many of the birds being remounted. As the only trained official in the Museum is Mr. Bolton himself, though the Museum is a large one and belongs to the city, the fact that so much was done last year is a testimony to the zeal of the curator. Perhaps the most important work of the kind is that which has been effected upon the numerous and valuable Liassic fossil reptiles, which were in a very unsatisfactory condition. By arrangement with the authorities of the British Museum of Natural History, the worst of the specimens have been thoroughly repaired by one of their expert staff, and in this way they have been saved from further injury. Thanks to the committee of the Egypt Exploration Fund, the Museum possesses one of the most complete collections of Egyptian antiquities to be found in the provinces, and it has the advantage of being compact and consecutive in historical continuity rather than large and disconnected. The Museum is evidently appreciated, for the number of visitors in 1901 was 116,246, which is nearly twice as many as in 1898, when the present curator commenced his duties. The long and valuable list of donations also shows that interest is taken in the work of the Museum, but it is difficult to see how these gifts can be properly taken in hand, registered, classified and exhibited to the best advantage by the present very inadequate scientific staff. The latest donation is from Lady Smyth, who has presented to the Museum a large part of the

natural history collections of the late Sir Greville Smyth. Among the specimens are a fine egg of the Great Auk, an egg of the *Aepyornis maximus*, a collection of British and foreign birds' eggs and nests, a large collection of birds' skins, comprising a skin of the Apteryx, a collection of the Lepidoptera of India, Ceylon, South America and southern Europe, and also a very complete collection of British species, a collection of exotic Coleoptera, and a choice series of shells. The whole of these valuable natural history specimens are contained in a costly range of cabinets. Lady Smyth has also promised to present two specimen heads of the red deer bred in Ashton Park.

THE "Acker" fusion process for the electrolytic production of caustic alkali and chlorine is reported to be working successfully at Niagara Falls. The process depends upon the decomposition of molten salt with a carbon anode, and a kathode of molten lead. A lead-sodium alloy is formed at the kathode. The circulation and renewal of the molten kathode material is effected by means of high-pressure-steam and an injector. The lead-sodium alloy is carried into a separate vessel, where the steam decomposes the alloy with formation of sodium hydrate, hydrogen and lead. By careful regulation of the steam supply, the caustic alkali can be obtained as fused anhydrous NaOH, and the necessity for evaporation of the surplus water at a later stage is avoided. The hydrogen gas is collected and burnt, the heat being utilised for the preliminary heating of the rock salt used to feed the cell; while the molten lead flows back into the cell and functions again as kathode. The mechanical difficulties that have had to be surmounted in the transfer of this process from the laboratory to the works have been great, but, according to the *Electrician* of January 17, 3000 h.p. is now being utilised by this most interesting process at Niagara Falls, and anhydrous caustic soda is being produced, without any after boiling-down or evaporation. This latter is one of the chief features of the Acker process, and if the saving in fuel which results is not balanced by very heavy charges for cell maintenance and repairs, the process would appear to have a highly successful future before it.

THE *Bulletin international* of the Cracow Academy for November, 1901, contains an account, by M. L. Marchlewski, of the researches of the late Prof. Marcellus Nencki. Nencki was born in 1847 at Sieradz, Poland, and studied at Cracow, Jena and Berlin. He held office as assistant lecturer in pathological anatomy at Bern, and in 1878 was appointed professor of physiological chemistry. From 1891 till his death he was head of the chemical department of the Institute for Practical Medicine at St. Petersburg. He made many important advances in the study of physiological chemistry.

THE *Rendiconto* of the Naples Academy contains a short abstract of a paper by G. de Lorenzo, to be published in the *Atti* of the Academy, dealing with the superficial origin of volcanoes. Signor de Lorenzo seeks to prove, from a study of the volcanoes of southern Italy, that eruptive phenomena in general, and volcanic phenomena in particular, are intimately connected with mountain formation, and like the latter represent purely superficial effects on the earth, a view which is inconsistent with the hypothesis that they are due to an incandescent central fluid mass within. Signor de Lorenzo has illustrated his theory by pictures of Monte Nuovo, a hill of which the only illustration, even in recent treatises, has been that of Hamilton, dating from last century.

THE *Journal* of the Society of Arts contains a paper by Mr. Frank Gray on elliptographs. The various mechanical apparatus for drawing an ellipse are considered by Mr. Gray to depend on four methods, namely, the focal method, the trammel method, the mechanical method and the projective method. After reading the paper we are inclined to think that while the instruments described by Mr. Gray are highly ingenious, there is still room for someone to invent a really *simple* and portable instrument for drawing circles in perspective, an operation that is of constant occurrence in geometrical drawing. Many of the instruments described appear to be best suited to drawing large ellipses, whereas small ellipses are often required for diagrammatic illustrations. Moreover, a further desideratum is to be able to adjust easily an instrument to draw an ellipse of given dimensions, in particular one where two conjugate diameters, instead of the principal axes, are given. Among the instruments considered by Mr. Gray was Nasmyth's instrument now in the possession of the Board of Education. It is remarkable that so late as 1894 two Germans obtained a patent in Great Britain for a "trammel, pure and simple."

AN important paper on the electromagnetic properties of convection currents is published by Prof. A. Righi in the *Nuovo Cimento* (5, ii). It deals with the four fundamental principles according to which it is believed that (1) a moving charge generates a magnetic field, (2) changes in a magnetic field produce an electrostatic field, (3) a moving pole generates an electrostatic field, (4) changes in an electrostatic field produce a magnetic field. Experiments of Crémieu have thrown some doubt on the production of a magnetic field by convection of electrostatic charges, and even the existence of unclosed currents has been suggested. Prof. Righi gives a critical examination of Crémieu's experiments, as also of those of Rowland, Lodge, Wilson, Pender and others, and describes experiments in verification of the second of the four phenomena. The general conclusion is that Crémieu's experiments need not shake our faith in modern electrical theory, although it still appears desirable, if not necessary, that new and accurate researches should be undertaken for the purpose of confirming the above four phenomena individually as well as other phenomena depending on the same laws.

WE have received from the publisher (Mr. L. U. Gill) a copy of the seventh issue of that useful little work, "The Naturalists' Directory." The new volume appears to be much better than its predecessors.

THE *Proceedings* of the Indiana Academy of Sciences for 1900 contains a list of the papers read at the sixteenth annual meeting, many of these being printed only in brief abstract. The president's address is illustrated with some excellent reproductions of photographs of microscopic objects.

IN the Report for the year 1901, the Northumberland Sea Fisheries Committee gives a most satisfactory account of the food-fishes of the district, based on the experimental trawling excursions carried on during the past ten years. The results for the whole four stations where the experiments have been conducted are as follows:—"Turbot have remained steady; brill seem to be improving in numbers; soles are getting less numerous every year, practically speaking; plaice have slightly improved, and dabs have greatly improved in numbers; flounders also presented a slight increase." A total increase of about 20 per cent. in the number of food-fishes frequenting the bays is estimated to have taken place during the last five years, and the Committee therefore feels justified in saying that the locality is slowly recovering from the effects of the excessive in-shore trawling carried on just previous to the commencement of the experiments.

THE *Scientific American* for January 18 issues a supplement (No. 1359) devoted to a comparison of the Panama and Nicaragua canal routes. The supplement contains an exhaustive

article on each canal and a digest of the report of the Canal Commission; it is illustrated by about forty views and diagrams. In the ordinary number is a short summary of the matter to be found in the supplement, and a full-page illustration showing the two canals in plan.

THE *National Geographic Magazine* publishes, as a supplement to its January number, the official map of the Philippines prepared by the United States Signal Officer under the direction of General Greely. The map is in two sheets, on a scale of 1:900,000, and shows telegraph lines and cables, telephone lines, open ports, lighthouses and post offices. The spelling of names is that adopted by the U.S. Board on Geographic Names. A remarkable feature is the large amount of country, in the island of Mindoro especially, which remains blank on the map, awaiting exploration.

DR. MARTIN KNUDSEN contributes a paper on the oceanography of the straits connecting the Baltic and the North Sea to the January number of *La Geographie*, in which he gives a short account of the work of the Danish Commission during the past ten years, and brings it into relation with the researches of Pettersson and Ekman. The seasonal variations of the inflowing and outflowing streams are fully described; a section is devoted to the discussion of the distribution of temperature in the Kattegat and the western Baltic, and another to the relative volumes of the Baltic current and the inflowing current of salter water, as deduced from the salinity observations. With regard to the Baltic current, the remarkable result has been arrived at that its volume is four to six times greater than can be accounted for by the supply of fresh water by rainfall in the Baltic basin alone, and that this cause is largely assisted by the winds and by the variations of atmospheric pressure on the surface of the sea itself.

A CATALOGUE of the types and figured fossils in the geological department of the American Museum of Natural History, New York, has been published as the eleventh volume of the *Bulletin* of the Museum. It is needless to say that such catalogues are of great service to palæontologists. The Museum contains the James Hall collection, which includes a large number of type and figured Palæozoic fossils; it also contains other interesting and important collections from strata of various ages in North America, including the fruits and seeds from the Eocene beds of Brandon, Vermont, described by Lesquereux, Pliocene and post-Pliocene fossils from South Carolina, &c. There are also Cretaceous fossils from Syria, Jamaica, &c. The term "type" is employed to embrace not only the specimens actually used by an author in the original description of a species, but those specimens which have been used by the same author in the further elucidation of the species in subsequent publications. This valuable record, for which we are indebted to Mr. R. P. Whitfield, the curator, and his associate, Mr. E. O. Hovey, enumerates 8345 type and figured specimens, representing 2721 species and 190 varieties.

AMONG the forthcoming publications of the Clarendon Press is an authorised translation of Schimper's "Geography of Plants," by Profs. Percy Groom and W. R. Fisher.

THE third volume of Lord Rayleigh's collected papers, containing papers published from 1887 to 1892, has been published by the Cambridge University Press. The next volume will bring the collection down to nearly the present time, and will, it is hoped, be ready in about a year. The complete work will then be reviewed in these columns.

MESSRS. F. VIEWEG AND SON, Brunswick, announce that the preparation of a biography of the late Prof. Helmholtz has been undertaken by Prof. Leo Königsberger, and will be published by them. The work will contain the letters which passed between Helmholtz and his father, and correspondence with personal and scientific friends. Many men of science will look forward with pleasure to the publication of the biography of one who contributed so much to the progress of natural knowledge.

MR. H. K. LEWIS, of Gower Street, W.C., is extending his circulating library of medical and scientific books. New books and new editions are added to the library immediately on publication, so that it is possible for students with limited incomes to keep themselves in close touch with all important additions to scientific literature. The library provides a useful means for obtaining standard works for study, or for examination with a view to purchase. The lists of scientific books and periodicals circulated by Mr. Lewis are worth attention.

IN the Siebenbürgen salt district (Transylvania) are some warm salt lakes which have recently been examined by A. V. Kalecsinsky, chemist to the Hungarian Geological Survey. They are remarkable for having a layer of warm or even hot salt water between two colder bodies of water, the surface being fresh water while the rest is highly saline. In the Medoc See, for example, when the surface was in summer at a temperature of 21° C., at a depth of 1·3 metres the temperature was 56° C. and the specific gravity 1·17, thence declining gradually to the bottom to 19° C. with a specific gravity of 1·19, corresponding to 25 per cent. of salt in solution. The warm layer in summer has been found to reach 70° to 71° C., but during winter months it cools until the minimum in May is only 26° C. The author concludes that the lakes are not fed by hot springs nor warmed by chemical agency, but derive their heat from the sun. As the specific heat of brine is below that of water, the saline water is more readily warmed, and the fresh surface water prevents any rapid loss of heat by radiation. Some future useful application may, he thinks, be made of these natural heat-accumulators.

THE additions to the Zoological Society's Gardens during the past week include two Vulpine Phalangers (*Trichosurus vulpecula*), two Laughing Kingfishers (*Dacelo gigantea*) from Australia, a Weka Rail (*Ocydromus australis*) from New Zealand, presented by H.R.H. the Prince of Wales, K.G.; a Malayan Paradoxure (*Paradoxurus hemaphroditus*) from Burmah, presented by Capt. Burnett; a Red-bellied Spider Monkey (*Ateles rufiventris*) from Colombia, a Long-haired Spider Monkey (*Ateles vellerosus*) from Central America, a Bungoma River Turtle (*Emyda granosa*), seven Roofed Terrapins (*Kachuga tectum*), five Hamilton's Terrapins (*Damonia hamiltoni*) from India, two Bicheno's Finches (*Estrelda bichenovii*) from Australia, deposited; a Sykes's Monkey (*Cercopithecus albigularis*) from East Africa, purchased; three Red River Hogs (*Potamochaerus penicillatus*) born in the Gardens.

OUR ASTRONOMICAL COLUMN.

EARLY OBSERVATIONS OF ALGOL STARS.—In the *Harvard College Observatory Circular*, No. 64, Prof. E. C. Pickering furnishes particulars of additional observations of recently discovered variables, which have been obtained from examination of the photographs taken with the 8-inch Draper telescope.

78 (1901) Cygni.—R.A. = 20h. 18m. 4s.·0; Decl. = +42° 46′·4 (1855).

This star was announced as variable by Mr. Williams. On referring to the Harvard collection the star has been found on 177 plates, the first being on 1885 September 19 ten of the photographs showing the star to be fainter than the normal brightness. Determinations with the 12-inch meridian photometer give the maximum magnitude as 10′47, and taking this value, a light curve has been determined from observations with the 15-inch equatorial. The magnitude appears to decrease to about 13·05 at minimum. With an adopted period of 3d. 10h. 49m. 12s. a table of residuals is formed from the old and new measures, and more accurate results will probably

be obtained when the photographic light curve is better known, and also by correcting for aberration.

93 (1901) Sagittæ.—R.A. = 19h. 14m. 26s. ; Decl. = +19° 25′·4 (1900).

The variability of this star was announced by Dr. Schwab, and subsequent inspection of the Harvard plates showed that there were 155 records of nearly normal brightness, the magnitude at this stage being 6·50, and 13 where the star was near minimum. A photograph obtained on 1895 August 22 shows a sudden change during the exposure from 9th to 8th magnitude. The range in light appears to be greater than that of any other Algol star. The suggested period of seventeen days does not appear to satisfy the observations, and observers in other situations are asked to forward any determinations as soon as possible.

UNITED STATES NAVAL OBSERVATORY REPORT.—The report of work accomplished at this observatory during the year ending June 30, 1901, has recently been distributed, and is here summarised.

26-inch Equatorial.—This instrument has been in charge of Prof. See, who has been engaged in determinations of the diameters of the planets and satellites of the solar system, observations of Eros for parallax, double star observations, &c. These, so far as reduced, have been published from time to time in the *Astronomische Nachrichten*.

12-inch Equatorial.—During the greater part of the year this has been dismounted for repairs. Since its readjustment it has been used for the observation of zone stars, double stars, &c., and also for the entertainment of visitors to the observatory, 765 admission cards having been issued during the year.

9-inch Transit Circle.—The regular sun, moon and planet work has been continued, and in addition a revision of the Astronomische Gesellschaft zones and the zone of zodiacal stars undertaken for the Paris Astronomical Conference of 1896. The instrument is in need of thorough repair, as an examination of the pivots reveals considerable inequalities, and the present method of oblique illumination is to be replaced by an axial arrangement.

6-inch Transit Circle.—Observations have been continued on comparison stars for planets, special stars for Eros reductions, and determinations of personal equation. A serious difficulty, however, has been the persistence of the large diurnal change of azimuth with temperature. Numerous experiments have been made, but the error is only partially remedied.

Clock Vault.—A considerable amount of time has been spent in an attempt to bring the timekeepers under more constant conditions. A vault eight feet square and seven feet high has been made in the basement of the observer's room near the 6-inch transit circle. In this a 9-inch brick wall encloses a wooden hut, with an intervening air space of one foot containing hot water pipes. The roof is covered over with boards enclosing a 6-inch layer of asbestos wool. The room is entered by triple doors, and it is hoped that by these precautions constant temperature conditions will be attained. The whole is on the summit of a hill to avoid drainage difficulties.

Prime Vertical Transit and 5-inch Altazimuth.—These instruments have been used in conjunction for the determination of latitude variation, the two distinct types of observation constituting a valuable check on the accuracy of results obtained.

40-foot Photoheliograph.—During the year photographs of the sun were obtained on 116 days. Of these, sunspots were recorded on 24 days. The photographs show many faculæ and fine detail in the granulation of the solar surface.

Nautical Almanac.—This is now under the direction of Prof. W. S. Harshman. Special effort is to be made to ensure the publication three years in advance. Investigations are being made to provide tables for Jupiter's satellites and the inner satellite of Uranus, and a new catalogue of zodiacal stars for computing occultations will be used in the preparation of the volume for 1905.

For a considerable time an important section of the staff was absent on the eclipse expedition to Sumatra. Although most of the parties were unfortunate in having bad weather, the observers at Fort de Kock obtained excellent photographs of the phenomenon.

Meteorological observations have been continued as in former years, but all the magnetic determinations have been discontinued owing to the interference of currents from the various electric systems in the neighbourhood.

THE DISCOVERY OF THE FUTURE.[1]

IT will lead into my subject most conveniently to contrast and separate two divergent types of mind, types which are to be distinguished chiefly by their attitude towards time and more particularly by the relative importance they attach and the relative amount of thought they give to the future of things.

The first of these two types of mind, and it is, I think, the predominant type, the type of the majority of living people, is that which seems scarcely to think of the future at all, which regards it as a sort of black non-existence upon which the advancing present will presently write events. The second type, which is, I think, a more modern and much less abundant type of mind, thinks constantly and by preference of things to come, and of present things mainly in relation to the results that must arise from them. The former type of mind, when one gets it in its purity, is retrospective in habit, and it interprets the things of the present, and gives value to this and denies it to that, entirely with relation to the past. The latter type of mind is constructive in habit, it interprets the things of the present and gives value to this or that, entirely in relation to things designed or foreseen. While from that former point of view our life is simply to reap the consequences of the past, from this our life is to prepare the future. The former type one might speak of as the legal or submissive type of mind, because the business, the practice and the training of a lawyer dispose him towards it ; he of all men must most constantly refer to the law made, the right established, the precedent set, and most consistently ignore or condemn the thing that is only seeking to establish itself. The latter type of mind I might for contrast call the legislative, creative, organising or masterful type, because it is perpetually attacking and altering the established order of things, perpetually falling away from respect for what the past has given us. It sees the world as one great workshop, and the present is no more than material for the future, for the thing that is yet destined to be. It is in the active mood of thought while the former is in the passive ; it is the mind of youth, it is the mind more manifest among the western nations while the former is the mind of age, the mind of the oriental.

Things have been, says the legal mind, and so we are here. And the creative mind says, we are here, because things have yet to be.

Now I do not wish to suggest that the great mass of people belong to either of these two types. Indeed, I speak of them as two distinct and distinguishable types mainly for convenience and in order to accentuate their distinction. There are probably very few people who brood constantly upon the past without any thought of the future at all, and there are probably scarcely any who live and think consistently in relation to the future. The great mass of people occupy an intermediate position between these extremes, they pass daily and hourly from the passive mood to the active, they see this thing in relation to its associations and that thing in relation to its consequences, and they do not even suspect that they are using two distinct methods in their minds.

But for all that they are distinct methods, the method of reference to the past and the method of reference to the future, and their mingling in many of our minds no more abolishes their difference than the existence of piebald horses proves that white is black.

I believe that it is not sufficiently recognised just how different in their consequences these two methods are, and just where their difference and where the failure to appreciate their difference takes one. This present time is a period of quite extraordinary uncertainty and indecision upon endless questions—moral questions, æsthetic questions, religious and political questions—upon which we should all of us be happier to feel assured and settled, and a very large amount of this floating uncertainty about these important matters is due to the fact that with most of us these two insufficiently distinguished ways of looking at things are not only present together, but in actual conflict in our minds, in unsuspected conflict ; we pass from one to the other heedlessly without any clear recognition of the fundamental difference in conclusions that exists between the two, and we do this with disastrous results to our confidence and to our consistency in dealing with all sorts of things.

But before pointing out how divergent these two types or habits of mind really are, it is necessary to meet a possible objection to what has been said. I may put that objection in this

[1] A discourse delivered at the Royal Institution on Friday, January 24, by Mr. H. G. Wells.

form—Is not this distinction between a type of mind that thinks of the past and of a type of mind that thinks of the future a sort of hair-splitting almost like distinguishing between people who have left hands and people who have right? Everybody believes that the present is entirely determined by the past, you say; but, then, everybody believes *also* that the present determines the future. Are we simply separating and contrasting two sides of everybody's opinion? To which one replies that we are not discussing what we know and believe about the relations of past, present and future, or of the relation of cause and effect to each other in time. We all know the present depends for its causes on the past and that the future depends for its causes upon the present. But this discussion concerns *the way in which we approach things* upon this common ground of knowledge and belief. We may all know there is an east and a west, but if some of us always approach and look at things from the west, if some of us always approach and look at things from the east, and if others again wander about with a pretty disregard of direction, looking at things as chance determines, some of us will get to a westward conclusion of this journey, and some of us will get to an eastward conclusion, and some of us will get to no definite conclusion at all about all sorts of important matters. And yet those who are travelling east, and those who are travelling west, and those who are wandering haphazard, may be all upon the same ground of belief and statement and amidst the same assembly of proven facts. Precisely the same thing will happen if you always approach things from the point of view of their causes, or if you approach them always with a view to their probable effects. And in several very important groups of human affairs it is possible to show quite clearly just how widely apart the two methods, pursued each in its purity, take those who follow them.

I suppose that three hundred years ago all people who thought at all about moral questions, about questions of right and wrong, deduced their rules of conduct absolutely and unreservedly from the past, from some dogmatic injunction, some finally settled decree. The great mass of people do so to-day. It is written, they say. Thou shalt not steal, for example—that is the sole, complete and sufficient reason why you should not steal, and even to-day there is a strong aversion to admit that there is any relation between the actual consequences of acts and the imperatives of right and wrong. Our lives are to reap the fruits of determinate things, and it is still a fundamental presumption of the established morality that one must do right though the heavens fall. But there are people coming into this world who would refuse to call it right if it brought the heavens about our heads, however authoritative its sources and sanctions, and this new disposition is, I believe, a growing one. I suppose in all ages people in a timid, hesitating, guilty way have tempered the austerity of a dogmatic moral code by small infractions to secure obviously kindly ends, but it was, I am told, the Jesuits who first deliberately sought to qualify the moral interpretation of acts by a consideration of their results. To-day there are few people who have not more or less clearly discovered the future as a more or less important factor in moral considerations. To-day there is a certain small proportion of people who frankly regard morality as a means to an end, as an overriding of immediate and personal considerations out of regard to something to be attained in the future, and who break away altogether from the idea of a code dogmatically established for ever. Most of us are not so definite as that, but most of us are deeply tinged with the spirit of compromise between the past and the future; we profess an unbounded allegiance to the prescriptions of the past, and we practise a general observance of its injunctions, but we qualify to a vague, variable extent with considerations of expediency. We hold, for example, that we must respect our promises. But suppose we find unexpectedly that for one of us to keep a promise, which has been sealed and sworn in the most sacred fashion, must lead to the great suffering of some other human being, must lead, in fact, to practical evil? Would a man do right or wrong if he broke such a promise? The practical decision most modern people would make would be to break the promise. Most would say that they did evil to avoid a greater evil. But suppose it was not such *very* great suffering we were going to inflict, but only some suffering? And suppose it was a rather important promise? With most of us it would then come to be a matter of weighing the promise, the thing of the past, against this unexpected bad consequence, the thing of the future. And the smaller the overplus of evil consequences, the more most of us would vacillate. But neither of the two types of mind we are contrasting would vacillate at all. The legal type of mind would obey the past unhesitatingly, the creative would unhesitatingly sacrifice it to the future. The legal mind would say, "they who break the law at any point, break it altogether," while the creative mind would say, "let the dead past bury its dead." It is convenient to take my illustration from the sphere of promises, but it is in the realm of sexual morality that the two methods are most acutely in conflict.

And I would like to suggest that until you have definitely determined either to obey the real or imaginary imperatives of the past, or to set yourself towards the demands of some ideal of the future, until you have made up your mind to adhere to one or other of these two types of mental action in these matters, you are not even within hope of a sustained consistency in the thought that underlies your acts, that in every issue of principle that comes upon you, you will be entirely at the mercy of the intellectual mood that happens to be ascendant at that particular moment in your mind.

In the sphere of public affairs also, these two ways of looking at things work out into equally divergent and incompatible consequences. The legal mind insists upon treaties, constitutions, legitimacies and charters; the legislative incessantly assails these. Whenever some period of stress sets in, some great conflict between institutions and the forces in things, there comes a sorting between these two types of mind. The legal mind becomes glorified and transfigured in the form of hopeless loyalty, the creative mind inspires revolutions and reconstructions. And particularly is this difference of attitude accentuated in the disputes that arise out of wars. In most modern wars there is no doubt quite traceable on one side or the other a distinct creative idea, a distinct regard for some future consequence. But the main dispute even in most modern wars and the sole dispute in most mediæval wars will be found to be a reference, not to the future, but to the past; to turn upon a question of fact and right. The wars of Plantagenet and Lancastrian England with France, for example, were based entirely upon a dummy claim, supported by obscure legal arguments, upon the crown of France. And the arguments that centre about the present war in South Africa ignore any ideal of a great united South African State almost entirely, and quibble this way and that about who began the fighting and what was or was not written in some obscure revision of a treaty a score of years ago. Yet beneath the legal issues, the broad creative idea has been very apparent in the public mind during this war. It will be found more or less definitely formulated beneath almost all the great wars of the past century, and a comparison of the wars of the nineteenth century with the wars of the middle ages will show, I think, that in this field also there has been a discovery of the future, an increasing disposition to shift the reference and values from things accomplished to things to come.

Yet though foresight creeps into our politics and a reference to consequence into our morality, it is still the past that dominates our lives. But why? Why are we so bound to it? It is into the future we go, to-morrow is the eventful thing for us. There lies all that remains to be felt by us and our children and all those that are dear to us. Yet we marshal and order men into classes entirely with regard to the past, we draw shame and honour out of the past; against the rights of property, the vested interests, the agreements and establishments of the past, the future has no rights. Literature is for the most part history or history at one remove, and what is culture but a mould of interpretation into which new things are thrust, a collection of standards, a sort of bed of King Og, to which all new expressions must be lopped or stretched? Our conveniences, like our thoughts, are all retrospective. We travel on roads so narrow that they suffocate our traffic; we live in uncomfortable, inconvenient, life-wasting houses out of a love of familiar shapes and familiar customs and a dread of strangeness, all our public affairs are cramped by local boundaries impossibly restricted and small. Our clothing, our habits of speech, our spelling, our weights and measures, our coinage, our religious and political theories, all witness to the binding power of the past upon our minds. Yet—we do not serve the past as the Chinese have done. There are degrees. We do not worship our ancestors or prescribe a rigid local costume; we venture to enlarge our stock of knowledge, and we qualify the classics with occasional adventures into original thought. Compared with the Chinese we are distinctly aware

of the future. But compared with what we might be, the past is all our world.

The reason why the retrospective habit, the legal habit, is so dominant and always has been so predominant, is of course a perfectly obvious one. We follow the fundamental human principle and take what we can get. All people believe the past is certain, defined and knowable, and only a few people believe that it is possible to know anything about the future. Man has acquired the habit of going to the past because it was the line of least resistance for his mind. While a certain variable portion of the past is serviceable matter for knowledge in the case of everyone, the future is, to a mind without an imagination trained in scientific habits of thought, non-existent. All our minds are made of memories. In our memories each of us has something that without any special training whatever will go back into the past and grip firmly and convincingly all sorts of workable facts, sometimes more convincingly than firmly. But the imagination, unless it is strengthened by a very sound training in the laws of causation, wanders like a lost child in the blackness of things to come and returns—empty.

Many people believe, therefore, that there can be no sort of certainty about the future. You can know no more about the future, I was recently assured by a friend, than you can know which way a kitten will jump next. And to all who hold that view, who regard the future as a perpetual source of convulsive surprises, as an impenetrable, incurable, perpetual blackness, it is right and reasonable to derive such values as it is necessary to attach to things from the events that have certainly happened with regard to them. It is our ignorance of the future and our persuasion that that ignorance is absolutely incurable that alone gives the past its enormous predominance in our thoughts. But through the ages, the long unbroken succession of fortune tellers—and they flourish still—witnesses to the perpetually smouldering feeling that after all there *may* be a better sort of knowledge—a more serviceable sort of knowledge than that we now possess.

On the whole there is something sympathetic for the dupe of the fortune teller in the spirit of modern science; it is one of the persuasions that come into one's mind, as one assimilates the broad conceptions of science, that the adequacy of causation is universal; that in absolute fact, if not in that little bubble of relative fact, which constitutes the individual life, in absolute fact the future is just as fixed and determinate, just as settled and inevitable, just as possible a matter of knowledge as the past. Our personal memory gives us an impression of the superior reality and trustworthiness of things in the past, as of things that have finally committed themselves and said their say, but the more clearly we master the leading conceptions of science the better we understand that this impression is one of the results of the peculiar conditions of our lives and not an absolute truth. The man of science comes to believe at last that the events of the year A.D. 4000 are as fixed, settled and unchangeable as the events of the year 1600. Only about the latter he has some material for belief and about the former practically none.

And the question arises how far this absolute ignorance of the future is a fixed and necessary condition of human life, and how far some application of intellectual methods may not attenuate even if it does not absolutely set aside the veil between ourselves and things to come. And I am venturing to suggest to you that, along certain lines and with certain qualifications and limitations, a working knowledge of things in the future is a possible and practicable thing.

And in order to support this suggestion I would call your attention to certain facts about our knowledge of the past, and more particularly I would insist upon this, that about the past our range of absolute certainty is very limited indeed. About the past I would suggest we are inclined to overestimate our certainty, just as I think we are inclined to underestimate the certainties of the future. And such a knowledge of the past as we have is not all of the same sort, or derived from the same sources.

Let us consider just what an educated man of to-day knows of the past. First of all he has the reallest of all knowledge, the knowledge of his own personal experiences, his memory. Uneducated people believe their memories absolutely, and most educated people believe them with a few reservations. Some of us take up a critical attitude even towards our own memories; we know that they not only sometimes drop things out, but that sometimes a sort of dreaming or a strong suggestion will put things in. But for all that memory remains vivid and real as no other knowledge can be, and to have seen and heard and felt is to be nearest to absolute conviction. Yet our memory of direct impressions is only the smallest part of what we know. Outside that bright area comes knowledge of a different order, the knowledge brought to us by other people. Outside our immediate personal memory there comes this wider area of facts, or quasi-facts, told us by more or less trustworthy people, told us by word of mouth or by the written word of living and of dead writers. This is the past of report, rumour, tradition and history, the second sort of knowledge of the past. The nearer knowledge of this sort is abundant and clear and detailed, remoter it becomes vaguer, still more remotely in time and space it dies down to brief, imperfect inscriptions and enigmatical traditions, and at last dies away, so far as the records and traditions of humanity go, into a doubt and darkness as black, just as black, as futurity. And now let me remind you that this second zone of knowledge outside the bright area of what we have felt and witnessed and handled for ourselves, this zone of hearsay and history and tradition completed the whole knowledge of the past that was accessible to Shakespeare, for example. To these limits man's knowledge of the past was absolutely confined save for some inklings and guesses, save for some small, almost negligible beginnings, until the nineteenth century began. Beside the correct knowledge in this scheme of hearsay and history a man had a certain amount of legend and error that rounded off the picture in a very satisfying and misleading way, according to Bishop Ussher, just exactly 4004 years B.C. And that was man's universal history—that was his all, until the scientific epoch began. And beyond those limits—? Well, I suppose the educated man of the sixteenth century was as certain of the non-existence of anything before the creation of the world as he was, and as most of us are still, of the practical non-existence of the future, or at any rate he was as satisfied of the impossibility of knowledge in the one direction as in the other.

But modern science, that is to say, the relentless systematic criticism of phenomena, has in the past hundred years absolutely destroyed the conception of a finitely distant beginning of things; has abolished such limits to the past as a dated creation set, and added an enormous vista to that limited sixteenth century outlook. And what I would insist upon is that this further knowledge is a new kind of knowledge, obtained in a new kind of way. We know to-day, quite as confidently and in many respects more intimately than we know Sargon, or Zenobia, or Caractacus, the form and the habits of creatures that no living being has ever met, that no human eye has ever regarded, and the character of scenery that no man has ever seen or can ever possibly see; we picture to ourselves the labyrinthodon raising its clumsy head above the waters of the Carboniferous swamps in which he lived, and we figure the pterodactyls, those great bird lizards, flapping their way athwart the forests of the Mesozoic age with exactly the same certainty as that with which we picture the rhinoceros or the vulture. I doubt no more about the facts in this further picture than I do about those in the nearest. I believe in the megatherium which I have never seen as confidently as I believe in the hippopotamus that has engulfed buns from my hand. A vast amount of detail in that further picture is now fixed and finite for all time. And a countless number of investigators are persistently and confidently enlarging, amplifying, correcting and pushing further and further back the boundaries of this greater past, this pre-human past that the scientific criticism of existing phenomena has discovered and restored and brought for the first time into the world of human thought. We have become possessed of a new and once unsuspected history of the world—of which all the history that was known, for example, to Doctor Johnson, is only the brief concluding chapter. And even that concluding chapter has been greatly enlarged and corrected by the exploring archæologist working strictly upon the lines of the new method, that is to say, the comparison and criticism of suggestive facts.

I want particularly to insist upon this, that all this outer past—this non-historical past—is the product of a new and keener habit of inquiry, and no sort of revelation. It is simply due to a new and more critical way of looking at things. Our knowledge of the geological past, clear and definite as it has become, is of a different and lower order than the knowledge of our memory, and yet of a quite practicable and trustworthy order, a knowledge good enough to go upon. And if one were to

speak of the private memory as the personal past, as the next wider area of knowledge as the traditional or historical past, then one might call all that great and inspiring background of remoter geological time, the inductive past.

And this great discovery of the inductive past was got by the discussion and rediscussion and effective criticism of a number of existing facts, odd-shaped lumps of stone, streaks and bandings in quarries and cliffs, anatomical and developmental details that had always been about in the world, that had been lying at the feet of mankind so long as mankind had existed, but that no one had ever dreamt before could supply any information at all, much more reveal such astounding and enlightening vistas. Looked at in a new way they became sources of dazzling and penetrating light; the remoter past lit up and became a picture. Considered as effects, compared and criticised, they yielded a clairvoyant vision of the history of interminable years.

And now—if it has been possible for men by picking out a number of suggestive and significant looking things in the present, by comparing them, criticising them, and discussing them, with a perpetual insistence upon *why*? without any guiding tradition, and indeed in the teeth of established beliefs, to construct this amazing searchlight of inference into the remoter past—is it really, after all, such an extravagant and hopeless thing to suggest that, by seeking for operating causes instead of for fossils and by criticising them as persistently and thoroughly as the geological record has been criticised, it may be possible to throw a searchlight of inference forward instead of backward and to attain to a knowledge of coming things as clear, as universally convincing and infinitely more important to mankind than the clear vision of the past that geology has opened to us during the nineteenth century?

Let us grant that anything to correspond with the memory, anything having the same relation to the future that memory has to the past, is out of the question. We cannot imagine, of course, that we can ever know any personal future to correspond with our personal past, or any traditional future to correspond with our traditional past. But the possibility of an inductive future to correspond with that great inductive past of geology and archæology is an altogether different thing.

I must confess that I believe quite firmly that an inductive knowledge of a great number of things in the future is becoming a human possibility. I believe that the time is drawing near when it will be possible to suggest a systematic exploration of the future. And you must not judge the practicability of this enterprise by the failures of the past. So far nothing has been attempted, so far no first-class mind has ever focussed itself upon these issues. But suppose the laws of social and political development, for example, were given as many brains, were given as much attention, criticism and discussion as we have given to the laws of chemical combination during the last fifty years—what might we not expect?

To the popular mind of to-day there is something very difficult in such a suggestion, soberly made. But here, in this Institution which has watched for a whole century over the splendid adolescence of science, and where the spirit of science is surely understood, you will know that as a matter of fact prophecy has always been inseparably associated with the idea of scientific research. The popular idea of scientific investigation is a vehement, aimless collection of little facts, collected as the bower bird collects shells and pebbles, in methodical little rows, and out of this process, in some manner unknown to the popular mind, certain conjuring tricks—the celebrated wonders of science—in a sort of accidental way emerge. The popular conception of all discovery is accident. But you will know that the essential thing in the scientific process is not the collection of facts, but the analysis of facts; facts are the raw material and not the substance of science; it is analysis that has given us all ordered knowledge, and you know that the aim and the test and the justification of the scientific process is *not* a marketable conjuring trick, but prophecy. Until a scientific theory yields confident forecasts you know it is unsound and tentative; it is mere theorising, as evanescent as art talk or the phantoms politicians talk about. The splendid body of gravitational astronomy, for example, establishes itself upon the certain forecast of stellar movements, and you would absolutely refuse to believe its amazing assertions if it were not for these same unerring forecasts. The whole body of medical science aims, and claims the ability, to diagnose. Meteorology constantly and persistently aims at prophecy, and it will never stand in a place of honour until it can certainly foretell. The chemist forecasts elements before he meets them—it is very properly his boast—and the splendid manner in which the mind of Clerk Maxwell reached in front of all experiment and foretold those things that Marconi has materialised is familiar to us all.

And if I am right in saying that science aims at prophecy, and if the specialist in each science is in fact doing his best *now* to prophesy within the limits of his field, what is there to stand in the way of our building up this growing body of forecast into an ordered picture of the future that will be just as certain, just as strictly science, and perhaps just as detailed as the picture that has been built up within the last hundred years to make the geological past? Well, so far and until we bring the prophecy down to the affairs of man and his children, it is just as possible to carry induction forward as back; it is just as simple and sure to work out the changing orbit of the earth in the future until the tidal drag hauls one unchanging face at last towards the sun as it is to work back to its blazing and molten past. Until man comes in, the inductive future is as real and convincing as the inductive past. But inorganic forces are the smaller part and the minor interest in this concern. Directly man becomes a factor the nature of the problem changes, and our whole present interest centres on the question whether man is, indeed, individually and collectively incalculable, a new element which entirely alters the nature of our inquiry and stamps it at once as vain and hopeless, or whether his presence complicates, but does not alter, the essential nature of the induction. How far may we hope to get trustworthy inductions about the future of man?

Well, I think, on the whole, we are inclined to underrate our chance of certainties in the future just as I think we are inclined to be too credulous about the historical past. The vividness of our personal memories, which are the very essence of reality to us, throws a glamour of conviction over tradition and past inductions. But the personal future must in the very nature of things be hidden from us so long as time endures, and this black ignorance at our very feet, this black shadow that corresponds to the brightness of our memories behind us, throws a glamour of uncertainty and unreality over all the future. We are continually surprising ourselves by our own will or want of will; the individualities about us are continually producing the unexpected, and it is very natural to reason that as we can never be precisely sure before the time comes what *we* are going to do and feel, and if we can never count with absolute certainty upon the acts and happenings even of our most intimate friends, how much the more impossible is it to anticipate the behaviour in any direction of states and communities?

In reply to which I would advance the suggestion that an increase in the number of human beings considered may positively simplify the case instead of complicating it, that as the individuals increase in number they begin to average out. Let me illustrate this point by a comparison. Angular pit sand has grains of the most varied shapes. Examined microscopically you will find all sorts of angles and outlines and variations. Before you look, you can say of no particular grain what its outline will be. And if you shoot a load of such sand from a cart you cannot foretell with any certainty where any particular grain will be in the heap that you make. But you can tell, you can tell pretty definitely, the form of the heap as a whole. And further, if you pass that sand through a series of shoots, and finally drop it some distance to the ground, you will be able to foretell that grains of a certain sort of form and size will for the most part be found in one part of the heap, and grains of another sort of form and size will be found in another part of the heap. In such a case, you see, the thing as a whole may be simpler than its component parts, and this I submit is also the case in many human affairs. So that because the individual future eludes us completely, that is no reason why we should not aspire to, and discover and use, safe and serviceable generalisations upon countless important issues in the human destiny.

But there is a very grave and important-looking difference between a load of sand and a multitude of human beings, and this I must face and examine. Our thoughts and wills and emotions are contagious. An exceptional sort of sand grain, a sand grain that was exceptionally big and heavy, for example, exerts no influence worth considering upon any other of the sand grains in the load. They will fall and roll and heap themselves just the same, whether that exceptional grain is with them or not. But an exceptional man comes into the world, a Cæsar or a Napoleon or a Peter the Hermit, and he appears to persuade

and convince and compel and take entire possession of the sand heap—I mean the community—and to twist and alter its destinies to an almost unlimited extent. And if this is indeed the case, it reduces our project of an inductive knowledge of the future to very small limits. To hope to foretell the birth and coming of men of exceptional force and genius is to hope incredibly, and if, indeed, such exceptional men do do as much as they seem to do in warping the path of humanity, our utmost prophetic limit in human affairs is a conditional sort of prophecy. *If* people do so and so, we can say, then such and such results will follow, and we must admit that that is our limit.

But everybody does not believe in the importance of the leading man. There are those who will say that the whole world is different by reason of Napoleon. But there are also those who will say the whole world of to-day would be very much as it is now if Napoleon had never been born. There are those who believe entirely in the individual man and those who believe entirely in the forces behind the individual man, and for my own part I must confess myself a rather extreme case of the latter kind. I must confess I believe that if by some juggling with space and time Julius Cæsar, Napoleon, Edward IV., William the Conqueror, Lord Rosebery and Robert Burns had all been changed at birth, it would not have produced any serious dislocation of the course of destiny. I believe that these great men of ours are no more than images and symbols and instruments taken, as it were, haphazard by the incessant and consistent forces behind them; they are the pen-nibs Fate has used for her writing, the diamonds upon the drill that pierces through the rock. And the more one inclines to this trust in forces, the more one will believe in the possibility of a reasoned inductive view of the future that will serve us in politics, in morals, in social contrivances, and in a thousand spacious ways. And even those who take the most extreme and personal and melodramatic view of the ways of human destiny, who see life as a tissue of fairy godmother births and accidental meetings and promises and jealousies, will, I suppose, admit there comes a limit to these things, that at last personality dies away and the greater forces come to their own. The great man, however great he be, cannot set back the whole scheme of things; what he does in right and reason will remain, and what he does against the greater creative forces will perish. We cannot foresee him, let us grant that. His personal difference, the splendour of his effect, his dramatic arrangement of events will be his own—in other words, we cannot estimate for accidents and accelerations and delays—but if only we throw our web of generalisation wide enough, if only we spin our rope of induction strong enough, the final result of the great man, his ultimate surviving consequences, will come within our net.

Such, then, is the sort of knowledge of the future that I believe is attainable, and worth attaining. I believe that the deliberate direction of historical study and of economic and social study towards the future, and an increasing reference, a deliberate and courageous reference, to the future in moral and religious discussion, would be enormously stimulating and enormously profitable to our intellectual life. I have done my best to suggest to you that such an enterprise is now a serious and practicable undertaking. But at the risk of repetition I would call your attention to the essential difference that must always hold between our attainable knowledge of the future and our existing knowledge of the past. The portion of the past that is brightest and most real to each of us is the individual past, the personal memory. The portion of the future that must remain darkest and least accessible is the individual future. Scientific prophecy will not be fortune telling, whatever else it may be. Those excellent people who cast horoscopes, those illegal fashionable palm-reading ladies who abound so much to-day, in whom nobody is so foolish as to believe, and to whom everybody is foolish enough to go, need fear no competition from the scientific prophets. The knowledge of the future we may hope to gain will be general and not individual; it will be no sort of knowledge that will either hamper us in the exercise of our individual free will or relieve us of our personal responsibility.

And now, how far is it possible at the present time to speculate on the particular outline the future will assume when it is investigated in this way?

It is interesting, before we answer that question, to take into account the speculations of a certain sect and culture of people who already, before the middle of last century, had set their faces towards the future as the justifying explanation of the present. These were the positivists, whose position is still most eloquently maintained and displayed by Mr. Frederic Harrison, in spite of the great expansion of the human outlook that has occurred since Comte. If you read Mr. Harrison, and if you are also, as I presume your presence here indicates, saturated with that new wine of more spacious knowledge that has been given the world during the last fifty years, you will have been greatly impressed by the peculiar limitations of the positivist conception of the future. So far as I can gather, Comte was, for all practical purposes, totally ignorant of that remoter past outside the past that is known to us by history, or if he was not totally ignorant of its existence, he was, and conscientiously remained, ignorant of its relevancy to the history of humanity. In the narrow and limited past he recognised, men had always been like the men of to-day; in the future he could not imagine that they would be anything more than men like the men of to-day. He perceived, as we all perceive, that the old social order was breaking up, and after a richly suggestive and incomplete analysis of the forces that were breaking it up, he set himself to plan a new static social order to replace it. If you will read Comte, or, what is much easier and pleasanter, if you will read Mr. Frederic Harrison, you will find this conception constantly apparent—that there was once a stable condition of society with humanity, so to speak, sitting down in an orderly and respectable manner; that humanity has been stirred up and is on the move, and that finally it will sit down again on a higher plane, and for good and all, cultured and happy, in the re-organised positivist state. And since he could see nothing beyond man in the future, there, in that millennial fashion, Comte had to end. Since he could imagine nothing higher than man, he had to assert that humanity, and particularly the future of humanity, was the highest of all conceivable things.

All that was perfectly comprehensible in a thinker of the first half of the nineteenth century. But we of the early twentieth, and particularly that growing majority of us who have been born since the "Origin of Species" was written, have no excuse for any such limited vision. Our imaginations have been trained upon a past in which the past that Comte knew is scarcely more than the concluding moment; we perceive that man, and all the world of men, is no more than the present phase of a development so great and splendid that beside this vision epics jingle like nursery rhymes, and all the exploits of humanity shrivel to the proportion of castles in the sand. We look back through countless millions of years and see the great will to live struggling out of the intertidal slime, struggling from shape to shape and from power to power, crawling and then walking confidently upon the land, struggling generation after generation to master the air, creeping down into the darkness of the deep; we see it turn upon itself in rage and hunger and reshape itself anew, we watch it draw nearer and more akin to us, expanding, elaborating itself, pursuing its relentless inconceivable purpose, until at last it reaches us and its being beats through our brains and arteries, throbs and thunders in our battleships, roars through our cities, sings in our music and flowers in our art. And when—from that retrospect—we turn again towards the future, surely any thought of finality, any millennial settlement of cultured persons, has vanished from our minds.

This fact that man is not final is the great unmanageable disturbing fact that rises upon us in the scientific discovery of the future, and to my mind at any rate the question what is to come *after* man is the most persistently fascinating and the most insoluble question in the whole world.

Of course we have no answer. Such imaginations as we have refuse to rise to the task.

But for the nearer future, while man is still man, there are a few general statements that seem to grow more certain. It seems to be pretty generally believed to-day that our dense populations are in the opening phase of a process of diffusion and aëration. It seems pretty inevitable also that at least the mass of white population in the world will be forced some way up the scale of education and personal efficiency in the next two or three decades. It is not difficult to collect reasons for supposing, and such reasons have been collected, that in the near future, in a couple of hundred years as one rash optimist has written, or in a thousand or so, humanity will be definitely and consciously organising itself as a great world State, a great world State that will purge from itself much that is mean, much that is bestial, and much that makes for individual dulness and dreariness, grey-

ness and wretchedness in the world of to-day. And although we know that there is nothing final in that world State, although we see it only as something to be reached and passed, although we are sure there will be no such sitting down to restore and perfect a culture as the positivists foretell, yet few people can persuade themselves to see anything beyond that except in the vaguest and more general terms. That world State of more efficient, more vivid, beautiful and eventful people is, so to speak, on the brow of the hill, and we cannot see over—though some of us can imagine great uplands beyond and something, something that glitters elusively, taking first one form and then another, through the haze. We can see no detail, we can see nothing definable, and it is simply, I know, the sanguine necessity of our minds that makes us believe those uplands of the future are still more gracious and splendid than we can either hope or imagine. But of things that can be demonstrated we have none.

Yet I suppose most of us entertain certain necessary persuasions, without which a moral life in this world is neither a reasonable nor a possible thing. All this paper is built finally upon certain negative beliefs that are incapable of scientific establishment. Our lives and powers are limited, our scope in space and time is limited, and it is not unreasonable that for fundamental beliefs we must go outside the sphere of reason and set our feet upon Faith. Implicit in all such speculations as this, is a very definite and quite arbitrary belief, and that belief is that neither humanity nor in truth any individual human being is living its life in vain. And it is entirely by an act of faith that we must rule out of our forecasts certain possibilities, certain things that one may consider improbable and against the chances, but that no one upon scientific grounds can call impossible. One must admit that it is impossible to show why certain things should not utterly destroy and end the entire human race and story, why night should not presently come down and make all our dreams and efforts vain. It is conceivable, for example, that some great unexpected mass of matter should presently rush upon us out of space, whirl sun and planets aside like dead leaves before the breeze, and collide with and utterly destroy every spark of life upon this earth. So far as positive human knowledge goes, this is a conceivably possible thing. There is nothing in science to show why such a thing should not be. It is conceivable, too, that some pestilence may presently appear, some new disease, that will destroy, not 10 or 15 or 20 per cent. of the earth's inhabitants as pestilences have done in the past, but 100 per cent., and so end our race. No one, speaking from scientific grounds alone, can say—that cannot be. And no one can dispute that some great disease of the atmosphere, some trailing cometary poison, some great emanation of vapour from the interior of the earth, such as Mr. Shiel has made a brilliant use of in his "Purple Cloud," is consistent with every demonstrated fact in the world. There may arise new animals to prey upon us by land and sea, and there may come some drug or a wrecking madness into the minds of men. And finally there is the reasonable certainty that this sun of ours must some day radiate itself towards extinction; that at least *must* happen, it will grow cooler and cooler, and its planets will rotate ever more sluggishly until some day this earth of ours, tideless and slow moving, will be dead and frozen, and all that has lived upon it will be frozen out and done with. There surely man must end. That of all such nightmares is the most insistently convincing.

And yet one doesn't believe it.

At least I do not. And I do not believe in these things because I have come to believe in certain other things,—in the coherency and purpose in the world and in the greatness of human destiny. Worlds may freeze and suns may perish, but there stirs something within us now that can never die again.

Do not misunderstand me when I speak of the greatness of human destiny.

If I may speak quite openly to you, I will confess that, considered as a final product, I do not think very much of myself or (saving your presence) my fellow creatures. I do not think I could possibly join in the worship of humanity with any gravity or sincerity. Think of it. Think of the positive facts. There are surely moods for all of us when one can feel Swift's amazement that such a being should deal in pride. There are moods when one can join in the laughter of Democritus; and they would come oftener were not the spectacle of human littleness so abundantly shot with pain. But it is not only with pain that the world is shot—it is shot with promise. Small as our vanity and carnality makes us, there has been a day of still smaller things. It is the long ascent of the past that gives the lie to our despair. We know now that all the blood and passion of our life was represented in the Carboniferous time by something—something, perhaps, cold-blooded and with a clammy skin, that lurked between air and water, and fled before the giant amphibia of those days.

For all the folly, blindness and pain of our lives, we have come some way from that. And the distance we have travelled gives us some earnest of the way we have yet to go.

Why should things cease at man? Why should not this rising curve rise yet more steeply and swiftly? There are many things to suggest that we are now in a phase of rapid and unprecedented development. The conditions under which men live are changing with an ever-increasing rapidity, and, so far as our knowledge goes, no sort of creatures have ever lived under changing conditions without undergoing the profoundest changes themselves. In the past century there was more change in the conditions of human life than there had been in the previous thousand years. A hundred years ago inventors and investigators were rare scattered men, and now invention and inquiry is the work of an organised army. This century will see changes that will dwarf those of the nineteenth century as those of the nineteenth dwarf those of the eighteenth. One can see no sign anywhere that this rush of change will be over presently, that the positivist dream of a social reconstruction and of a new static culture phase will ever be realised. Human society never has been quite static, and it will presently cease to attempt to be static. Everything seems pointing to the belief that we are entering upon a progress that will go on, with an ever-widening and ever more confident stride, for ever. The reorganisation of society that is going on now beneath the traditional appearance of things is a kinetic reorganisation. We are getting into marching order. We have struck our camp for ever and we are out upon the roads.

We are in the beginning of the greatest change that humanity has ever undergone. There is no shock, no epoch-making incident—but then there is no shock at a cloudy daybreak. At no point can we say, here it commences, now, last minute was night and this is morning. But insensibly we are in the day. If we care to look we can foresee growing knowledge, growing order, and presently a deliberate improvement of the blood and character of the race. And what we can see and imagine gives us a measure and gives us faith for what surpasses the imagination.

It is possible to believe that all the past is but the beginning of a beginning, and that all that is and has been is but the twilight of the dawn. It is possible to believe that all that the human mind has ever accomplished is but the dream before the awakening. We cannot see, there is no need for us to see, what this world will be like when the day has fully come. We are creatures of the twilight. But it is out of our race and lineage that minds will spring, that will reach back to us in our littleness to know us better than we know ourselves, and that will reach forward fearlessly to comprehend this future that defeats our eyes. All this world is heavy with the promise of greater things, and a day will come, one day in the unending succession of days, when beings, beings who are now latent in our thoughts and hidden in our loins, shall stand upon this earth as one stands upon a footstool, and shall laugh and reach out their hands amidst the stars.

THE WEST INDIAN AGRICULTURAL CONFERENCE, 1902.

THE fourth Agricultural Conference under the presidency of Dr. D. Morris, Imperial Commissioner of Agriculture for the West Indies, was held on January 4 to 6. The opening ceremony was attended by the Governor and the chief members of the military and civil services of the Colony. The delegates, some sixty in number, included representatives of the scientific and educational staffs of all the West Indian colonies.

The president delivered an address reviewing the work of the Department of Agriculture during its three years of existence. Under the head of sugar industry, experimental stations were at work at British Guiana, Barbados, Antigua and St. Kitts raising and testing large numbers of seedling canes, and extensive series of experiments were being carried out with manures. The insect and fungoid diseases of the sugar-cane were being carefully worked out, and schemes for central

factories at Barbados and Antigua were gradually taking shape. The diseases of cacao were receiving careful attention, and amongst subsidiary industries the best method of converting lime juice into citrate of lime was being investigated; attempts were being made to establish a trade in sweet potatoes between Barbados and London, to grow Irish potatoes for the London market, and to develop the onion industry in Antigua, Montserrat and Dominica; and plantations of the Central American rubber (*Castilloa elastica*) had been started at Trinidad and Tobago. A bee expert had been employed for several months to visit and advise bee-keepers, and lately an illustrated pamphlet containing information respecting bee-keeping in the West Indies had been published. Very favourable conditions existed in many of the West Indian colonies for raising horses, cattle and small stock, and efforts were being made to improve native breeds by the importation of stallion ponies, Maltese jacks and jennies, pedigree bulls, pigs, sheep, goats and poultry. The direct fruit trade recently established between Jamaica and the United Kingdom by means of a subsidised steamship service had proved entirely successful, and it was difficult to over-estimate the possibilities in this direction, in which many of the smaller West Indian islands might participate.

Agricultural education had formed an important part of the work done; courses of lectures in agriculture were being delivered in all parts of the West Indies to school teachers, and by this means the subject was being introduced into the primary schools. In the higher grade schools and colleges it was sought to establish lectureships in agricultural science; a lecturer had been provided by the Department at Barbados and Jamaica, and favourable reports had been received upon the results of their work. Seven agricultural scholarships had been founded, and it was hoped soon to be able to increase the number in order to afford opportunity to the most promising boys in the smaller islands to obtain sound agricultural teaching. Agricultural schools at St. Vincent, Dominica and St. Lucia had been established, at which seventy boys were being maintained for three or four years free of cost to their parents and carefully trained in the science and practice of agriculture. Attached to the schools were experiment stations, where the boys carry on all light operations and raise a portion of their own food. A series of lectures to planters had been given in Barbados the full text of which would shortly be published. Agricultural shows under the auspices of the Imperial Department of Agriculture were now regularly held at seven of the islands, and these shows were gradually drawing attention to the better cultivation and preparation of produce and bringing prominently into notice the varied resources of the islands.

Besides the journal of the Imperial Department of Agriculture (*West Indian Bulletin*), of which the last number of the second volume was in the press, twelve pamphlets, containing in the aggregate 417 pp., had been published since the last conference. These pamphlets contain information specially applicable to tropical conditions, and 30,000 copies are in course of being distributed. The principal subjects dealt with are:—"The General Treatment of Insect Pests" (first and second editions), "Scale Insects of the Lesser Antilles" (part i.), "Cultivation of Vegetables," "Hints for cooking Sweet Potatoes," "Bee-keeping in the West Indies," "Manures and Leguminous Plants at Barbados, 1898–1901," "Hints for School Gardens," "Seedling and other Canes in the Leeward Islands, 1900–1901," "Seedling and other Canes at Barbados, 1901." Of "Nature Teaching" (pp. 12 and 199) 2000 copies have been published and nearly all distributed. The Department contemplates the publication of a fortnightly paper, to be called the *Agricultural News*, containing hints and advice on all points of interest to the West Indies.

The sugar industry was the first subject taken up for discussion by the Conference; short papers were read by those engaged in sugar-cane experiments in the various colonies, summarising the progress made during the past year; a discussion ensued in which the agricultural representatives took an important part. While no seedling could be put forward at present to displace the old and well-tried varieties, it was felt that the progress made encouraged the view that the production of seedlings was destined to play an important part in the future existence of the sugar-cane industry in the West Indies. The accounts given of recent manurial experiments confirmed the importance of active nitrogenous manures, but tended to show that in many soils phosphatic manures did not increase the yield. The general consensus of opinion was in favour of supplementing the experimental station plots by trials upon a large scale on the estates, and this method has been already adopted in several colonies.

The proceedings included important papers by Mr. H. H. Cousins (Government chemist, Jamaica) and Mr. Joseph Shore (Jamaica), on "The Sugar Industry of Jamaica," and accounts of the life-history of the lady bird borer (*Sphenophorus sacchari*), by Mr. Maxwell Lefroy, and of "The Field Treatment of Cane Tops in reference to Fungoid Disease," by Mr. A. Howard.

On the second day, papers on agricultural education were read by Mr. A. B. McFarlane (principal of the Teachers' Training College, Jamaica), Mr. W. R. Buttenshaw (lecturer in agricultural science, Jamaica) and Messrs. J. E. Reece, J. A. Harbin and C. M. Martin, inspectors of schools at Barbados, Grenada and the Leeward Islands. An educational section, with the Bishop of Barbados as chairman and Mr. C. M. Martin as secretary, reported upon questions connected with agricultural teaching at primary schools. A chemical section, with Prof. J. B. Harrison (British Guiana) as chairman and Prof. J. P. d'Albuquerque (Barbados) secretary, reported upon chemical methods in sugar-cane work.

Papers were also read on "Suggestions for Regulating the Quality of Exported Fruit," by Mr. Sydney Olivier (Colonial Secretary, Jamaica), "The Preparation of Citrate of Lime," by Mr. Francis Watts (Government chemist, Leeward Islands), "Scale Diseases," by Mr. H. Maxwell Lefroy (entomologist to the Department), "Agricultural Boards," by Mr. Sydney Olivier, "The Preparation of Essential Oils," by Mr. Hart (Superintendent of the Botanic Gardens, Trinidad), "The Removal of Epiphytic Vegetation on the Stems of Cacao and Lime Trees," by Mr. A. Howard (mycologist to the Department), and "The Aloe Industry of Barbados," by Mr. W. G. Freeman (technical assistant to the Department).

J. P. d'Albuquerque.

THE LEONID SHOWER OF 1901.

It now seems possible to give a brief review of the character of the Leonid shower which occurred last November, a considerable number of reports being available for the purpose. Certain other results obtained in various quarters of the globe doubtless still remain unpublished, but it is not likely that they will materially differ from those already before us.

In England the display of Leonids cannot be said to have been a conspicuous or a plentiful one, though it was decidedly stronger than in either of the years 1899 or 1900. Fortunately, the sky was clear on the nights following November 14 and 15, and a large number of observations were secured in different parts of the country. On the morning of November 15, Mr. H. Corder at Bridgwater watched the firmament for an hour and a half and saw 50 meteors, three-quarters of the number being Leonids, so that the horary rate of their apparition was about 25. Mr. E. C. Willis, of Norwich, found the hourly number 22 on the same morning, while on the following morning it was 18. Mr. J. R. Henry, of Dublin, observing from 1h. to 3.30, saw Leonids as bright as the first and second magnitude falling at the rate of 12 per hour. The maximum was apparently attained just before the morning twilight began to overpower the fainter stars. The horary numbers quoted above may be fairly considered to approximate the truth. It is true that some other observers saw fewer meteors, but as they were engaged in recording the individual paths, a considerable number must have altogether escaped their notice.

But the real maximum of the shower certainly occurred after sunrise in England; this is proved by observations from America, where the meteors were far more numerous, though the display was only of secondary importance. Mr. E. L. Larkin, at the observatory on Echo Mountain, S. California, counted 297 meteors on November 15, 4h. to 5h. a.m. (local time), so they were falling at the rate of 5 per minute. The maximum was at about 4h. 20m.–25m. a.m. One fireball left a streak for 14 minutes, and the meteors generally were very brilliant, two being estimated twenty times as bright as Venus, three ten times as bright, twelve five times as bright, and twenty-five equal to Venus. Forty were equal to Jupiter. At Ladd Observatory, Providence, the number seen was 2 per minute on the morning of November 15, while at several other places in the States the rate was 3 or 4 per minute between about 3h. 30m. and 5h. 30m. a.m.

At Carlton College, Northfield, Minn., it was estimated that four observers might have counted about 1600 meteors per hour. There was a marked falling off in numbers on the morning of November 16. Yet at two stations, according to newspaper reports, the shower was quite striking on the latter morning, for at Los Angeles one observer is said to have counted 385 meteors in the hour between 4h. and 5h. a.m., while at Phœnix 200 were seen in half an hour. It is highly probable, however, judging from the character of the shower as recorded at other stations, that in the two latter cases the observations were really made on the morning of the 15th and not on the 16th as stated in the newspaper accounts, which are often erroneous in such matters.

The maximum of the display must have occurred at about 11h. 30m. a.m. G.M.T. November 15, according to some of the best American descriptions. Possibly it may have been attained even later than this, for the morning twilight must have affected the observations to some extent. If the time of greatest frequency was after that stated, the phenomenon at its best could only have been observed from the Pacific Ocean, and it is not probable that we shall get any satisfactory reports from this region.

Though the shower was pretty active, it does not appear that photography has afforded any material assistance in recording its features. Plates were exposed at many observatories, but trails were absent upon them except in one or two isolated instances.

In England a number of meteors were doubly observed during the Leonid epoch, and their real paths have been calculated. In the following table are given the heights, &c., of 8 Leonids, of 1 Leo Minorid, of 1 δ Leonid, and of a remarkably slow-moving meteor from Cetus :—

Date. 1901.	G.M.T.	Mag.	Height at beginning.	Height at ending.	Path.	Velocity per second.	Radiant point. α	Radiant point. δ
	h. m.		Miles	Miles.	Miles.	Miles.	°	°
Nov. 14	13 32	1->1	85	52	66	Rapid	156	+32
	13 37½	2 - 1	77	57	38	Rapid	152	+30
	13 42	2½ - ♀	81	67	67	55	174	+20
	14 24	4 - 2	82	57	44	Rapid	152	+25
	14 38	2 - 2	67	54	22	37	152	+23
	15 7	3 - 1	95	55	60	Rapid	152	+23
	15 23	>1 - 2½	72	47	36	72	151	+25
	16 0	1->1	91	61	41	54	149	+20
	16 7	1	86	60	35	Rapid	151	+23
Nov. 15	13 8	1½-1	43	37	28½	7¾	38	−21
	13 48	2-2½	76	59	37	37	151	+21

The mean height of 8 true Leonids was 81 to 56 miles and the mean radiant-position 151°·2+23°·7.

The place of the radiant found by Mr. Winslow Upton at the Ladd Observatory, Providence, was on November 15 a.m. 150¾°+21½°, and on November 16 a.m. 151°+21¼°.

The next return of the Leonids will be regarded in an interesting light, for 1902 will afford the 1000th anniversary of the first record of the shower (902). The moon will be full at the middle of November, but as the meteors of this swarm are often brilliant, some of them are likely to be distinguished in spite of the illuminated sky. There were showers of Leonids in 902, 1002, 1202 and 1602, and the revival of the display in 1901 encourages the hope that something may be seen of it in 1902, though the parent comet will be about three and a half years past its perihelion. W. F. DENNING.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The 231st meeting of the Junior Scientific Club was held on January 31. Two papers were read, one by Prof. H. A. Miers, F.R.S., Magdalen, on gold-mining in Klondike, and the other, by Mr. H. L. Tidy, New College, on some curious sounds. The officers of the Club for this term are :—President, Mr. H. H. Cooke, New College ; biological secretary, Mr. E. Burstal, Trinity ; chemical secretary, Mr. S. P. Grundy, Balliol ; treasurer, Mr. E. L. Kennaway, New College ; editor, Mr. H. D. Davis, Balliol.

IN reply to a question in the House of Commons on Monday as to the approximate date of the introduction of the Education Bill promised in the King's Speech, Mr. Balfour said he was unable to give a date, but he hoped the Bill would be introduced before Whitsuntide.

CORRESPONDENCE classes in various branches of engineeri have been successfully carried on in the United States for sever years. Prof. Andrew Jamieson, late professor of electric engineering at the Glasgow Technical College, has no established similar classes in Glasgow for students of electrical and machanical engineering. We are glad to notice that all students are advised to take a course of practical mathematics before devoting themselves to other subjects.

THE annual general meeting of the Association o Technical Institutions was held on Friday last in London. Lord Avebury, the president for the ensuing year, delivered an address in which he showed that the system of technical and higher education in Germany had been to the industrial advantage of the nation. If Britannia is to rule the waves she must be able to rule the steam engine and dynamo as well. Resolutions were adopted to the following effect :—(*a*) That this Association strongly approves the general principles on which the Government Education Bill of 1901 was based, and trusts that the Government will carry a Bill embodying these principles, with such amendments as may prove necessary, in the next session of Parliament. (*b*) That the Bill should prescribe that the residue under section 1 of the Local Taxation Account (Customs and Excise) Act, 1890, including any balance thereof which may remain unexpended at the end of the financial year, shall be applied for the purposes of education, and shall be administered by the education authority. (*c*) That an extension of the rating power by only 1d. in the pound, as was proposed in the Bill of 1901, would be wholly inadequate—especially in the case of the county boroughs—to defray the necessary additional charges in respect of secondary education which would fall upon the local authorities. (*d*) That it should be made a condition of the application of the residue under section 1 of the Local Taxation (Customs and Excise) Act, 1890, to the purposes of secondary education in general, that adequate provision shall first have been made for technical instruction, as was done in clauses one (1) and two (1) of the Duke of Devonshire's Education Bill of 1900. (*e*) That the Government should at once introduce and pass a Bill placing primary, secondary and technological education under the supervision of one local authority appointed as a rule for an area not less than that of a county or a county borough.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 23.—"On the Causation of the so-called 'Peripheral Reflex Secretion' of the Pancreas. (Preliminary Communication.)" By W. M. Bayliss, D.Sc. and Ernest H. Starling, M.D., F.R.S.

Introduction.—It has long been known that the introduction of acid into the duodenum causes a flow of pancreatic juice, and it has been shown recently by Popielski, and by Wertheimer and Le Page, that this flow still occurs after nervous isolation of duodenum and pancreas. Wertheimer also mentions that the flow can be excited by injection of acid into the jejunum, but not by introduction of acid into the lower part of the ileum. These authors conclude that the secretion is a local reflex, the centres being situated in the scattered ganglia of the pancreas, or, in the case of the jejunum, in the ganglia of the solar plexus (Wertheimer).

Results.—The secretion excited by introduction of acid into the jejunum cannot be reflex, since it occurs after extirpation of the solar plexus and destruction of all the nervous filaments passing to the isolated loop of jejunum. It also occurs after intravenous injection of 0·01 gramme atropin sulphate. It must therefore be due to direct excitation of the gland cells be a substance or substances conveyed to the gland from the bowel by the blood stream.

The exciting substance is not acid. Wertheimer has shown that injection of 0·4 per cent. HCl into the blood stream has no excitatory influence on the pancreas.

The secretion must therefore be due to some substance produced in the intestinal mucous membrane under the influence of the acid, and carried thence by the blood stream to the gland. This conclusion was at once confirmed by experiment.

When the mucous membrane of the jejunum or duodenum is exposed to the action of 0·4 per cent. HCl a body is produced which, when injected in minimal doses into the blood stream,

produces a copious secretion of pancreatic juice. This body, which for the present is termed *secretin*, is associated with another body with a pronounced lowering effect on the blood pressure. The two bodies are not identical, since acid extracts of the lower end of the ileum produce the pressure-lowering effect, but have no excitatory influence on the pancreas.

Observations indicate that *secretin* is probably a body of very definite composition, and of small molecular weight. Dr. Osborne is at present engaged in an investigation of its chemical characters and identity.

"On the Excretory Organs of Amphioxus." By Edwin S. Goodrich, M.A., Fellow of Merton College, Oxford. Communicated by E. Ray Lankester, F.R.S.

Linnean Society, January 16.—Prof. S. H. Vines, F.R.S., president, in the chair.—Mr. Alfred O. Walker exhibited some branches of cherry affected with a fungus disease caused by *Gnomonia erythrostoma*.—Mr. J. E. Harting exhibited some heads of wild sheep, together with photographs and lantern-slides, to illustrate a recent suggestion as to the use and value of spiral horns in feral species. Dr. George Wherry, of Cambridge, who originated the discussion and was present as a visitor, selected *Ovis nivicola* of Kamtschatka as a typical species to support his theory, and pointed out that while the horns were enormous, the ear was remarkably short, situated exactly in the axis of the spiral, and, as it were, at the apex of a hollow cone formed by the great spiral horn. This he regarded as a provision of Nature to enable the animal to hear better and to determine the direction of sounds when there is a mist or fog, the horn acting like an Admiralty megaphone when used as an ear-trumpet. Mr. Harting pointed out that the remarkably large spiral horns were peculiar to the male sex, and that if they were to be regarded as of use for the preservation of the species, the ewes, which required the most protection, would be in that respect defenceless. This would be especially the case with *Ovis nivicola*, the sexes of which, according to Dr. Guillemard ("Voyage of the *Marchesa*," vol. i. p. 214), lived apart in small herds for some portion of the year. It was a significant fact, also, that wild sheep, like other wild animals, posted sentries whilst feeding to prevent being surprised by their enemies, and it was the experience of those who hunted them that when approached the alarm was generally given by a ewe. He thought that wild sheep and goats, like deer, relied more upon their sense of sight and smell than upon their hearing, and that the large horns, like those of other ruminants, were simply weapons of defence against wild carnivora, and of offence against rivals during the breeding-season, as in the case of deer. Dr. Wherry, in reply, thought it would be found, in the case of ewes in which the horns were either absent or rudimentary, that the ears, by way of compensation, were much larger than those of the rams; but he had been unable to find anywhere a head of a female *Ovis nivicola* for examination.—Messrs. H. and J. Groves read a paper on the use of Linnean specific names. They showed that great diversity of practice existed in dealing with these names, and pointed out the necessity of arriving at some agreement as to their use as a first step towards uniformity in nomenclature. They grouped the Linnean specific names under the following heads:—(1) Those applied to distinct species fairly well understood in Linnæus's time, and still generally accepted. (2) Those which are now considered to include two or more species, combined by Linnæus owing to either (*a*) the imperfect knowledge of the plants at the time, or (*b*) the different ideas then and now as to the extent of species. (3) Those about which there is more or less doubt as to their proper application, owing to (*a*) the descriptions being imperfect, (*b*) the synonymy (often the most important part of the description) being contradictory, or (*c*) confusion due to changes made by Linnæus himself after publication. After discussing the various methods adopted and the difficulties connected with each, Messrs. Groves recommended that in doubtful cases, so far as possible, the description in conjunction with the reference to earlier authors should be relied on, always construing the species liberally, and that when the specimens in the Linnean herbarium or amendments in the second edition of "Species Plantarum" are at variance with this conception of the species, they should be disregarded. As regards group 2, they recommended that the name should be retained for the type if specified, or if not to the species which may be most fairly regarded as the type, and in the absence of such to the residuary species after others had been cut off; and as regards group 3, that unless the evidence is hopelessly vague, or contradictory, the names should be retained for the species for which the weight of evidence points to their having been intended. Specimens were exhibited of the plants which, following the practice advocated, would stand as *Hypericum quadrangulum*, L., *Epilobium alpinum* and *E. tetragonum*, L., and *Sparganium erectum*, L., also of the allied species in each case bearing on the question.

CAMBRIDGE.

Philosophical Society, January 20.—Prof. Macalister, president, in the chair.—On the question of "predisposition" and "immunity" in plants, by Prof. H. Marshall Ward, F.R.S. The author directed attention to previous work by himself and others which indicates that plants are not merely passive to the attacks of parasites, and especially referred to experiments with the rust fungi (Uredineæ) which clearly show that not only do these parasites vary and differ in their powers of adaptation to different hosts of the same species or genus, but the hosts exert definite reactions on the fungi. In particular, the results of a large series of infection experiments made by the author with the uredo of *Puccinia dispersa*, the brown rust of the bromes, were summarised. During the past summer more than 1800 such experimental infections were made on twenty-two varieties and species of Bromus, belonging to four out of the five subgenera. The infecting spores were derived from three different species of Bromus. The results show distinctly that not only does the power of the fungus to attack a given species of the flowering plant depend on the specific nature of the latter, but it also depends on the specific nature of the previous host on which the spores were produced. The conclusion is arrived at that specific predisposition and immunity in plants depend on similar internal mechanisms and conditions to those which determine the possibility or otherwise of cross-fertilisation, and just as this possibility varies and may be increased or diminished by inheritance in breeding, so may the capacity of resistance to infection vary and be increased or diminished in different races. It is probable that secretions of enzymes, chemotactic substances, toxins and antitoxins in the cell play a part in all such processes.—On the genito-urinary organs of dipnoan fishes, by Mr. Graham Kerr.—Further observations on the biological test for blood, by Mr. George H. F. Nuttall. The paper refers to studies of what the author terms "blood-relationship" amongst animals by means of test-tube reactions with various anti-sera. The results of the investigation of some 440 species of blood go to show that the biological test for blood may possess considerable value in relation to zoological study.

MANCHESTER.

Literary and Philosophical Society, January 21.—Mr. Charles Bailey, president, in the chair.—Mr. W. E. Hoyle made some remarks on a case of failure of concrete flooring strengthened by steel bands.—A paper, entitled "On *Xenophyton radiculosum* (Hick), and on a stigmarian rootlet probably related to *Lepidophloios fuliginosus* (Williamson)," was read by Prof. F. E. Weiss. He gave his reasons for regarding the fossil Xenophyton, described by the late Thomas Hick in 1891, as a stigmarian "root" or rhizome, which, on account of the peculiar structure of its vascular cylinder and of its massive and well-preserved middle cortex, he considered to be closely allied to the lepidodendroid stem known as *Lepidophloios fuliginosus*. He also described a stigmarian rootlet, which he considered to be related to Lepidophloios. This rootlet was further remarkable on account of the presence, in its well-preserved cortex, of a vascular branch similar to that described for stigmarian rootlets of a different type by Renault. Prof. Weiss stated that he had been able to confirm the occurrence of such branches from the central cylinder in several other stigmarian rootlets, in the collection of the Manchester Museum.

EDINBURGH.

Royal Society, December 16, 1901.—Prof. Geikie in the chair.—Dr. T. J. Jehu read a paper on a bathymetrical and geological study of the lakes of Snowdonia and eastern Carnarvonshire. It was clearly demonstrated that ice action had been an important factor in the formation of many of the valleys and lakes of the district, although at the same time it was also evident that other geological agents had been at work. The comparatively great depth of certain of the lakes, of which

sixteen had been studied in detail, left no doubt as to their glacial origin.

January 6.—Sir W. Turner in the chair.—A paper by Mr. F. Fraser, on a theoretical representation leading to general suggestions on the ultimate constitution of matter and ether, was communicated by Prof. Chrystal. The fundamental novelty was the conception of an atom of matter as a kind of ether bubble. The ether was supposed to be an assemblage of rapidly moving corpuscles rebounding after collision without loss of energy, and in this a spherical vacuity was produced forming the atom, the corpuscles in the spherical surface being kept circulating in the surface by the impacts of the corpuscles from outside, which on their part were unable to penetrate within the sphere because of the barrier of swiftly moving corpuscles in the surface. The author believed that this hypothesis gave the gravitation law of attraction between two neighbouring bubbles. The paper also contained speculations relating to valency in chemistry.—A paper was read by Dr. D. H. Scott on the primary structure of certain Palæozoic stems with the dadoxylon type of wood. The principal result of the investigation, as a whole, was to show that in a number of stems of Palæozoic age with secondary wood of the well-known dadoxylon type there were around the pith distinct usually mesarch strands of primary xylem, forming the downward continuation of the leaf-trace bundles. Hence, the anatomical structure typically represented by *Lyginodendron Oldhamii* proves to have been widely distributed among Palæozoic plants, and to have been common to stems which on other grounds would be reasonably referred to Cordaiteæ. Thus new links have been found connecting this gymnospermous family with the Cycadofilices, and through them with some primæval group of ferns.—Dr. Thomas Muir communicated a paper on a continuant resolvable into rational factors, and a note on selected combinations.—Dr. Hugh Marshall read a note on a suggested modification of the sign of equality in chemical notation, in which he proposed that in chemical equations representing actions which actually occur the sign of equality should be composed of singly barbed arrows arranged so as to differentiate the most important varieties of chemical action. The symbols suggested were : $\rightleftharpoons$, $\rightleftharpoons$, $\rightleftharpoons$, $\rightleftharpoons$, the first for irreversible actions, the second for reversible actions, such as dissociation, &c., the third for reversible actions with definite transition point (in which case the temperature might be stated above the symbol), and the fourth for reversible actions which, under the conditions of the experiment, are practically completed in the direction indicated, so that the reversible character of the action is not of immediate importance. It might also be used in doubtful cases.

PARIS.

Academy of Sciences, January 27.—M. Bouquet de la Grye in the chair.—An apparatus for measuring the variations of small zenithal distances, by M. G. Lippmann. The apparatus described makes the zenith visible in the field of observation as a small artificial star, which shows amongst the real stars. It possesses the advantages of requiring no special regulation or stability, and visual observations may be replaced by photography.—On some properties of the radiation from radioactive bodies, by M. Henri Becquerel. It has been shown in earlier papers that radium rays are divided into two groups in a strong magnetic field, one part being not affected and giving a strong impression on a photographic plate, the other being deviated in a manner similar to the kathode rays. No portion of the polonium rays is deviable. An analogous experiment has now been made with uranium. The times of exposure were necessarily very long, twenty and forty-two days in two experiments. The whole of the uranium rays appear to be deviated, the non-deviable portion, if it exists, being of an intensi y which is negligibly small compared to the whole radiation. This would appear to show a fundamental difference between uranium and radium. It has been previously found that the dark radiation from radium is capable of transforming white into red phosphorus, and analogous experiments with uranium showed that the uranium rays possess the same property.—On the preparation of tantalum in the electric furnace and on its properties, by M. Henri Moissan. An alloy of niobium and tantalum was first prepared by reducing niobite with sugar charcoal in the electric furnace ; this was then converted into fluotantalate and fluoniobate of potassium, and these salts separated by Marignac's method. The tantalic acid prepared in this way was then reduced with charcoal in the electric furnace in a graphite crucible. Metallic tantalum was thus obtained containing only a small quantity of carbon as impurity, as a brilliant metallic mass, with a crystalline fracture, of density 12·79. Its behaviour towards various chemical reagents is given in detail.—On a class of rational transformations, by M. Ivar Fredholm.—On the resolution of singular points of algebraic surfaces, by M. Beppo Levi.—The experimental definition of the different kinds of X-rays by radiochromometry, by M. L. Benoist. The unequal variations of transparency of two different bodies is utilised, when the quality of the X-rays changes, to define a series of qualities of rays by a series of relative transparencies, for example, of aluminium with respect to silver. The scale of rays thus constituted is always comparable to itself, when the two bodies and their thicknesses are defined.—On an apparatus for automatically registering discharges in the atmosphere, by M. J. Fényi. A coherer and a bobbin are inserted in the circuit of a Meidinger cell. A magnetised needle is placed in the centre of the bobbin, and this is deviated and closes the registering circuit when the coherer becomes conducting owing to a discharge.—On the vapour pressures of hydrogen selenide and the dissociation of its hydrate, by MM. de Forcrand and Fonzes-Diacon. The vapour pressures were measured at four points, $-42°$, -30, $0°{\cdot}2$ and $30°{\cdot}8$, and from these a curve was constructed. From this the heat of vaporisation was calculated by means of the Clapyron formula. A similar set of determinations was made for the hydrate.—On lithium antimonide and on the preparation of some alloys of lithium, by M. P. Lebeau. Lithium and antimony readily combine, giving rise to a large development of heat, but the violence of the reaction is so great that a definite compound could not be obtained in this way. But the electrolysis of a mixture of the chlorides of lithium and potassium with a kathode of antimony readily gives a definite crystallised antimonide of the formula $SbLi_3$. The same method can be applied to the preparation of a certain number of other alloys of lithium.—The action of copper hydrate on aqueous solutions of metallic salts, by M. A. Mailhe.—Contribution to the study of the aluminium-iron and aluminium-manganese alloys, by M. Léon Guillet.—On glyceroarsenic acid, by M. V. Auger. Arsenic acid and glycerol readily react, producing acid esters with the elimination of one or two molecules of water, but the product obtained is immediately hydrolysed on contact with cold water.—On the assimilation of lactic acid and of glycerol by *Eurotyopsis Gayoni*, by M. P. Mazé.—On the modifications of the segmentary organs of Syllis, and their functions, at the stage of reproduction, by M. G. Pruvot.—On the mechanism of the formation of the purple of molluscs, by M. Raphael Dubois. The production of the colour would appear to be due to two substances, one of which is a macrozymase, to which the name of purpurase is given. The action of light is necessary to the production of the purple.—On the physiological effects of the poison of the filaments and tentacles of the Cœlenterata, by MM. P. Portier and Charles Richet.—The apolar and closed divergent chains in ferns, by MM. C. Eg. Bertrand and F. Cornaille.—On the withering of vines caused by *Coepophagus echinopus*, by MM. L. Mangin and P. Viala.—The study of the daily variations of the meteorological elements in the atmosphere, by M. L. Teisserenc de Bort.—On the origin and age of the spring of Vaucluse, by M. E. A. Martel.

NEW SOUTH WALES.

Royal Society, December 4, 1901.—Prof. T. W. E. David, F.R.S., vice-president, in the chair.—The gums, resins and other vegetable exudations of Australia, by Mr. J. H. Maiden. The author gives a list of natural orders which in Australia yield both gums and resins, classifying them according as the gum or resin is the predominating substance. The paper contains a tentative list of those orders which yield kinos, and a list is given of those exudations which specially merit the attention of the research chemist. Then follows the main portion of the paper, which contains notes on all the exudations known to the author, arranged in botanical sequence.—On the principle of continuity in the generation of geometrical figures in homaloidal space of n-dimensions, by Mr. G. H. Knibbs. The author discussed the philosophical basis of the idea of the continuous generation of geometrical figures, and showed that we are compelled to admit the conceptional existence of a space of different orders, as well as dimensions, of infinity and zero, the interpretation of such being in all cases unambiguous.—Some theorems, concerning geometrical figures in space n dimensions, whose $(n-1)$ dimensional generatrices are n^{ic} functions of their position

on an axis, straight, curved, or tortuous, by Mr. G. H. Knibbs. In this paper the author showed that certain theorems developed in two previous papers might be extended greatly in generality, and were applicable to *quanta* determinations in *n*-dimensional space.—Rock-holes used by the aborigines for warming water, by Mr. R. H. Mathews. The author showed that the natives were in the habit of immersing heated stones in small quantities of water for the purpose of warming it for drinking, and in some cases to assist in cooking their food.—Some aboriginal tribes of Western Australia, by Mr. R. H. Mathews. Mr. Mathews also contributed an article on some aboriginal tribes of Western Australia, describing their divisions into intermarrying sections; lists of totems, comprising animals, plants and other natural objects, attached to each of the sections, were also given. The laws regulating marriage and descent were explained, together with a brief outline of the structure of the language. Mention was made of their legends, knowledge of the cardinal points, and customs of genital mutilation, the whole concluding with a comprehensive vocabulary.—Projects for water conservation, irrigation and drainage in New South Wales, by Mr. H. G. McKinney.

ST. LOUIS.

Academy of Science, January 6.—Mr. Henry W. Eliot, president, in the chair.—On behalf of herself and a considerable number of other persons, Mrs. William Bouton presented to the Academy a collection of 633 butterflies mounted on Denton tablets, on condition that the collection should be made accessible to the public. The following papers were presented by title:—New species of plants from Missouri, by Messrs. K. K. Mackenzie and B. F. Bush.—Revision of the North American species of Triodia, by Mr. B. F. Bush.—Prof. A. S. Chessin exhibited a gyroscope and explained how an accurately constructed and rapidly rotated gyroscope might be made to indicate the position of the meridian plane, the direction of the polar axis of the earth and the latitude of the place of observation, thus serving the purpose of the mariner's compass, but more accurately, because of the fact that the compass indicates the magnetic pole and not the true pole. The following formulæ pertaining to the subject were furnished:—

$$T=\pi\sqrt{\frac{A+C_1+A_2}{C\omega\Omega\cos\lambda}}\qquad T^1=\pi\sqrt{\frac{A+C_1+A_2}{C\omega\Omega}},$$

where T and T^1 are the durations of a complete oscillation of the gyroscope when its axis is made to remain in the horizontal and the meridian planes respectively; ω and Ω the angular velocities of rotation of the earth and the gyroscope respectively; A, A_1, A_2 and C, C_1, C_2 the equatorial and the axial moments of inertia of the gyroscope and the two rings on which it is mounted. From these formulæ the latitude (λ) of the place of observation is derived, namely:—

$$\cos\lambda=\frac{T^{12}}{T^2}.$$

—Prof. F. E. Nipher made a further statement concerning his results in the attempt to produce ether waves by the explosion of dynamite. He had obtained some results which seemed to show that magnetic effects could be thus produced.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 6.

ROYAL SOCIETY, at 4.30.—The Stratifications of Hydrogen: Sir William Crookes, F.R.S.—The Density and Coefficient of Cubical Expansion of Ice: Dr. J. H. Vincent.—On the Increase of Electrical Resistivity caused by alloying Iron with various Elements, and the Specific Heat of those Elements: Prof. W. F. Barrett, F.R.S.—Continuous Electrical Calorimetry: Prof. H. L. Callendar, F.R.S.

SOCIETY OF ARTS, at 4.30.—The Coal Resources of India: Prof. W. R. Dunstan, F.R.S.

LINNEAN SOCIETY, at 8.—On a Method of Investigating the Gravitational Sensitiveness of the Root-tip: F. Darwin, F.R.S.—An Extinct Family of Ferns: Dr. D. H. Scott, F.R.S.

CHEMICAL SOCIETY, at 8.—An Investigation into the Composition of Brittle Platinum: W. N. Hartley.—Conversion of *l*-Hydroxycamphene into β-Halogen Derivatives of Camphor: M. O. Forster.—Tetrazoline, Part II.: S. Ruhemann and H. E. Stapleton.—(1) The Solubilities of the Calcium Salts of the Acids of the Acetic Acid Series; (2) The Equilibrium between a Solid and its Saturated Solution at various Temperatures: J. S. Lumsden.—The Influence of Temperature on Association in Benzene Solution, and the Value of the Molecular Rise of Boiling Point for Benzene at Different Temperatures: W. R. Innes.—The Magnetic Rotation of Ring Compounds; Camphor, Limonene, Carvene, Pinene, and some of their Derivatives: W. H. Perkin, sen., F.R.S.—Polymerisation Products from Diazoacetic Ester: O. Silberrad.

RÖNTGEN SOCIETY, at 8.30.—A System of Radiography: E. W. H. Shenton.

FRIDAY, FEBRUARY 7.

ROYAL INSTITUTION, at 9.—The New Mammal from Central Africa and other Giraffe-like Animals: Prof. E. Ray Lankester, F.R.S.

GEOLOGISTS' ASSOCIATION, at 7.30.—Annual General Meeting.—Address on a Dozen Years of London Geology (Eocene, Chalk, and Underground): W. Whitaker, F.R.S., President.

MONDAY, FEBRUARY 10.

SOCIETY OF ARTS, at 8.—Personal Jewellery from Prehistoric Times: Cyril Davenport.

IMPERIAL INSTITUTE, at 8.30.—The Coloured Races in Australia: Hon. Sir Horace Tozer, K.C.M.G.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Ancient Kingdom of Kongo; Rev. Thomas Lewis.

TUESDAY, FEBRUARY 11.

ROYAL INSTITUTION, at 3.—The Cell: its Means of Offence and Defence: Dr. A. Macfadyen.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Port of Dundee: G. C. Buchanan.

WEDNESDAY, FEBRUARY 12.

SANITARY INSTITUTE, at 8.—Discussion on the Prevention of Small-Pox in the Metropolis: Opened by A. Wynter Blyth.

THURSDAY, FEBRUARY 13.

ROYAL SOCIETY, at 4.30.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Researches on the Electrical Conductivity and Magnetic Properties of upwards of 100 different Alloys of Iron: Prof. W. F. Barrett, F.R.S., and W. Brown.—On some Conclusions deduced from the preceding Paper: Prof. W. F. Barrett, F.R.S.

MATHEMATICAL SOCIETY, at 5.30.—On the Density of Linear Sets of Points: W. H. Young.—On Plane Cubics: Prof. A. C. Dixon.

FRIDAY, FEBRUARY 14.

ROYAL INSTITUTION, at 9.—Magic Squares and other Problems on a Chess Board: Major P. A. MacMahon, F.R.S.

PHYSICAL SOCIETY, at 5.—Annual General Meeting.—Address by the President, Prof. S. P. Thompson, F.R.S.—Mr. T. H. Littlewood will exhibit an Atwood's Machine.

ROYAL ASTRONOMICAL SOCIETY, at 3.—Annual General Meeting.

MALACOLOGICAL SOCIETY, at 8.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Some Public Health Aspects of the Question of Sewage Disposal: C. Johnston.

SATURDAY, FEBRUARY 15.

ROYAL INSTITUTION, at 3.—Some Electrical Developments: Lord Rayleigh, F.R.S.

CONTENTS.