THURSDAY, MARCH 23, 1905.

THE KALAHARI DESERT.

Die Kalahari. Versuch einer physisch-geographischen Darstellung der Sandfelder des südafrikanischen Beckens. By Dr. Siegfried Passarge. Pp. xvi+822; illustrated; and with a "Kartenband" containing 11 maps and 10 sheets of sections, sketches, &c. (Berlin: Dietrich Reimer [Ernst Vohsen], 1904.) Herausgegeben mit Unterstützung der königlich-preussischen Akademie der Wissenschaften. Price 80 marks (unbound).

NOW if we could imagine that Mr. Shandy the elder were alive, this is a book that, like many another of its class, would have delighted him. Hereby he could have proved triumphantly to Yorick the potency of that great scheme of education—that "north-west passage to the intellectual world"—which he propounded so enthusiastically upon a memorable occasion. His scheme, it will be remembered, was that upon every substantive in the dictionary the Auxiliaries (so gravely misunderstood by the Corporal and Uncle Toby) should be brought to bear exhaustively:—"Every word, Yorick, by this means, you see, is converted into a thesis or an hypothesis:—every thesis and hypothesis have an offspring of propositions;—and each proposition has its own consequences and conclusions; every one of which leads the mind on again, into fresh tracts of enquiries and doubtings.—'The force of this engine,' added my father, 'is incredible. . . .'"

Even up to the numberless "tracts of enquiries and doubtings," it is in this spirit that Dr. Passarge has attacked "Die Kalahari"; and the book before us, with its mass of spacious solidly printed pages, is the result. It is a work which compels our admiration, not only for the thorough and painstaking manner in which its author has carried out his personal investigations, often in circumstances of great difficulty; but also for the acumen with which he has grasped the bearing of his observations upon problems of world-wide range; and for the astounding industry with which he has pushed his researches into all the ramifications of his subject. In giving us, for the first time, an adequate knowledge of a large part of that hitherto little known region of South Africa, the Kalahari Desert, he has also contributed most significantly to our earth-knowledge in general. Hence his book, besides forming the basis for all future work in the Kalahari, must have a weighty influence in many questions pertaining to the geological history of the continent of Africa and to the changes of climate that are recorded in the rocks of many other parts of the globe.

We feel that it is a forlorn hope to attempt within the limits of our space to present in true proportion even an outline of the contents of this great mass of information with its leaven of speculative deduction. But let us to the attack!

Dr. Passarge was attached, as mining expert, to an expedition of the British West Charterland, Ltd., organised to explore the Kalahari, under the leadership of Sir Frederick Lugard, during the years 1896–9. Of the main expedition and its personnel we hear very little throughout the book. It had left Palapye some time before Dr. Passarge reached that place, at the beginning of October, 1896. He followed with a small party, and a few days after starting he was stricken with fever. A woful month ensued, during which, with a dying prospector as his companion in misfortune, he lay in or under the wagon as it trekked slowly north-westward across the eastern part of the desert.

Not until the middle of November did he regain his feet; but his recovery thereafter was rapid, and his field-work in various parts of the Middle Kalahari was carried on subsequently without serious interruption until its termination in October, 1898. During the two years thus spent, his traverses extended east and west over a breadth of about 700 km., and north and south for about 500 km., the site of the desiccated Lake Ngami lying roughly central to these journeys. His official investigations were directed chiefly to the islands of ancient rocks with which the region is sparingly studded, mainly in the form of subdued hill-chains but occasionally in comparatively low-lying tracts that have remained uncovered by the superficial formations of the desert. To reach these islands it was necessary to cross the level sandy veldt for longer or shorter distances—traverses that were often very difficult and full of hardship—and Dr. Passarge had thus the opportunity to carry out that careful study of desert conditions in the Kalahari which forms what we must regard as the main subject of his book. The ancient rocks were found to consist of two great series of unfossiliferous greywackes, schists, and limestones, often much altered by dynamic and thermal agencies, and probably in the main pre-Cambrian, though possibly ranging down into Cambrian times. Among these ancient sediments there are many intrusions of acid and basic igneous rocks. The thin superficial deposits, though incomparably more recent, are believed by Dr. Passarge to include beds that may date back to Eocene times. By their composition and structural alteration through weathering, these desert-formations are held to indicate the successive conditions that have ruled in the region since Mesozoic times; and it is in his discussion of these deposits that the author gives the fullest play to his powers.

To take the contents of the book in their given order:—After a modest preface, the author deals, in chapter i., with the explorations of his predecessors in the Kalahari. The list of references added at the end of the chapter constitute his bibliography of the subject—a convenient arrangement that is followed throughout the book. In the second chapter Dr. Passarge gives a consecutive account and itinerary of his travels and experiences. This account is to a large extent repeated and amplified in the topographical descriptions of later chapters. The third chapter is occupied with a short description and categorical formulation of the topographical and hydrographical conditions of South Africa generally, through

all its divisions and subdivisions. In chapter iv. the author deals in the same manner with South African geology, with the literature of which he appears to be well acquainted. Respecting this literature, he remarks (p. 39):—

"So ist denn die Geschichte der geologischen Forschung in Südafrika eine wahre Komödie der Irrungen. So viel Forscher, so viel Ansichten! Ja, ein und derselbe Forscher . . . haben ihre Auffassung wiederholt gewechselt. . . ."

He debates anew the many doubtful points in the correlation of the rocks, and expresses his views thereon. This chapter with its bibliographical appendix might be used as a general introduction to the study of South African geology. It is illustrated by a geological map of Africa south of 10° S. lat. (Blatt ii. in the "Kartenband"), which, though rough in execution and crude in colouring, serves to give at a glance the main lines on which the rocks of this part of the continent are arranged. The climate of South Africa and of the Kalahari afford material for chapter v., which includes a summary of the author's personal observations on the weather, and concludes with some very acceptable notes on the rapidly progressive desiccation of the country, based on a comparison of the experiences of the earlier and later explorers.

Then follows a solid block of chapters—vi. to xxiv., pp. 105–530—devoted, except for an interlude in chapters xvi. and xvii., to the detailed account of the author's investigations in the several districts visited—the Kwebe and neighbouring hill ranges; the region bordering on Ngami and the Botletle River; the Haina Veldt; the Chanse Veldt and the adjacent German frontier; the western part of the Okavango basin with its rapidly perishing river-system, of which the description is of extreme interest; the Kaukau Veldt; the Kung Veldt; and the Mahura Veldt. With many an "Überblick" and "Rückblick," "Übersicht" and "Folgerung," the author pursues his way through masses of detailed observations, all carefully classified, subdivided, and marked with sign-posts in the form of head-lines; and many a pertinent interrogative sentence, spaced out in the text, is conscientiously answered or as conscientiously evaded by further questions. It is in these chapters that the operation of the Auxiliaries is most forcefully felt. To the general reader the greater part of these details must be arid, as befits the description of a desert, yet not without refreshing oases here and there. Nor can it be denied that in a region undergoing such rapid changes in respect to rainfall and drainage-systems, the full particulars as to the exact condition of all the water-pans at the time that they were examined are certain to prove of value in the future for purposes of comparison; while to the geological traveller who may hereafter visit the Middle Kalahari the whole of these chapters are likely to prove of service. Indeed, when we remember how much more might have been written from the impressions of a trained observer at work in a new country during two whole years, we feel, on the whole, inclined to be grateful to Dr. Passarge for his moderation.

The two chapters already mentioned as forming an interlude to the topographical details are comparatively amusing. The first (xvi.) describes the geological effect of the burrowing animals of the desert, both mammals and insects, upon the superficial formations, with numerical calculations as to its efficacy in producing large results. The second gives a summarised description of the structure of the deposits found on the sites of the desiccated lakelets or "Kalkpfannen" of a certain district, with a particular inquiry into the origin of the water-holes ("Pfannenkrater") that in many cases still persist within them. After stating the problem in his favourite manner, under various headings in interrogative form, the author proceeds to show that all the peculiar features of the water-holes may be assigned to the agency of the wild animals that have used them as drinking places and bath-tubs. He enumerates these animals; shows from the records of the first white travellers how multitudinous they once were; gathers data from the Berlin Zoological Gardens as to the drinking capacity of most of the larger herbivores; supplements this with observations on the drinking of his draught animals when trekking in the desert; calculates the amount of dissolved and suspended matter in the water of the "pans," and how much would be carried away in the interiors of the beasts that drank it; and also how much they removed on their exteriors after their occasional mud-baths. Then, the cubic space of the water-hole being known, and the number of its former visitants estimated, a simple calculation brings out the number of years in which, by this agency, the hole could have been produced.

Is there not the germ of a glorious question for some future examination paper in the following sentences?—

"Nehmen wir die Oberfläche eines Nashorns auf 6 qm an und die Kruste nach jedem Schlammbad auf 1 mm, so trägt jedes Tier 6 l Schlamm fort. Wenn also 10 dieser Tiere während der Trockenzeit (180 Tage) täglich baden, tragen sie im Jahr 10.8 cbm Schlamm fort, im Laufe von weniger als 2000 Jahren also den Inhalt einer Pfanne von 20,000 cbm. Das würden 10 Nashörner allein fertig bringen!" (p. 321).

Let us acknowledge, however, that from this singular line of research a very important deduction is drawn, and is in keeping with all the other evidence:—

"Denn diese Zahl besagt, dass vor dieser Zeit—sagen wir rund 6000–7000 Jahren—das Chansefeld ein wesentlich anderes Klima gehabt haben muss" (p. 322).

After giving, in chapter xxx., a summary of our scanty knowledge of the vast area of the Kalahari beyond the regions which he visited, the author proceeds to epitomise his own observations and to deal with the broader aspects of his subject. The orographic and hydrographic conditions of the Kalahari as a whole are briefly stated in chapter xxxi., with a summary of the evidence for the rapidly progressive desiccation of the land in a definite direction. Then follow chapters on the basement-rocks (das Grundgestein) of the region; on the development and

antiquity of the South African land-mass; and on the superficial formations (die Deckschichten). In chapter xxxv., entitled "Die Mesozoische Wüsten-periode," the author discusses the different stages of alteration shown both by the older rocks and by the superficial formations, through "einkieselung" or cementation by infiltrated silica, and "verkieselung" or replacement of carbonates by silica; and he gives his reasons for recognising successive periods of alteration and deposition consequent upon changes in the physical conditions of the land. He goes far afield in his argument, touching upon the various effects of rock-weathering under almost every climate of the globe, but with especial reference to desert-conditions. He brings this information to bear upon the South African geology generally, where he recognises evidence for desert-conditions of great antiquity and long duration, but with occasional intermission. Whether these speculations are well founded it will remain for the keen investigators now working in South Africa to decide.

In the same strain of more or less hypothetical deduction following upon an epitomised re-statement of the main facts, are the next two chapters—xxvi. "Die Periode der Brackwasserkalke und der Laterite," and xxvii. "Die Pluvialzeit und ihr Abklingen bis zur Gegenwart"—in which the probable condition of the interior of South Africa is traced through Tertiary and post-Tertiary times. It seems somewhat hazardous to correlate the isolated and widely scattered patches of thin sandstone and limestone by their lithological characters alone, and to assign them to successive periods. One line of argument by which the author reaches his conclusions with respect to the age of the desert-beds of the Kalahari is by comparing them with the more readily determinable Tertiary succession of Egypt. On questionable grounds he suggests that his "Pfannensandstein" may be assigned to the Eocene, his "Kalaharikalk" to a somewhat moist episode in Miocene and Lower Pliocene times; after which he recognises a period of dry conditions in the Middle Pliocene, and then a Pluvial period of late Pliocene and early post-Pliocene times. This Pluvial period may be accepted with some confidence as being in close relation to the occurrence of the Glacial period in northern Europe. Evidence from many other parts of the world tends to show that the progressive desiccation that has gone on since that period has not by any means been confined to the African continent.

Among the interesting side-issues raised or recapitulated in these later chapters of the book are questions as to the antiquity of the Kalahari fauna; the geological effect of wind-action; the obliteration of dry river-beds; "zoogene erosion"; the change of climate in North Africa during historic times; and others that we have no space even to catalogue.

The next—and last—chapter gives a review of the plant-life of the Kalahari, with especial reference to the evidence which it bears as to the changing conditions of the land. Then follow various appendices, occupying one hundred pages. These contain a few astronomical observations; a petrographical description of 447 rock-specimens and slides by Prof. Kalkowsky; twelve chemical analyses of rocks; an account of the land and freshwater shells from the newer superficial deposits by Prof. E. v. Martens; a full account of the diatoms by H. Reichelt; and a list of plants. The last twenty-seven pages of the book are occupied by the classified indices.

There is no attempt at artistic embellishment in the text-illustrations; and the same may be said of the numerous sheets of maps, plans, and sections contained in the "Kartenband," some of which, indeed, appear scarcely to justify their reproduction, while in many the scale seems to be unnecessarily large.

And now that we have growled our way through the book, and have earned the concluding pipe of peace, let us add that when a capable and earnest worker is willing, in publishing his results, to undergo the severe labour that a production of this kind must have entailed, our sense of gratitude toward him should be paramount, and should stifle all minor complaints and especially the impatient grumbling that arises in the main from our own unrealised indolence.

G. W. L.

ANIMAL PHOTOGRAPHY.

Photography for the Sportsman Naturalist. By L. W. Brownell. American Sportsman's Library. Pp. xviii+311; illustrated. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1904.) Price 8*s.* 6*d.* net.

ON several previous occasions we have had the pleasure of noticing some of the admirable volumes belonging to that series of the "Sportsman's Library" which deals exclusively with the various animals constituting the sportsman's quarry. In the volume now before us we have, on the other hand, one of a second series devoted to different aspects of sports and matters connected therewith. In regarding practical photography as an essential element in the education and outfit of every modern sportsman who desires to be something more than a mere slayer of game, the editor has undoubtedly been well advised; and he also has been exceptionally fortunate in securing the services of an expert with the experience and reputation of Mr. Brownell to make known to the beginner the mysteries of the camera and the technique of outdoor animal photography. If the reader is careful to bear in mind that when the author refers to "our animals" he means the members of the North American and not of the British fauna, the book will, we venture to think, prove as acceptable to sportsmen and field-naturalists on this side of the Atlantic as to the countrymen of the author; and if this turn out to be the case, a wide circulation would seem to be assured.

In his introduction Mr. Brownell gives a concise and yet comprehensive sketch of the history of photography, dwelling especially on the enormous strides it has made during the last half-dozen years. The loss of time that he himself experienced in having to learn everything for himself when first taking up animal photography is alluded to as a kind of justification (if one be needed) for the appearance of his

volume, while the value of accurate photographs of animals as a means of instruction in natural history is noticed in the concluding paragraphs of the introduction.

Possibly, and if so pardonably, the author is inclined to over-rate the importance of photographic illustrations in zoological work. In many respects, such as representing birds in their natural surroundings, its importance cannot, indeed, be over-estimated. But when the author goes on to deride the work of the pencil of the artist as a means of illustrating books on natural history, and to declare that the wood-cut and the "process-block" are things of the past in this connection, we take leave to differ from such a sweeping assertion. Nor are we alone in so doing, for Mr. W. T. Hornaday, in his recently issued "American Natural History," takes occasion to point out that photography has its limitations in the portrayal of animals, and that some illustrations demand the artist's pencil in order to become satisfactory zoological portraits. It is quite true, as Mr. Brownell urges, that the sketch, as compared with the photograph, may be crude and unfaithful to nature, yet it will nevertheless often accentuate or display essential features which are scarcely perceptible or absolutely hidden in the sun-portrait.

With this reservation, we are absolutely at one with the author in regard to the extreme importance and value of photography in natural history work, and, like him, we look forward to the time when real colour-photography will have been discovered and made available for everyday use. After describing in full detail the general technique of the photographic art and the kinds of camera and other apparatus best suited to the outdoor photographer of animal life, the author proceeds to discuss the mode of procedure in the case of different subjects, devoting one chapter to the larger mammals, another to the small mammals, a third to birds, and so on. So far as we can judge, all his advice is to the point, and the illustrations given as samples are in most cases admirable animal portraits. Not that attention is confined to animated nature, for we have a chapter on plant-photography, and another on the use of the camera in depicting sporting scenes and incidents, each as charmingly illustrated as their predecessors. Above all, the book is by no means dry reading, the technical details being enlivened with numerous and appropriate anecdotes. Mr. Brownell has, in fact, succeeded in producing a treatise on practical field-photography which it will be very hard to beat.

R. L.

A POPULAR STAR ATLAS.

Popular Star Maps. A Rapid and Easy Method of Finding the Principal Stars. By Comte de Miremont, F.R.A.S. (London: George Philip and Son, Ltd., 1904.) Price 10*s.* 6*d.* net.

IT is by no means an easy task to construct a series of charts of the principal stars in the sky that will at once be of service to those wishing to make themselves familiar with the chief constellations or star groupings. Many, if not the majority, of star atlases printed for beginners are so belaboured with lines indicating right ascensions and declinations, names of constellations, Greek letters or numbers against each star, different notations for variable stars, &c., that when the beginner turns his eyes from the starry heavens towards a chart in order to find out the particular grouping in question he is unable to recognise it among the innumerable markings. For this reason many who have made valiant attempts to learn the stars have given up trying, and it is the atlases that are to blame and not the seekers after knowledge.

The ideal set of charts for a beginner should in the first place represent the appearance of the starry heavens as near as possible, and consist of maps showing small white discs or stars on a dark background, the discs or stars varying in size according to the magnitude of the star; secondly, a fairly large region should be included in each map; thirdly, only stars to the third or fourth magnitude should be inserted; and lastly, each map should have an accompanying duplicate chart or key-map on the same scale, but with dark discs or stars on a white background, on which as much information as may be useful should be given.

In this way the beginner can at once find his particular stars on the first map, and learn their names, &c., on the accompanying key-map. This seems to be the logical method of aiding those who are not accustomed to deal with star charts, and it is a pleasure to find that such a series of maps is now available for those who wish to take advantage of them.

The charts is question, ten in number, and each accompanied by a key-map, have been prepared by Comte de Miremont, one who is thoroughly acquainted with the stars from the navigating point of view, and is familiar with the desire of sailors and others for a simple star atlas. Stars to the fourth magnitude only are inserted, and these are represented, on charts 10 inches square, as white stars on a dark blue background; in the accompanying but separate key-maps, of the same size, the stars are black on a white background. Great care has been taken to ensure accuracy in the star positions.

The method of projection, namely, the gnomonic, is also one which lends itself well to this type of atlas, for the whole of the celestial sphere can be projected on six plates, each plate thus representing one side of a cube enveloping the sphere. The upper and lower sides of the cube enclose the north and south polar regions respectively, and the other four sides the equatorial regions. To render more clearly the relations to each other of star groups near the edges of each of these equatorial sides in contact, four additional overlapping maps are added. Thus there are ten charts in all, and there is this advantage, that each one with its corresponding key-map can be taken out of the portfolio and used in the observatory, in the field, or on board ship by itself. On each chart and its key is a scale of right ascensions with the seasons of the year when each of the constellations is

visible in these longitudes; the declinations are omitted from the maps, but this information, and the right ascensions of every star marked, are given in the table showing the mean places (and annual change) for January, 1904. Other lists include the names of the constellations and the principal stars in each, and a complete alphabetical list of stars in the maps.

With regard to the general get-up of the maps, letterpress, and portfolio which encloses them, more could not be desired, and great credit is due to both compiler and publisher for producing such a serviceable and handsome set of star charts for the use of beginners, and at such a low price. W. J. S. L.

A CONTRIBUTION TO MUSEUM HISTORY.

The History of the Collections contained in the Natural History Departments of the British Museum. Vol. i. Pp. xvii+442. (London: Printed by Order of the Trustees of the British Museum, 1904.)

EVERY museum of the first rank has two histories, one of which is usually written but rarely published—the history of the gradual accumulation of the museum material, by purchase, exchange, or donation, and another, which can hardly ever be written—the history of the internal metabolism, the arrangement and re-arrangement, the differentiation and integration, the "Kampf der Theile im Organismus." It may not be difficult to indicate how various museums have adapted themselves to the advance of science and to their growing constituency under the influence of effective directors, how nature has crept in between the teeth of the abstractive scientific fork, how evolutionary series have replaced static taxonomic displays, how problems of practical human interest have been recognised, how a mere chamber of horrors has become an introduction to a rational study of pathological variation, and so on; but who can ever tell the detailed physiological story of the metamorphoses? For the great museum is an organism of many parts, each with its *spiritus rector*, each developing independently, and yet in cooperation with the rest. It may not be difficult to show how a museum has changed or is changing as the various objectives—for instruction, for investigation, for inspiration—have become more clear to the organisers; when, for instance, the simple step is taken of discriminating between what can be usefully exhibited and what should be as usefully concealed; but who can ever tell how much even this simple step costs? Is the priceless connecting link to be shown with blinds up or with blinds down, or not at all? But we must not intrude further into the real history of a great museum; it is an intricate story of thrust and parry between keepers and their environment, both animate and inanimate. The history before us is a history, not of the British Museum (Natural History Departments) as a growing organism; it is the history of the collections—a story of accretion.

The first volume of the history of the collections preserved in the four natural history departments of the British Museum deals with the botanical, geological, and mineralogical material, and also with the libraries. It has been produced at the suggestion of the director, Prof. E. Ray Lankester, by the officers in charge of the collections. Mr. B. B. Woodward has written the history of the libraries; Mr. George Murray, assisted by Mr. Britten, that of the department of botany; Dr. Arthur Smith Woodward, with valuable help from the late keeper, Dr. Henry Woodward, and from Dr. Bather, assistant keeper, that of the department of geology; and Mr. Fletcher that of the department of minerals. The second volume will deal with the department of zoology.

It need hardly be said that the various histories of the collections are scholarly productions; they tell of the foundation-stones and of the additions made from year to year, and they give an annotated alphabetical list of the numerous benefactors and vendors. The result is not adapted for fireside perusal, but it is very impressive, giving us a correct idea of the variety, extent, and importance of the immense series of collected specimens which are carefully guarded and ordered, "not only" (according to the terms of Sir Hans Sloane's will) "for the inspection and entertainment of the learned and curious, but for the general use and benefit of the public to all posterity." And it is also interesting to turn over the leaves and observe how many famous names occur on the honourable lists. Many of the short biographical notes in the geological and mineralogical sections supply valuable historical material. A useful addendum, we think, would have been a series of references to the catalogues and memoirs in which the collected material has been described.

The book will be of great value to investigators who wish to trace collections and specimens, or who wish to know beforehand what to expect in the British Museum; and everyone will agree that it furnishes abundant documentary proof of the carefulness and business-like methods of the great museum, which is one of the national assets that we have most reason to be proud of.

SCIENCE AND METAPHYSICS.

Scientific Fact and Metaphysical Reality. By Robert Brandon Arnold. Pp. xxiii+360. (London: Macmillan and Co., Ltd., 1904.) Price 10s. net.

IF this book does not conform to the adage "*Nonum prematur in annum*"—for Mr. Arnold's undergraduate career is no distant memory—that is no ground for complaint. The work is not only one of great promise, but a notable performance. In originality of conception, vigour and clearness of statement, width of outlook and fairness to all the aspects of experience, it would be with difficulty surpassed. At the same time it is quite unpretentious; there is no parade of learning; there is not a single foot-note. The one digression of any length—on

modern militarism—is as interesting as it is pardonable.

The following are some of the main characteristics of the author's point of view:—(1) While defending metaphysics from the charge of being "built upon air or quicksands," he readily admits that it has not always taken full advantage of the science which it knows, and that greater accuracy of scientific detail ought to be displayed if it is to appeal to the "plain man" with some knowledge of physics, chemistry, and biology. In the same spirit the chapters on God and the Absolute and Human Immortality attempt to do something like justice to the religious aspirations of the "plain man," which are so severely neglected in such a work as "Appearance and Reality." (2) Mr. Arnold prefers *activity* to *existence* as a basis for investigation. The lower animals, in his view, display only "teleological activities"; the entity "mind" (self-conscious and introspective) belongs only to men. And perhaps not even to all men: "a human being might theoretically pass through life and never be actual mind; possibly with some savages this is almost the truth." (3) Again, Mr. Arnold is fond of the contrast between the individuation (real and objective in every sense) by means of the atom or the electron—"the true physical entities"—and the individuation by means of colour, sound, and the like which depends on our "particular sensuous evolution." The latter form of individuation, which finds expression particularly in the "material totalised image," seems therefore to show that in mind (including "teleological activity") there is something new in principle. "But by asking whether it is a new entity we merely confuse matters. For we should thus assume that the physical world is once and for all limited to atomic activities, whereas all observations tend to show that the various entities are continually changing and re-organising themselves, and developing new relations and qualities." In one sense Mr. Arnold claims that his view of mind in the non-introspective animal is as materialistic as it could be, since mind under such conditions "is matter totalised in a special manner in relation to an external crisis." But he hastens to add that "pre-mental matter was not merely the matter of physics and chemistry." And mind in man he certainly regards as something very different.

It is impossible to do justice to this suggestive work in a short notice, and we are well aware that the above is only a hasty and somewhat arbitrary selection of a few of the topics treated. The views of matter and ether, in particular, might well have a notice of their own; so might the chapter on psycho-physical interaction, which is almost a model of philosophical discussion. In this last the theory is stated that the initial impulse required to liberate the energy of the muscular system comes ultimately from "external sources," *e.g.* when the sight of some object moves us to pursue it, from the ethereal vibrations which we apprehend as light. But for the author's defence (in many ways successful) against the obvious objections to this view, we must refer to the book itself.

OUR BOOK SHELF.

Index of Spectra. (Appendix O.) By W. Marshall Watts, D.Sc. (Lond). Pp. 40. (Manchester: Abel Heywood and Son, 1904.) Price 3*s*.

THIS is the latest addition to the very useful series of appendices which Dr. Marshall Watts has given to his well-known "Index of Spectra." In it he has brought together the arc spectrum of molybdenum by Hasselberg, the spark spectra of calcium, scandium, indium, beryllium, lithium, thallium, antimony, and arsenic, by Exner and Haschek; of calcium, lithium, thallium, and antimony, by Eder and Valenta; of radium, by Runge and Precht; and the oxy-hydrogen flame spectra of lithium, potassium, rubidium, and cæsium, by Ramage. Hasselberg's comprehensive record of the arc lines of molybdenum takes up about half the pages of the appendix. In the cases of metals investigated both by Exner and Haschek, and Eder and Valenta, the records are compared in parallel columns. The oscillation frequencies corresponding to the wave-lengths of all the lines given have been reduced by the compiler.

La Matière, l'Éther et les Forces physiques. By Lucien Mottez. Pp. 236. (Paris: Gauthier Villars, 1904.) Price 4 francs.

THE time is fast coming when the qualification which will play the most important part in determining a man's reputation as a physicist will be that he shall abstain from writing books on the philosophy of ether, matter, and the universe. The present book discourses pleasantly about gravitation, heat, electricity and magnetism, polarisation of light, chemical action, and such like matters. It is hardly the kind of book to which a beginner would turn to get his first lessons on physics, as the style is too discursive, and it contains little but what an average physicist either knows or has probably thought of already; and yet we can only say about books of this kind, "still they come." Who reads them?

The Uses and Wonders of Plant-hairs. By Kate E. Styan. Pp. iv+65; with plates. (London: Bemrose and Sons, Ltd.) Price 1*s*.

THE nature and purpose of plant-hairs will have occurred to many teachers as a favourable subject for a course of nature-study. The presence or absence of hairs in allied plants, even in the same plant when growing under different conditions, their position and form, their mechanism and use, afford plenty of opportunity for consideration and deduction. The book offers a fair *résumé* of facts, but it is not obvious that the writer is recording personal observations, and the appendix of illustrations loses some of its value as no allusion is made to it in the text.

LETTER TO THE EDITOR.

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

The Planet Fortuna.

ALTHOUGH NATURE is scarcely the proper place for a disquisition on a Latin quotation, perhaps you will admit of a further correction of "W. T.'s" correction (p. 461) of the lines quoted by "W. E. P." Numen is, I believe, never used except in the sense of *good* luck, being derived from nuo, and signifying the nodding approval of the gods; hence "Nullum numen habes, si sit prudentia," would mean just the opposite to the obvious sense of the passage. The best editions give, in both the satires where the line occurs, "Nullum numen abest," and this makes sense. Except for this word, "W. T.'s" version is correct.

SPENCER PICKERING.

STATE AID FOR HIGHER EDUCATION.

THE announcement that the committee, presided over by Mr. Haldane, M.P., appointed to consider the allocation of the Treasury grant to the university colleges has finished its inquiry, was made in our issue of last week. In the note dealing with the subject on that occasion the part of the grant to be received by each college was specified, and the fact remains to be recorded that 9000*l.* has been allotted to the purchase of books, apparatus, specimens, instruments, &c., to form equipment for teaching of a university character. As will be known already to most readers of NATURE, the Treasury this year has doubled its contribution to the university colleges, and in this way has acknowledged the national services which these institutions are rendering. The total Treasury grant to the fourteen university colleges is now 54,000*l.*

That the grant has been increased in this substantial manner is certainly a matter for congratulation, and men of science will view with satisfaction the evidence this additional State aid for higher education affords that the Government is beginning to realise the important part played by higher education in securing national efficiency—especially by higher education in science, using that term in its most catholic sense. But, even at the risk of appearing to be ungracious, it must be pointed out at once that the amount is even now ludicrously small and altogether inadequate when regarded as the contribution of the State to the pressing work of placing our system of higher education upon a satisfactory basis. As has been consistently and persistently urged in these columns, there is an enormous amount of leeway to be made up before the facilities for education of university standard in Great Britain can be compared with those in several European countries and with those in the United States, compared, that is, with any chance of a satisfactory result. The reason is a simple one. Great Britain alone among the first-class nations of the world has not learnt that the reign of muscle is over, that success, whether in commerce or war, will be always with the most highly trained and scientifically educated people. Other nations have taken this truth to heart, and believe enthusiastically that what is worth having is worth paying for, and paying for well. Surely, in view of the object-lesson that events in Manchuria afford, it will not be long before our own country will be prepared to make great sacrifices to secure as efficient a system of higher education as that of any other nation on the face of the earth.

The total grant to the fourteen university colleges is, as has been said, 54,000*l.*, and this is a large sum compared with what the colleges have received in previous years. But the State endowment of the University of Berlin in 1891–2 amounted to very nearly 169,000*l.*; that is to say, one university in Germany receives from the State in a year more than three times as much as our fourteen university colleges receive together from the Treasury. A single fact of this kind is enough to convince the student of educational problems that while Germany takes higher scientific education seriously, and reaps the advantages of her sacrifices, Great Britain has still to understand that commercial success and educational efficiency stand in the relation of effect and cause. If at the present day there still exist sceptics as to our educational inefficiency and our national parsimony towards universities and colleges, the presidential address of Sir Norman Lockyer to the British Association at Southport in 1903 may be commended to them. Though men of science who have at heart the true welfare of their country are at present rather like "voices crying in the wilderness," it is clearly their duty to continue to urge the paramount importance of higher scientific education and of scientific research, and to petition the Government to act more generously on their behalf.

But it is not enough to provide large and adequate State grants for education in order to secure efficiency in the face of modern needs. It is just as important so to choose the subjects of study and to arrange the curricula of schools and colleges that our boys and young men may begin life as well and as suitably trained as the youths of other countries. The kind of education suited to the conditions of the days of the Renaissance is not in harmony with the needs of the twentieth century. The work of men of science in the last century has revolutionised life, and our system of education must be adapted to existing circumstances. The custodians of English education are still too much actuated by mediæval ideals. The entrance of the student of science to the older universities is still obstructed by an obsolete and ludicrous test in Greek. There is a tendency even yet among those in charge of our Department of Education to discourage and hamper the instruction in science in our elementary and secondary schools. The Prime Minister is reported once to have said that the only knowledge our boys have of natural phenomena is that obtained on the cricket and football fields, and on the river. The man of science has still much to teach his fellow citizens. The work to which Huxley gave so much of his energy is not yet done, and it is the duty of his successors to continue his efforts, and to take every opportunity of advocating the application of the principles of science to educational administration.

It must be recognised that there are many ways of obtaining culture. The idea of the Middle Ages that culture was obtainable only by studying Latin and Greek, though true enough then, is to-day hopelessly narrow and indicative rather of the state of mind of the Philistine. The scholar steeped in classical lore, yet ignorant of nature's laws and of modern literature, is but an uneducated pedant. The scientific specialist with a complete knowledge of some restricted subdivision of science, yet knowing nothing of the ideas of ancient and modern poets and philosophers, is but a narrow technical registrar. Culture is something broader and higher than anything with which the pedant or cataloguer is acquainted. The man of science desirous of producing cultured men and women will strive so to arrange school and college time-tables that they contain in due measure subjects designed to cultivate and develop all the faculties of the healthy human mind; and in this work the heritage which has been left us by the nineteenth century will not be ignored. The teachings of science, the love of truth wherever it may lead, will be inculcated consistently, so that a race may be produced able to deal with modern problems in a modern way.

Though the Government moves but slowly, and perceives so incompletely the unsatisfactoriness of our supply of higher education, there is cause for satisfaction in another direction. There are growing evidences that the broad-minded policy of wealthy men in the United States, which leads them to give of their millions to colleges and universities, is being emulated in a measure by our merchant princes. We have on several occasions lately been able to record noble instances of private munificence on behalf of higher education, and it may be that before long the Government will recognise its imperative duty.

CAVE HUNTING.[1]

SINCE the memorable researches of Dr. Buckland in the early part of last century, the exploration of British caves has had a great fascination for many investigators. This is no matter for surprise, for there are many points of interest which await elucidation regarding prehistoric man and the animals by which he was surrounded in very early times, and there is a great probability that some of these problems will be solved by cavern researches. When we remember, also, how much has already been revealed by cave hunting, we are led to hope for more in the future, and consequently investigations in this direction raise our expectations.

The current number of the *Quarterly Journal* of the Geological Society contains an interesting account of a cave discovered about two years ago near Brassington, Derbyshire. Shortly after its discovery the cave was visited by a number of "ardent collectors," and many bones and teeth were carried away; but very soon permission was given by Major Nicholson, the owner, for the deposits to be carefully investigated on behalf of the Derbyshire Archæological and Natural History Society, the work falling almost wholly on the authors of this paper.

The cave is in a quarry situated on the south-eastern edge of the Mountain Limestone plateau, and its floor is about 1090 feet above Ordnance Datum, the top of the quarry being some 30 feet higher. The highest part of the plateau in the neighbourhood is formed by the Harbro Rocks, which at some little distance, and with a depression between, rise to a height of 1244 feet, that is, about 120 feet higher than the entrance to the swallow hole which opened into the top of the cavern.

The cavern itself was a master joint in the limestone, enlarged by the action of water, and when found (it is now entirely destroyed) extended about 120 feet from the S.S.E. to the N.N.W., and in this direction it deepened considerably. Much care seems to have been taken to keep separate the bones from each layer, and fifteen spots are marked on the section given to indicate distinct layers or places where bones were discovered. Eventually, however, these were grouped into three series:—(1) The upper inclined layers which had accumulated to the S.S.E. of the swallow hole, and from which they were evidently derived. By far the greater number of the specimens were found in this part of the cave. To the N.N.W. of the swallow hole very few bones were met with, and the deposit was of a more irregular character, seeming to indicate a different mode of origin.

(2) The second division included all that was obtained in a stratum about three feet in depth excavated below the level of the quarry floor, and extending throughout the length of the cave. Very few bones were found, but these included remains of hyæna and of a small deer which it was important to know were present at this early stage of the cave's history.

(3) The third, and oldest series of deposits, were some highly inclined beds at the N.N.W. end of the cave, which were explored to a considerable depth in the hope of meeting with Pliocene mammals, such as were recognised by Prof. W. Boyd Dawkins in the cave at Doveholes in 1903, but unfortunately without finding any such remains. We wish the explorers had had more success in this deeper exploration; however, it is satisfactory to know that the search was made, even though the results were negative.

The number of bones yielded by this cave could scarcely have been less than 10,000, for the authors have accounted for 8000, and many were carried away before they began work. Nearly half these remains belonged to bovine and cervine animals, while between six and seven hundred of them are referable to hyænas. It seems pretty certain that this cave was a hyæna-den, and although no entrance was found except the swallow hole, yet it is possible that this was the means of access.

Some twenty-seven species of mammals, birds, and amphibia have been identified from Hoe Grange cave, but about half of these belong to the smaller forms of vertebrates, which as a rule have not been recorded in cave researches. The rich harvest of these small creatures which rewarded the patient labour of Mr. Lewis Abbott some ten years ago in the rock fissure at Ightham, Kent, has caused more careful search to be made for them in recent researches, and with good results, such as those of Mr. R. S. Ussher in his cave hunting in Ireland during the last two or three years, only a part of which have yet been published. Search was made for these smaller animals at Hoe Grange, but with only partial success. Among the larger animals represented in the cave, the lion will perhaps attract most attention, and one of the few specimens obtained is part of the lower jaw of a cub with some of the milk teeth still in place. The hyæna, wild cat, wolf, fox, grisly bear, and badger are the other carnivores which have been identified.

Rhinoceros remains occurred in some abundance, and the teeth show that they belong to the *Rhinoceros leptorhinus*, not to the woolly rhinoceros, the form hitherto found in Derbyshire. The elephant is re-

FIG. 1.—Hoe Grange Quarry, showing entrance to Cave. From photograph by H. Arnold-Bemrose.

[1] "On an Ossiferous Cave of Pleistocene Age at Hoe Grange Quarry, Longcliffe, near Brassington (Derbyshire)." By H. H. Arnold Bemrose, J.P., M.A., and E. T. Newton, F.R.S. (*Quart. Journ.* Geol. Soc. vol. lxi. p. 43, 1904.)

presented by a single specimen, part of a milk molar of *Elephas antiquus;* this again is peculiar, the elephant previously met with in Derbyshire being the mammoth (*E. primigenius*). The presence of *Elephas antiquus* and *Rhinoceros leptorhinus,* as we learn from the discussion following the paper, led Prof. Dawkins to regard the deposits at Hoe Grange as belonging to the older Pleistocene group of caves.

Among the numerous bovine remains there are no horn-cores and frontal bones to indicate the species to which these remains belong, and the measurements of several metacarpals given in the paper show that limb-bones alone are not sufficient to indicate whether the remains are those of Bos or of Bison.

The Cervidæ are represented by four species, the

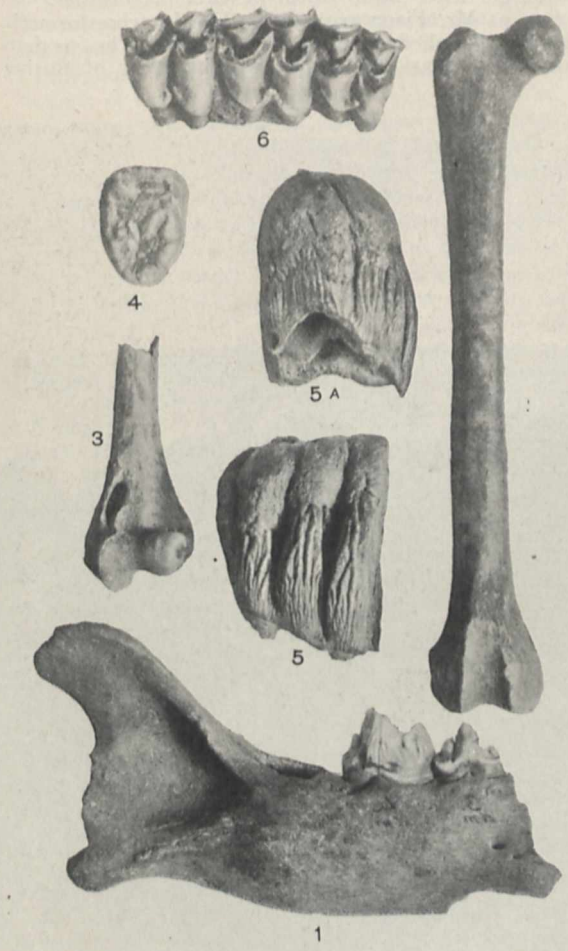

FIG. 2.—Mammalian Bones from Hoe Grange Cavern. 1, Lion-cub, lower jaw; 2. Wild Cat, femur; 3, Wild Cat, humerus; 4, Bear, molar tooth; 5, 5A, *Elephas antiquus*, milk tooth; 6, Fallow-deer, three molar teeth.

great Irish deer (*Cervus giganteus*), the red deer (*C. elaphus*), the roebuck (*Capreolus caprea*), and another form, intermediate in size between the last two, which is regarded by the authors as fallow deer (*Cervus dama*). Bones and teeth of the last-named form were very numerous, nearly 1600 specimens having been found. If these remains are indeed parts of Pleistocene fallow deer, and we see no way to any other conclusion, they are of the greatest interest. The fallow deer has not hitherto been accepted, at least by modern writers, as a member of the British Pleistocene fauna, but is thought to have been introduced to this country probably by the Romans.

There are two points, however, which have to be settled before we can accept this addition to our Pleistocene mammals:—(1) Are these remains certainly those of fallow deer? and if so (2) Is the deposit in which they were found really of Pleistocene age?

It is to be regretted that there are no sufficiently well preserved antlers to define the species clearly, but the limb-bones and teeth are of such a size that if there had been no question of age there would have been little or no doubt in referring them to fallow deer. In the circumstances the authors have carefully measured the teeth and made comparisons with both fallow and red deer, and feel compelled to regard these remains as parts of fallow deer or of a closely allied species. The only Pleistocene species of a size which might compare with these bones and teeth is the *Cervus Browni* described by Prof. Boyd Dawkins from Pleistocene beds at Clacton, and this is only known by its antler, which is distinguished from that of the fallow deer by the presence of an additional tine. It has been shown, however, that modern fallow deer sometimes have this additional tine (see NATURE, vol. xi., p. 210), and it thus becomes very doubtful whether *C. Browni* is really a distinct species. Although there are no antlers from Hoe Grange cave that can be compared with *C. Browni,* yet it seems almost certain that the authors are correct, and that these Hoe Grange remains are representatives of the fallow deer.

We have now to consider the age of the Hoe Grange deposits. There can be no question as to the Pleistocene age of the elephant, rhinoceros, hyæna, and lion, and there is no doubt as to the fallow deer bones being found with the remains of those animals; but it is just possible that the fallow deer was living in the neighbourhood at a time when a previously existing Pleistocene deposit was washed into this cave, and so the more modern animal got mixed with the older forms. In order that such a re-deposition of large bones might take place there must have been a considerable supply of water, and seeing that the cave at the present time is near the top of the plateau there is no collecting ground for water; and it becomes necessary to suppose that, at the time of the re-deposition of the bones, the land was much higher than it is now, and that it has since been denuded. But it must be remembered that this would mean a very large amount of denudation, and, if we are to accept the fallow deer as a Roman importation, this denudation must have taken place since Roman times, which seems extremely improbable. We think, therefore, that the authors are justified in regarding these particular cervine remains as those of fallow deer, and as good evidence that the species lived in this country in Pleistocene times.

A fallow deer's antler has been recorded recently by Dr. Herlaf Winge from an interglacial deposit in Denmark; and this early extension of the species so far north on the Continent makes its occurrence in England in Pleistocene times still more probable. It is remarkable that *Cervus dama,* or rather its equivalent, *C. Browni,* should have been so rarely found, hitherto, in Pleistocene deposits, seeing that it is so abundant in the Hoe Grange cave.

A word regarding the illustrations accompanying this paper, two of which, by the courtesy of the council of the Geological Society, we are able to reproduce. The views of the cave are very credit-

able reproductions, but we have nowadays become accustomed to good things of this kind. It is rarely, however, that we have seen such satisfactory reproductions of photographs taken directly from the fossils as we have in the two plates. Most of the good collotype reproductions of fossils that have recently appeared are from photographs of water-colour drawings, and some of them are certainly very effective; but there is the artist's equation to allow for. In the present case, no such allowance has to be made, and the figures of the lion's jaw as well as of the teeth of the fallow deer and elephant are admirable. These plates do credit to all concerned in their production.

FIJIAN FOLK-TALES.[1]

ETHNOLOGISTS have all along suspected that Mr. Fison has plenty of unpublished information concerning Fiji. They are grateful to him for what he has already published in the *Journal* of the Anthropological Institute, but they clamoured for more, and even now they will not remain satisfied with the handsome book that has just been issued by the De La More Press. This new book contains a dozen folk-tales capitally told; "each contains a genuine legend as its skeleton, for the flesh with which that skeleton has been covered, the most that can be claimed is that it is of the native pattern." The tales are interesting as stories, and have increased value when compared with other tales from Oceania, but their greatest importance rests in their value as evidence of the ideas and actions of the natives before the white man came. In the introduction Mr. Fison gives a long discussion concerning cannibalism, and he sums it up thus:—

"It is impossible to establish a certainty as to the origin of cannibalism, and the question resolves itself into a comparison of probabilities, the balance being in favour of the strongest motive. This is undoubtedly Hunger. It is stronger than Superstition; it is stronger than Revenge. Man is a carnivorous animal, whatever the vegetarians may say; and in a savage state of society, if he cannot get the food for which his stomach craves, he will '*kusima*' (crave, or hunger after flesh) until he eats his brother."

For, as Mr. Fison argues, the Fijians were formerly scantily supplied with animal food. The serious student is occasionally tantalised by hints of further information, and by allusions to possible discussions of social and other questions, all of which are passed by as not being suitable for a popular book; doubtless Mr. Fison was wise in restraining himself, but, for the sake of science, it is sincerely to be hoped that he will give all his information to the world in some form or another. In the meantime we thank Mr. Fison for this publication, which can be recommended to those who like interesting information about real savages told in a pleasing manner.

FIG. 1.—Bau, Fiji. From Fison's "Tales from Old Fiji."

[1] "Tales from Old Fiji." By Lorimer Fison. Pp. xlv+175; illustrated. (London: A. Moring, Ltd., the De La More Press, 1904.) Price 7s. 6d. net.

NOTES.

ON Friday last, March 17, the worlds of science and art combined to do honour to a man who has rendered to both services of the utmost value and of a nature that time cannot diminish—for so long as the human throat is capable of emitting musical sounds, and so long as throats are liable to disease, the great invention of Manuel Garcia will hold its place among vocalists and laryngologists. The celebration of Señor Garcia's centenary was held in the hall of the Royal Medical and Chirurgical Society, Hanover Square, under the direction of Sir Felix Semon, chairman of the Garcia committee. Señor Garcia sat alone on a daïs, while in front of him were ranked the representatives of kings, governments, universities, scientific societies, and his old pupils who had gathered to do him honour. Sir Felix Semon announced that that morning the King had invited Señor Garcia to Buckingham Palace, and with his own hands invested him with the insignia of Commander of the Royal Victorian Order, and had expressed a desire to be represented at the banquet in the evening by his Lord-in-Waiting, Lord Suffield. The Marquis de Villalobar then delivered a congratulatory message from the King of Spain, and added, "In the name of His Majesty and your motherland, I invest you with the Royal Order of Alfonso XII. as a reward of your merits and the services you have rendered to mankind. I desire also to make public the sentiments of my beloved Sovereign and of his Government to King Edward VII. for the distinction he has conferred upon our compatriot, and the hearty gratefulness of Spain to all who have come here to-day to honour Don Manuel Garcia." Other tributes followed thick and fast during a crowded hour. Prof. Fränkel presented on behalf of the German Emperor the great gold medal of science. Sir Archibald Geikie, Mr. Francis Darwin, and Prof. Halliburton, representing the Royal Society, presented an address, recalling the fact that their *Proceedings* for March 22, 1855, contained the epoch-making paper in which Señor Garcia laid the foundations of the experimental study of the voice. The Royal Prussian Academy of Sciences, the University of Königsberg, the Victoria University, the Medical Faculty of Heidelberg, the Royal Academy of Music, and the Royal College of Music sent distinguished representatives, who in rapid succession laid before the maestro illuminated addresses in rich profusion, until the table in front of him was heaped. We have not space to give the long list of public institutions and societies, laryngological and other, which brought tribute; but every quarter of the globe was represented, and during the proceedings a constant stream of telegrams poured in. After the addresses a portrait of Señor Garcia, painted by Mr. Sargent, R.A., and subscribed for by friends and admirers in all parts of the world, was unveiled and presented to him by Sir Felix Semon. The proceedings were concluded by a remarkably eloquent speech by Señor Garcia. In the evening Señor (now Don) Garcia was entertained at a banquet held in his honour at the Hotel Cecil.

WE learn from the *Times* that further papers have been published by the Government of India in respect to the late Mr. J. N. Tata's offer of an endowment in the shape of properties valued at 200,000*l.* for the creation of an institute of Indian research at Bangalore. Certain conditions in respect to Government assistance were attached to the offer, which was first made six years ago, and these have been the subject of prolonged discussion and correspondence between the Government, Mr. Tata during his lifetime, and his representatives. The papers now published show that the difficulties in the way of a settlement have been removed. Guarantees have been offered by the representatives of the donor to secure the full income estimated from the endowment properties, and the management of the latter is vested in a board the chairman of which is to be an officer selected by the Bombay Government. In addition to making a grant of 2½ lakhs of rupees (16,666*l.*) towards the construction of the necessary buildings and provision of scientific apparatus, the Government will make an annual grant to the institute of half the local assets up to a limit of 1½ lakhs of rupees, provided that the institute is conducted on lines approved generally by the Government. The scheme will provide for the reference of certain questions to the advisory committee of the Royal Society, or to such other scientific authority as may be appointed for the purpose. The Governor-General in Council disavows any desire to be intimately associated with the actual administration of the institute, or to claim a determining voice in the settlement of the lines of research to be followed or the methods of instruction to be employed. The Government will exercise no more than that degree of influence and control which is justified by the grant-in-aid that has been promised.

PROF. EMIL WARBURG, of Berlin, has been appointed president of the National Physical Laboratory at Charlottenburg, and his place in the university is to be taken by Prof. Paul Drude, of Giessen.

THE magnificent collection of birds' eggs possessed by the British (Natural History) Museum has been largely augmented by the gift of the splendid series brought together by Mr. W. Radcliffe Saunders, of High Bank, Tonbridge. This collection comprises close on ten thousand specimens of the eggs of Palæarctic species, together with one hundred and sixty-five nests.

WE regret to record the death at the age of seventy-six of Mr. Jeremiah Slade, one of the founders of the Geologists' Association. Mr. Slade had for many years been a teacher of geology, mineralogy, zoology, and botany at the Working Men's College, the Birkbeck Institution, and the City of London College. He was an ardent microscopist and member of the Quekett Microscopical Club.

THE anniversary dinner of the Chemical Society will be held on Wednesday, March 29.

THE sixth International Congress of Applied Chemistry will be held at Rome next year, probably during the week following Easter.

THE French Société d'Encouragement pour l'industrie nationale has awarded the Lavoisier medal to M. Héroult in recognition of his electrometallurgical researches. In recommending the award the committee refers to his work in connection with the manufacture of aluminium, and the preparation of steel in the electric furnace.

OFFICIAL statistics show that the production of natural gas in the United States in 1903 was greater than in any previous year. The production had a value of 7,143,000*l.*, or 16 per cent. more than that of 1902. Four States, Pennsylvania, West Virginia, Indiana, and Ohio, furnished together 94 per cent. of the supply of gas. The total volume of the gas at atmospheric pressure was 6757 million cubic metres, representing in heating value 12,129,468 tons of bituminous coal.

REUTER'S Agency has received some details of an expedition which went to British New Guinea in September, 1903,

and has lately returned to England. The expedition was organised by Major W. Cooke-Daniels, an American traveller, and it also included Dr. C. G. Seligmann, Dr. W. M. Strong, and Mr. A. H. Dunning. The objects were primarily ethnographical, but studies were also made in other branches of science, and a number of general pathological observations were made. A collection of photographs was secured by Mr. Dunning, and the travellers have brought back kinematograph pictures and a selection of phonographic records.

A CORRESPONDENT writing to the *Times* from Florence directs attention to the fact that the famous Tower of Galileo, on the hill of Arcetri above Florence, is now practically destroyed. This historic thirteenth century building—known locally as the Torre del Gallo—has for some months past been concealed in scaffolding set up for the purpose of raising its castellated tower by a third of its former height, of placing in its walls new windows, of adding a loggia, and, in fine, of converting the world famous "Star Tower" into a pretentious modern erection. To the Anglo-Saxon race Galileo's Tower possessed a special interest, in that it was the scene of the classic meeting between Milton and Galileo.

IN No. 1395 of the *Proceedings* of the U.S. National Museum, Mr. C. D. Walcott continues his account of American Cambrian brachiopods, describing several new genera and species. It is explained that these notes and their forerunners are published in the hope that they may be of service to students prior to the appearance of the full monograph promised on the subject.

WE have received the reports of the Wellington College and of the Felsted School science societies for 1904. The former, which is illustrated, contains summaries of a number of lectures delivered before the society, among which one by Mr. H. W. Monckton on the geology of the London district deserves special mention. In the Felsted report attention is directed to the lack of keenness displayed by the members of the zoological section, who failed to take nature-study seriously. Although one prize was offered for an account of the birds of the district, and a second for the best collection of butterflies and moths, there were no competitors.

IN addition to the *Bulletin* on the fauna and flora of the plateau of Baraque-Michel, already noticed (from an author's copy) in NATURE of March 16 (p. 468), No. 12 of the *Bulletin* of the Belgian Royal Academy contains two biological articles of considerable interest. In the first of these, Miss J. Wery discusses the attractions offered to bees by flowers, and, as the result of direct experiments, arrives at the following conclusions. Brilliantly coloured flowers offer much greater attraction when entire than when the petals, &c., have been cut away; honey has no attractive power; artificial flowers are just as attractive as natural ones if both are under glass shades; flower perfume by itself offers but little attraction; while colour and form, apart from scent, are powerfully attractive; the mingling of the three factors, form, colour, and scent, constitutes the most powerful attraction of all. Finally, if the latter item be reckoned as 100, the attractive power exerted by form and colour will be 80 per cent., while the other factors (pollen, nectar, and scent) will only rank as 20 per cent.

IN the second of the two articles from the *Bulletin* of the Belgian Academy referred to above, Prof. A. Lamcere discusses Darwin's theory of female sexual selection as the primary factor in the production of secondary sexual characters in the male, and comes to the conclusion that such an hypothesis offers an inadequate and untenable explanation of the phenomenon. In place of this, the author suggests that such features in the male are the equivalents of maternity in the female, that is to say, the products which in the female are required for generative purposes are superfluous in the male, and are accordingly employed for sexual ornament. If we mistake not, the same theory has been already promulgated by Captain Barrett-Hamilton.

WE have received copies of four articles from the third volume of "Marine Investigations in South Africa." In describing, in two of these, the polychætous annelids collected by Dr. Gilchrist, Prof. McIntosh directs attention to the community of type between South African and European marine annelids generally, many of the types from the two areas being specifically identical, while others, in a more or less modified form, extend eastwards into the Indian and Pacific Oceans, and westward to America. A nearly similar feature has been recorded in the case of crustaceans, and it thus seems that the distribution of invertebrates in these seas is governed by very different laws from those which obtain, for instance, in the case of the commoner food-fishes. The anatomy and variation of the Flabellum-like corals form the subject of the third article, in which Mr. J. S. Gardiner has found himself compelled to dissent from the classification of corals proposed by the late Prof. P. M. Duncan. In the fourth fasciculus Dr. Gilchrist continues his investigation into the development and life-history of South African fishes, describing and figuring a number of larvæ, some of which cannot at present be specifically identified.

IN the *Monthly Review* for March, Mr. W. E. Hodgson discourses very pleasantly on certain problems connected with salmon-fishing. After pointing out the inaccuracy of the common opinion that the north of Scotland in spring is necessarily colder than the south of England, the author proceeds to discuss the reason why loch-fishing for salmon is carried on with a minnow instead of with a fly. One reason seems to be that salmon lie deeper in the water than trout, and will consequently, owing to the set of their eyes, see the approach of a boat at a greater distance. A minnow trolled behind a boat is probably, therefore, the best lure for *Salmo salar*; but whether the boatmen are right in giving a sinuous course to the boat is very questionable. In the first place a boat may be rowed right over a deep-lying salmon without being seen by the fish; secondly, there is considerable reason to believe that disturbed water is conducive to the salmon biting; and thirdly, it is not unlikely that the fish which takes the trailing lure has not been lying in the wake of the boat, but may have made a dash from the side. Mr. Hodgson, who is by no means convinced that salmon fast during their sojourn in fresh water, thinks they take the minnow for a wounded fish, and dash at it owing to the impulse which makes most animals attack a cripple.

PART IV. of the third volume of *Biometrika* contains several memoirs of interest. Mr. Punnett contributes a careful study of variation in *Spinax niger*, showing, from an analysis of the characters of 263 adults and 304 embryos, that a well-marked sexual dimorphism exists in this shark, and that the variability of male embryos considerably exceeds that of male adults, this pointing to a more stringent selection in the case of the male. Homœosis rather than intercalation or excalation is held by the author to be the more feasible explanation of the various relative positions occupied by the structures examined—this sup-

porting Gegenbaur's theory of the origin of limbs. The same material is thought by Mr. Punnett to favour the hypothesis of gametic purity—a view from which Prof. Pearson dissents for reasons given. Dr. Beddoe's craniometric formula, lately published in *L'Anthropologie*, is vigorously impugned by M. A. Lewenz and Prof. Karl Pearson, who produce in evidence the "auto-icon" of Jeremy Bentham preserved at University College. In another paper, Prof. Edmond Gain deals with variation in the flower and heterostylism in *Pulmonaria officinalis*. Local races are shown to present significant differences in the former respect. The miscellanea include interesting applications of a new method of determining correlation.

THE Bureau of Forestry of the United States Department of Agriculture has erected an extensive plant on the grounds of the St. Louis Exposition for carrying out a series of experiments under the direction of Drs. von Schrenk and Hatt on the value and methods of preserving timber. According to the general programme, which is outlined in the *Press Bulletin*, No. 62, the timber will be subjected both to static and impact tests. Preliminary results indicate that steaming reduces the strength of the timber in proportion to the pressure and duration of the process.

UNDER the title "Place-constants for *Aster prenanthoides*," Mr. G. H. Shull has contributed to the *Botanical Gazette* (November, 1904) a biometric article based upon the number of bracts and florets which were counted on the inflorescences of this plant as collected in a specified area during the autumn of 1903. In general, the first head to bloom on any stem had the highest number of parts, and the last to bloom the lowest, but precocious flowering on the part of the weakest individuals produced a low mean at the beginning of the season, and the belated flowering of a few vigorous specimens caused a rise towards the end.

A PRACTICAL and detailed comparison of the cost of production of sugar on a muscovado estate and in a central factory using the vacuum pan with triple effect, such as that given by the Hon. R. Bromley, administrator of St. Kitts, in vol. v., No. 3, of the *West Indian Bulletin*, should carry conviction to the planters of Barbados and other islands, who, trusting to the high saccharose yield of their canes, and the profit on molasses, have preferred to retain their simple process of manufacture. Apart from the advisability of manufacturing a product of the best quality, the figures show that the profit per ton of sugar prepared in a central factory is four times that obtained on a muscovado estate.

THE Société Helvétique des Sciences naturelles celebrated, at its eighty-seventh congress at Winterthur, the fiftieth jubilee of the discovery of ancient pile dwellings, described by Dr. Ferdinand Keller. The report and appreciation of the work of Keller and others is written by M. F. A. Forel. The same authority lately directed attention (*Gazette de Lausanne*, January 19) to the discovery at Boiron, near Morges, by the Lake of Geneva, of a tomb or place of burial of the Bronze Age—the age of the old lake-city of Morges. Human bones, cinders and burnt earth, bronze trinkets, vases and other pottery were found, but of special interest was the discovery alongside the calcined human bones in the burial chamber, of leg-bones of a goat uninjured by fire, and evidently deposited with the flesh as an offering to the shades of the departed. M. Forel concludes from the evidence that a belief in the resurrection of the dead was held in the Bronze Age.

WE have received a copy of the results of the meteorological observations made at the stations in connection with the Deutsche Seewarte (Hamburg) for the year 1903. The stations number sixty-nine, and include hourly readings at four first-order observatories. The tables are arranged as in previous years, and leave nothing to be desired either in thoroughness of discussion or in detailed explanation of the methods employed. Mid-European time was adopted in Germany in April, 1893, but the observations are recorded according to local time as before, with the exception of the occurrences in the remarks column, which are stated in Mid-European time. A table is given showing the difference of these times for each of the stations.

THE last published *Bulletin* of the Philippine Weather Bureau (for August, 1904) contains, in addition to the usual useful summaries of meteorological and seismological observations at various stations, a valuable discussion of the cyclones which affected the archipelago, with a map showing their tracks. The director of the central observatory at Manila, the Rev. J. Algué, S.J., author of the valuable work, "The Cyclones of the Far East," makes a special study of these interesting phenomena, and his discussion of their behaviour is most instructive. During the month in question five typical cyclones are dealt with. One of them (August 17–21) moved at the rate of thirty miles an hour; this storm was experienced by the U.S. Army transport *Sherman*, near Formosa, and an interesting account of it is given by the second officer of that vessel.

A SUMMARY of the present state of knowledge in regard to long range weather forecasts, by Prof. E. B. Garriott, has been published by the Weather Bureau of Washington. It is accompanied by a paper by Prof. C. M. Woodward on the planetary equinoxes. Prof. Garriott finds that at the present time practically no value is to be attached to weather predictions based on astronomical phenomena or observations of birds, animals or plants. At the same time, every attention is being given to the advancement of meteorology on such a basis as may lead to substantial improvements in weather forecasting. In his prefatory report Mr. Willis L. Moore remarks:—"It is to be regretted that so many newspapers not only give space to these harmful predictions, but actually pay for them. Forecasts of this description may properly be classed with advertisements of quack medicines—they are both harmful in the extreme."

IN the February number of the *Bulletin de la Société astronomique de France*, M. J. Loisel presents his annual summary of the climatology of the past year. On one chart he shows the rainfall, the daily temperatures, the humidity, the barometric pressure, the insolation, the amount of cloud, and the declination and phase of the moon. Each of the atmospheric elements is then discussed in detail month by month. Among other outstanding features, one sees that the temperature during July, 1904, was abnormally elevated, whilst that of December was higher than that obtaining during November. The figures and the curve indicating the number of hours of sunshine are especially interesting, and show that in each of the months May, June, July and August there only occurred one day when the sun was completely obscured at Juvisy, whilst in July the number of hours of effective sunshine amounted to 72 per cent. of the theoretical number. A comparison of the solar radiation during 1903 and 1904 shows an increase of about 23,134 calories, or rather more than 16 per cent., in the latter year.

MORE than ten years ago Prof. Landolt described a series of experiments which were considered to throw doubt on the law of the conservation of mass in chemical action, and in 1901 Heydweiller concluded that a change in the total mass had been experimentally established in a number of cases. In a paper published by Antonino Lo Surdo in the *Nuovo Cimento* (1904, series 5, vol. viii.), the question is re-investigated. By excluding all possible sources of error, such, for instance, as a difference of temperature in the two arms of the balance, differences of volume of the vessels used, it is established that the change of mass due to the interaction between iron and basic copper sulphate, which by Heydweiller was considered to be about 0·2 milligram, in reality falls within the limits of the error of weighing, being certainly less than 0.02 milligram. In the experiments described, the sealed tubes in which the interaction took place were not removed from the balance during the whole of the series of weighings, and an ingenious mechanism was designed by which the tubes and weights were manipulated within the case.

THE operations of the Smithsonian Institution during the year ending on June 30, 1904, and the work of the U.S. National Museum, the Bureau of American Ethnology, the International Exchanges, National Zoological Park, and the Astrophysical Observatory, are described in Dr. S. P. Langley's report which has just reached us. Among the matters mentioned is the removal of the remains of James Smithson, founder of the Smithsonian Institution, from the British cemetery at Genoa to America, at the beginning of last year. The report states that the remains rest temporarily in a room at the Smithsonian Institution containing a few personal relics of Smithson, awaiting their final disposal by the Regents. Dr. E. W. Scripture, of Yale University, has been awarded a grant from the Hodgkins fund for the construction of a "vowel organ." Dr. Scripture expects to be able to construct an organ which can sing the vowels, or a vowel register which, attached to a pipe organ, may be used effectively in church music. An exploration of some of the glaciers of British Columbia has been undertaken by Dr. W. H. Sherzer, under the auspices of the Smithsonian Institution, for the purpose of gathering definite information regarding glacial phenomena, such as the nature and cause of the ice flow, the temperature of the ice at various depths, and its relation to air temperatures, the amount of surface melting, and the possible transference of material from the surface to lower portions. Reference is made in the report to the new building of the National Museum in course of erection in the Smithsonian Park. The floor area in the four stories of the new building will be about 9½ acres. The accessions to the museum in the year covered by the report amount to 241,547 specimens, which bring the total number of objects in the collections up to nearly six millions. The work of the astrophysical observatory has been chiefly concerned with solar radiation, and its possible variability. The investigations point to the conclusion that the radiation supplied by the sun may perhaps fluctuate within intervals of a few months through ranges of nearly or quite 10 per cent., and that these fluctuations of solar radiation may cause changes of temperature of several degrees centigrade nearly simultaneously over the great continental areas of the world.

The latest report issued by the Engineering Standards Committee deals with British standard specification for structural steel for marine boilers. Copies may be obtained from Messrs. Crosby Lockwood and Son at 2*s*. 6*d*. net.

MESSRS. HENRY SOTHERAN AND CO. have issued a new catalogue of second-hand books, containing works on mathematical, astronomical, physical, and chemical subjects. The works catalogued include the library of the late Prof. A. W. Williamson, F.R.S., and many important foreign works on the exact sciences published within the past twenty years.

OUR ASTRONOMICAL COLUMN.

THE ALTERNATING VARIABILITY OF MARTIAN CANALS.—During 1903 Mr. Lowell observed an apparent alternation in the visibility of the Martian canals Thoth and Amenthes, which he suggested might be due to the artificial regulation of a deficient water supply for irrigation purposes (NATURE, vol. lxix. p. 496).

In a telegram, dated March 10, communicated to Prof. E. C. Pickering and published in No. 4003 of the *Astronomische Nachrichten*, Mr. Lowell announces that he has again observed "a functional alternative visibility" of these two canals, both of which are double.

DISCOVERY OF JUPITER'S SIXTH SATELLITE.—In No. 100 of the *Publications* of the Astronomical Society of the Pacific, Profs. Perrine and Aitken describe the first observations of Jupiter's sixth satellite, and abstracts of their communications are published in No. 4002 of the *Astronomische Nachrichten*.

Prof. Perrine states that several years ago it was proposed that the Crossley reflector, when reconstructed, should be employed in a search for additional satellites to the outer planets. In accordance with this programme, photographs of Jupiter were taken on December 3, 8, 9 and 10, 1904, and a comparison of them showed that the planet, which was slowly retrograding at the time, was apparently accompanied by an object of the fourteenth magnitude. Photographs taken on January 2, 3 and 4 showed that the newly discovered object was following Jupiter in such a manner as to suggest its dependence on that body. The greatest elongation (west) of the new satellite, about 50′, seems to have been passed on December 25, and the inclination of its orbit to the ecliptic appears to be greater than those of the inner satellites. The direction of the satellite's motion, although apparently retrograde, cannot be determined until further observations have been made.

On January 28, Prof. Aitken, using the 36-inch refractor under unfavourable atmospheric conditions, found the satellite quite easily, using the position predicted from the Crossley photographs, and, after a few minutes' observation, the identification was confirmed by the motion in right ascension. Following the object for nearly an hour, he found it to have an hourly motion in R.A. of about +20″, and this agrees with the photographic result. A comparison with neighbouring faint stars showed that the satellite was about as bright as a star of the fourteenth magnitude.

FORTHCOMING OPPOSITIONS OF MARS.—As during the oppositions of Mars in 1905, 1907, and 1909 the planet will become successively more favourable for observation, Mr. R. Buchanan has communicated to *Popular Astronomy* (No. 3, vol. xiii.) the following figures, showing the respective conditions for each opposition:—

Year	Mars passes perihelion	Opposition	Distance from Earth	Brilliancy
1905	Nov. 7	May 8	0·543	36·8
1907	Sept. 22	July 5	0·411	75·4
1909	Aug. 13	Sept. 25	0·390	86·6

The sun's distance from the earth is taken as the unit of the mean "distance from earth." In the oppositions of 1901 and 1903 the respective apparent brilliancies of the planet were 20·0 and 23·4.

VARIABLE RADIAL VELOCITY OF SIRIUS.—In No. 70 of the Lick Observatory *Bulletins*, Prof. Campbell discusses the spectrographic observations of the bright component of Sirius made at Lick since 1896, thirty-one plates in all.

Before treating the main subject, however, he discusses the difficulty experienced in binary star work through the employment of numerous different systems of nomenclature to define the orbital elements, and then propounds a new

system which would be readily adaptable to all requirements, visual or spectroscopic.

The observations of Sirius have been made under varying conditions, instrumental and otherwise, and a better accordance in the individual results might be obtained by making the observations under uniform conditions. The resulting value, obtained from all the plates, gave the velocity of the system of Sirius as −7·36 km. per second. There is a marked progression among the individual values obtained for the velocity of the primary which is attributed to the effect of orbital motion. The sense of this progression indicates that the positive value of *i* (the inclination of the plane of the orbit) should be used. The above value, whilst disagreeing with others, agrees very well with the value obtained by Profs. Frost and Adams in 1901–2.

The values of the radial velocities of the centre of the system and of the primary and secondary components are given in a table, with yearly intervals, for a whole revolution, *i.e.* from 1870·09 to 1918·09, the time of the apastron passage being 1918·5110.

CONSTANT ERRORS IN MERIDIAN OBSERVATIONS.—In an address delivered to the astronomy section of the St. Louis International Congress of Sciences and Arts, Mr. J. G. Porter discussed the various sources of error to which meridian observations are peculiarly subject, and proposed various methods whereby the constant errors might be eliminated.

Among other methods for eliminating the magnitude error which affects right ascension determinations, he recommends the one proposed by Prof. Turner wherein the transits would be registered on a regularly moving photographic plate, the reticule wires being replaced by spots of light projected on to the plate at regular intervals from a fixed source.

Regarding declination observations, the error due to varying refraction is the most important, and Mr. Porter suggests that this might be eliminated by having a perfected system of fundamental stars well distributed over the sphere, from observations of which, on any evening, the deviation of the actual refraction from the assumed law might be determined and used to correct the observations. Another, more costly, method would be to have a number of observatories widely distributed in latitude, so that zenith observations, where refraction is non-effective, of more stars might be made. Mr. Porter considers the solution of this constant error difficulty in meridian observations to be one which is eminently suitable for international cooperation (*Popular Astronomy*, No. 3, vol. xiii.).

THE NATIONAL PHYSICAL LABORATORY.

ON Friday last the annual general meeting of the governing body of the National Physical Laboratory was held at that institution, when the report of work done in 1904 was received and the programme of work proposed for the forthcoming year approved. A number of guests were invited to meet the members of the general board and inspect the laboratory. Among those present were about thirty Members of Parliament, several colonial agents-general, and a representative gathering of leading physicists and engineers.

In the 45-page report submitted by the director, Dr. Glazebrook, are found particulars regarding the various researches and tests carried out during the past year, with special reference to the newer developments. The test work at Bushy for the year shows a marked growth, the total number of separate tests made having increased from 1330 in 1903 to 1906 in 1904, the increase being spread over almost all the different departments of the laboratory. These figures are distinct from the work of Kew Observatory, where in all more than 26,000 instruments were verified during the year.

In the engineering department, Dr. Stanton has made considerable progress with the research on the distribution of wind pressure over large areas, which forms a continuation of the important work embodied in his paper read at the Institution of Civil Engineers last session. A steel tower fifty feet high has been erected in the grounds, carrying large and small pressure plates with the necessary gauges. From the general results of the observations made it would appear that the distribution of pressure on the windward side of a large plate in the open air falls off more rapidly from the centre to the sides than in the case of a small plate, but that the ratio of the pressures on the windward and leeward sides appears to be practically the same in both cases.

The research on the specific heat of superheated steam by the continuous flow method has been continued by Mr. Jakeman, who has been mainly occupied in contending with certain experimental difficulties, such as the attainment of sufficiently high insulation between the various parts of the electrical superheater, especially at low superheats. Some preliminary figures have been obtained which do not appear to confirm the rapid rise in specific heat shown by the results of some recent observers.

A testing machine for studying the effect of alternating stresses of varying periodicity on engineering materials has been constructed and was described in last month's *Engineering* by Dr. Stanton. It has already been used on a set of nickel-steel specimens, which are the basis of a research in the metallurgical department.

A new building has been erected to house the new standard leading-screw machine, which is now at work. Several standard screws have been cut and measured for use in Government arsenals.

Dr. Chree, at the observatory department, has been occupied with some important investigations on terrestrial magnetism, and the measurement and tabulation of some of the old Kew magnetic records. The men of science of the British Antarctic Expedition have, since their return in September last, had the opportunity of again comparing with recognised standards many of their instruments, and arrangements have been made for cooperation with them in the reduction of the mass of magnetic and meteorological data they brought home with them.

In the physics department numerous researches have been in progress. We have only space for mention here of some of the more important. Dr. Harker, in the thermometry division, has been occupied with preliminary work on which it is hoped may ultimately be based some new direct electrical method of very high temperature measurement. With this object he has undertaken a study of the resistance and thermoelectric properties of solid electrolytic conductors such as are used in Nernst lamps. The existence at high temperatures of large thermoelectromotive forces between rods of the various earths made up as ordinary thermojunctions has been securely established by direct electrometric methods, and a new form of electric furnace has been designed capable of continued use at temperatures above 2000° C. By means of these furnaces and a number of thermojunctions of widely different properties, a careful re-determination of the melting point of platinum was made. More than sixty determinations concorded in giving a value which differs considerably from that now accepted. The results of this work are embodied in a paper just sent in to the Royal Society.

The research on the specific heat of iron, which has been extended to temperatures above 1100° C., is complete, and will shortly be published.

In the electrical standards department, Mr. Smith has been mainly occupied with work on the standard ampere balance designed by the late Prof. Viriamu Jones and Prof. Ayrton for the British Association committee on electrical standards. The weighing mechanism was constructed by Mr. Oertling, and the four marble cylinders carrying the coils have been successfully wound and insulated at the laboratory. On each cylinder are two double helices of bare copper wire. Though the air space between the consecutive turns is less than 0·006 inch, an insulation resistance over 30,000 megohms was finally secured for each of the coils. Many accessories have been constructed, and the outlook for a speedy determination of the absolute unit of current to at least one decimal place further than hitherto attained is very hopeful.

In electrotechnics, Mr. Paterson has installed large cells for ammeter verification, and for alternate current measurements a specially constructed set of Mr. Addenbrooke's instruments, and a Kelvin voltmeter with circular scale of 2½ metres radius. In photometry have been included in-

vestigations on several Harcourt 10-candle pentane lamps and a number of Fleming large bulb standard electric glow lamps, which now form the working standards of candle-power. Intercomparisons have been made by means of glow lamps with the National Standards Bureau of Washington, the Electrical Standardising Laboratories of New York, and the Berlin Reichsanstalt.

In the general electrical department, Mr. Campbell has devised a method for obtaining for inductance measurements alternating currents having very high frequencies and a wave form almost a pure sine-curve. A large amount of new apparatus has been set up for testing purposes, much of it of a novel character.

The standard current balances and electrostatic voltmeters have been studied, and it has been found that the allegation that the Kelvin balance, when used with alternating current, is affected by eddy currents in the metal parts near the coils is without foundation for all ordinary frequencies.

Researches on the distribution of temperature in field coils of dynamos and motors, and on the behaviour of insulating materials under heat treatment, have been made by Mr. Rayner, and form the subject of a report to the engineering standards committee communicated to the Institution of Electrical Engineers at their last meeting.

In the department of metallurgy, Dr. Carpenter and Mr. Keeling, during the early part of the year, completed their work on the range of solidification and critical ranges of iron-carbon alloys, and an account of the work was read at the meeting of the Iron and Steel Institute in May last. The value of Dr. Carpenter's work was recognised by his election as Carnegie scholar. On Mr. Keeling's leaving the laboratory, Mr. Longmuir, also a Carnegie scholar, was appointed on the staff, and Dr. Carpenter and he have since been carrying on, in cooperation with Mr. Hadfield of Sheffield, an elaborate systematic research on the properties of the nickel-steels. In all, seventeen different kinds of physical, mechanical, and chemical tests have been performed on the different samples used, which contained varying amounts of nickel up to 16 per cent. The results obtained will shortly be submitted to the alloys research committee of the Institution of Mechanical Engineers.

An investigation on modern high-speed tool steels, such as those shown in use in the engineering department on Friday last, has also been completed by Dr. Carpenter, cooling curves and photomicrographs having been obtained showing clearly the various modifications in structure after different heat treatment.

The optical department is rapidly being organised, and, in addition to lens testing, the work has included the accurate measurement of the angles of prisms and determination of the optical constants of numerous samples of glass.

In the weights and measures department, the chief work has been the study of the master screw of the new leading-screw lathe, which has been carefully calibrated throughout its entire length.

The foregoing serves to indicate the substantial progress made by the laboratory, and to prove that though it has only been at work a little more than three years, it has already begun to make its mark on the science and industry of the country, and to justify in a large measure the expectations of its promoters.

FUNGI.[1]

HAVING pointed out that the attempts to derive the word fungus from *funere*, or *funus* and *ago*, *fungor*, &c., have been shown to be failures—that it comes from the Greek σπογγος, and is the same word as sponge, the lecturer proceeded to give illustrations of the fungi known to the ancients. These were, of course, all of the larger kinds, since no knowledge of micro-fungi was possible. Nevertheless, references in the Old Testament show that certain diseases—mildew, smuts, &c.—were known to the Hebrews, but of course their connection with fungi was not suspected.

[1] Abstract of a discourse delivered at the Royal Institution on February 24 by Prof. H. Marshall Ward, F.R.S.

The Greeks and Romans not only knew several forms of Amanita, Agaricus, Boletus, Polyporus, and of Truffles, Morels, &c., but they discriminated clearly between the poisonous and wholesome species.

Their ideas as to the nature and origin of such fungi seem childish to us, but they were consistent with the naïf attitude of the Greeks towards natural objects. Theophrastus, about 320 B.C., Dioscorides, about 60 B.C., and Pliny, for example, argued that since truffles and other fungi had no roots, leaves, stems, &c., they are objects apart. They arise spontaneously from earth, or by fermentation from the sap of trees, or from water.

It is interesting to note that *Polyporus officinalis* was imported and used as an article of medicine not only during classical times, but also for centuries afterwards.

In mediæval times the herbalists chiefly copied from Galen, Theophrastus, &c., and as they had no figures the early herbals give us little information. In 1576, however, Clusius gave a series of wood-cuts which are well worth looking at, and in 1601 he made a series of water-colour sketches of eighty-two of the fungi of Austria—the first drawings of the kind known. Figures in Dalechamps, 1536, Dodoens, 1583, and Parkinson, 1640, may also be compared.

The next step forward was only possible after the microscope had come into use as a scientific instrument.

It is a curious point that abundant and conspicuous as the powdery spores of the fungi are, no one seems to have observed their importance until Micheli, in 1729, collected and sowed a series of them, and with results, for he obtained mycelia, and in a few cases even sporophores; but it was not until a century later, 1820, that Ehrenberg, in his classical "De Mycetogenesi," traced the larger fungi to their mycelial filaments, collected and sowed spores, and grew several species of Moulds, and especially discovered the sexual act in Zyzygites. For although Micheli's ideas had been confirmed by Gleditsch in 1753 and by Schaeffer in 1762, Rudolphi and Persoon had more or less denied the germination of spores, and insisted on the spontaneous generation of the moulds.

However, before 1840 Nees von Esenbeck had cultivated a Mucor from spore to spore, and Dutrochet, 1834, and Trog, 1837, had seen the "puffing" of asci and practically established the doctrine of wind-distribution of spores.

By these and similar successes the era of the Mould-fungi was initiated, and the labours of Corda, Tulasne, Pringsheim, Cohn, and De Bary soon introduced system into their study, and especially the exact study of life-histories showed what important results for morphology lay in the biological investigations of these micro-fungi.

The lecturer here gave illustrations of the commoner types of mould fungi, with notes on their botanical importance, and some remarks on the points he wished to emphasise later.

An early outcome of the investigations of the moulds and their allies was the discovery of what curious substrata some of them grow upon. A rapid survey of all saprophytic fungi shows that while the majority grow on the soil, on plant remains, or on dung of various kinds, peculiar forms or species occur on such bodies as resin, cork, bees' and wasps' nests, bones, limestone, insect-remains, horn, hair, feathers and hoofs, fats, and in chemical solutions such as picric acid, copper sulphate, arsenic, and poisons such as atropin, muscarin, and so forth.

Here, also, the lecturer gave some notes on details, of which the most striking was, perhaps, his own proof that the horn-destroying fungus will not act until its spores have been passed through the alimentary tract of an animal, or subjected to the influence of gastric juice.

In 1866, the year of publication of De Bary's book on mycology, a revolution in the study of fungi was brought about by the first morphological proof of parasitism and infection, and the clear distinction drawn between the saprophytic micro-fungi or "moulds" and the parasitic fungi which induce "diseases." The matter was of especial importance as explaining away prevalent erroneous ideas according to which these disease-fungi were outgrowths (*exanthemata*) from the moribund tissues of the host-plant itself.

De Bary's great service was to prove that a spore of a fungus arrived from outside, and after germinating on the

leaf or other organ of a plant, bored its way in, or through a stoma, and entered the tissues. Here it lived, as does a plant in any other medium, at the expense of the substances in the tissues, which it eventually kills. It then emerges and develops its spore on the outside.

Thus was founded the "germ theory" of disease.

The lecturer here gave illustrations of the kinds of parasites referred to, and showed how the spotting of leaves is brought about by various epiphytic and endophytic forms, such as Oidium and Erysiphe, Phytophthora, Ustilagineæ and Uredineæ, &c., and directed attention to certain special genera, such as Botrytis, Aspergillus, &c.

That the ancients were acquainted with the phenomena of rot in timber is attested by remarks of Theophrastus on hollow trees and the decay of oak; but it was not until about 1830 that any idea of connecting the phenomena with fungi can be traced, and even then Theod. Hartig, who discovered hyphæ in the rotten wood, thought they originated from the wood-fibres themselves. Schacht, in 1850 and 1863, figured many instances of hyphæ in wood, and showed that the fungus fed on the starch, pierced the cell-walls, and in some way induced their putrefaction; and to these and Willkomm's researches, in 1864, we may trace the origin of our knowledge of fungi as the causes of decay in timber.

Meanwhile the palæontologists also were bringing forward examples of fungus-hyphæ in fossil woods.

But the real founder of this important subject was R. Hartig, who in his works, 1874 and 1878, proved that not only are there several kinds of wood-rots in different species of trees, each induced by different forms of fungi, but that the different woods show special markings, and break up in peculiar manner for each case, so that particular kinds of rot can be recognised by particular symptoms. Hartig, moreover, showed how the fungi got into the tree, and that these wound-fungi have special peculiarities. He traced their hyphæ into the vessels and wood-elements, showed how they pierce the cell-walls, and, most important of all, proved that they dissolve out from the wood-elements the lignified constituents to which their fundamental physical properties —as wood—are due, and either leave the delignified walls soft and cellulose in character or dissolve them to a jelly.

Here the lecturer showed illustrations of the mode of action of dry rot, of *Polyporus igniarius*, and of other wood-destroying fungi, and referred to Czapek's recent discovery of Hadromal, the probable uniform constituent of wood hitherto vaguely known as Lignin.

In another direction activity was turned to the fungi which attack insects, and which are now known often to become epidemic, to the great advantage of areas devastated by locusts, cockchafers and other grubs, caterpillars, &c.

It is a remarkable fact that whereas the diseases of plants due to fungi are numbered by their thousands, only some two hundred or so of animal maladies due to fungi proper are known. Whether this is due to the more acid nature of vegetable sap, to the high temperature of animal tissues, or to the greater abundance of the anti-bodies in animals cannot be decided.

The lecturer gave illustrations of caterpillars with their destroyers, Cordyceps, Isaria, &c., growing from their mummified bodies, and referred to Torrubia's "Vegetable Wasp" legend of 1749. He also showed photographs of the "plant-worms" used in Chinese medicine, and rapidly surveyed the work of Cesati, Pasteur, De Bary, Cohn, &c., on Muscardine, Entomophthora, Empusa, Saprolegnia, and other insect-killing fungi.

But these entomophagous fungi are merely particular cases of mycoses. Every group of animals from the Protozoa and Infusoria upwards have their fungus parasites; hyphæ penetrate the ceratin of sponges and the calcareous walls of corals, and fishes and amphibia are by no means immune.

Birds and mammals suffer particularly from certain mycoses due to fungi which we have been in the habit of regarding as harmless moulds, *e.g.* Aspergillus, and even man is sometimes in danger from such fungi.

When, in 1869–70, Grohe and Block showed that small doses of the spores of Penicillium and Aspergillus are fatal to kittens, their statements were emphatically disbelieved; but Grawitz confirmed them, and the body of evidence showing that Aspergillus contains poisons toxic to birds and higher animals can no longer be overlooked. Some of these forms of aspergillosis are very serious diseases indeed.

While the new era of mycology was stimulating observers to new investigations into the life-histories of moulds, and of the parasites of animals and plants, and into the ætiology of the timber-destroying fungi, and so forth, on the one hand, it was, on the other, gradually attracting to its domain areas of investigation which had grown up independently out of the past, and which the older thinkers could never have dreamed of associating with fungi.

A conspicuous example was the study of fermentation, which, since Janssen in 1590 had brought forward a microscope of several lenses, and Leeuwenhoek had applied an improved form of it to the animalculæ in putrefying liquids, had undergone the initial stage of passage into the hands of the naturalists.

The lecturer then sketched in rapid outline the history of the theory of fermentation, from the early days when the lees or sediment (yeast) were known as the "*Faeces Vini*"—apparently owing to the shrewd suggestion of a Venetian doctor, who, in 1762, said putrefactive and fermentation processes are due to the vital activity of minute worms, the excreta (*faeces*) of which induce the turbidity and mal-odour of the liquid—to the days when the living plant-nature of these "*faeces*" was gradually established by the work of Astier, 1813, Desmazières, 1826, Quevenne, 1838, and Persoon, and especially by Erxleben, 1818, Kützing, 1834, Cagniard Latour and Schwann, 1837.

At the same time, the sketch included an outline of the first great controversies regarding abiogenesis or spontaneous generation, brought forward from its ancient strongholds in the ignorance of the classical and mediæval writers—*e.g.* Pliny, Bock, Van Helmont—by Needham in 1745, and confuted by Spallanzani, 1765–76, Schultze, 1836, Schröder and Dusch, 1854; and to which the *coup de grâce* was given by the work of Pasteur, 1862, Cohn, 1870–75, and Tyndall.

Information derived from the brewing of quass, saki, pulque, kava, toddy, koumiss, mead, metheglin, spruce and other beers and wines by peoples all over the world has only confirmed the ideas, of Pasteur especially, that all such fermentations are due to the presence of fungi; and although the discussions as to the process itself being due to catalytic actions and the communication of internal movements to the molecules of sugar broken up, initiated by Stahl in 1697, and revived in various forms by Liebig, 1839, and Naegeli, 1879, culminating in Buchner's views on the discovery of zymase in 1896–97, have modified the older forms of the vitalistic theory of Cagniard Latour and Pasteur, they have not dissociated fermentation from the life of the cell.

The lecturer then passed to a survey of the enzymes, those remarkable bodies which, though not themselves living, are capable of breaking up organic substances apart from the protoplasm of the cells which secrete them, and showed that since the discovery of diastase in malt by Payen and Persoz in 1833, of pepsin in gastric juice by Schwann in 1836, and of invertase in yeast by Berthelot in 1860, numerous other special enzymes have been isolated, and all the principal forms of sugar-inverting, starch-saccharifying, cellulose-dissolving, fat-splitting, proteid-converting, and oxidising enzymes occur in the fungi. Bourquelot has shown the presence of nine such enzymes in *Polyporus sulphureus* and of seven in Aspergillus alone.

The presence of certain deadly poisons in putrefying fish, flesh, &c., and the researches consequent on the increasing knowledge of septic poisoning of wounds—with which Lister dealt so practically at the time—led to researches which, in the hands of Brieger, Sonnenschein, Armand Gautier, Selmi, and others resulted in the isolation of more or less specific bodies, such as sepsin, cadaverine, ptomaines, leucomaines, &c. In 1876 Neucki obtained an unusually pure form, and the doctrine of ptomaine poisons may be regarded as thereby established.

For us, the point of interest here is that these poisons proved to be analogous, if not identical as a class, with a number of vegetable poisons, such as atropine, brucine, nicotine, strychnine, or at any rate presented striking resemblances to them in their physiological actions.

As close, or even closer, resemblances were found in the poisons extracted from the fungi; amanitin, bulbosin, cornutin, sphacelotoxin, &c., all came under the same general category. In 1880 Pasteur showed that fowl cholera could be produced by means of the poison excreted by the bacilli, from which the bacilli themselves had been removed; and

Brieger, in 1885, then showed the same to be true for tetanus and typhoid. Löffler, 1887, and Hankin, 1890, then showed the same to be true for diphtheria and for anthrax, and the toxins of tetanus, cholera, &c., were obtained shortly afterwards.

Thus was founded the doctrine of toxins. The bacilli of disease do not merely induce the formation of ptomaine poisons in the decomposing tissues; they form the toxins in their own cells, and then excrete them.

The lecturer then referred to the similarities of the venenenes of snakes, scorpions, and spiders; of the toxins in eels' blood; and of the vegetable toxins ricin, robin, &c., emphasising the fact that all these bacterial, animal, vegetable, and fungal poisons belong to one and the same great family of toxic bodies.

The horribly intoxicating and poisonous drink made by certain Siberian and Kamschatkan peoples from the fly Agaric, the dry gangrene and paralysis due to ergotism, now a rare disease in western Europe, and the effects of the toxins of tetanus, diphtheria, and other bacilli, all have points in common with the poisons of snakes, of certain seeds, and so on—certain Australian species of Swainsonia impel horses which have eaten it to behave as if trying to climb trees, or to refuse to cross a twig as if it were a large log, reminding one of the effects of *Amanita muscaria* on man.

In great part, if not entirely, owing to an experiment of Nuttall's in 1888, in which he found that normal blood has bactericidal properties, researches were undertaken which resulted in the discovery that the sera of animals, either normally or if rendered immune by minimal doses of toxins, contain antidotal substances to the toxins. Behring and Kitasato, in 1890, who demonstrated the antitoxic power of blood immunised with diphtheria or tetanus to the toxins of these bacilli, were followed in rapid succession by Brieger, Ehrlich, Pick, and others, and the doctrine of the anti-enzymes and antitoxins was established.

The lecturer then gave two illustrative cases. Dunbar, in 1903, showed that hay-fever, as already maintained by others, was not only due to the pollen of grasses, but he isolated from the pollen-grains a toxin which itself induces all the symptoms of the malady.

Not only so. He showed that the serum of horses, &c., to which the hay-fever is communicated becomes antitoxic to the malady. This antitoxin has been distributed, and the statistics uphold the accuracy of Dunbar's views.

That pollen-grains contain enzymes has long been known, and the experiments of Darwin and others have shown that some pollens are poisonous to the stigmas of the wrong plant. Another suggestive illustration is that given by Woron, in which, bees having conveyed pollen, together with the spores of a Sclerotinia, to the stigmas of certain species of Vaccinium, the pollen-tubes and the fungus-hyphæ race each other down the style, and the latter usually win, and destroy the ovules. Moreover, everyone knows how corrosive and destructive the pollen-tubes of pines, &c., are in the tissues, and we must not forget that pollen-grains are spores.

The second case dwelt on by the lecturer is that of pellagra, a disease to which the ill-nourished peasantry of maize-growing countries are liable in bad seasons, when the crops are poor and mouldy.

Cene and Beste, in 1902, referred the malady to the presence of an Aspergillus in the bad grain. They also extracted from this mould a highly toxic body. Mariani, in 1903, then showed that the blood of patients cured of pellagra is antitoxic to the poison of the disease.

The lecturer pointed out that, without committing ourselves to any premature opinion as to the absolute accuracy of these views, there are two increasing classes of evidence which support his suspicion that numerous as yet insufficiently examined cases of this kind will turn out to be due to what he calls "lurking parasites" in bad grain and fodders.

The first is the large class of mycoses now referred to the poisonous action of such a "mould" as Aspergillus, a fungus shown to abound in enzymes and toxic bodies. The second is the increasing number of cases of poisoning by fodder and grain-plants, normally wholesome, but found to be deleterious in certain circumstances or years.

Cases of poisonous wheat, oats, &c.—the "Taumel-Getreide," "Taumel-Roggen" of the Germans—have long been known, and the lecturer quoted cases where similar noxious effects are traced to the presence of Ustilagineæ, Helminthosporium, Cladosporium, and other fungi.

A notable case is that of the Darnel, a tiresome weed in some countries. The ancients—*e.g.* Galen—knew that darnel in bread causes dizziness, headache and sickness, and thought that neglected wheat, &c., was transformed into darnel. Hofmeister, in 1892, examined and extracted the toxic bodies, and confirmed the repeated statements as to their deleterious and even fatal action on animals.

Yet it was not until 1898 that Vogl discovered the existence of a mycelium in the seed-coats of the poisonous darnel, and in the same year this was confirmed by Hanausek and Nestler, though they did little beyond recording the presence of a fungus.

In 1903, Freeman, in the lecturer's laboratory at Cambridge, worked out the details, and left no doubt that the poisonous property is due to the fungus.

The lecturer then pointed out that a whole series of questions concerning these and similar diseases now being investigated in his laboratory lie under suspicion of connection with grain-poisoning, or at any rate with poisoning of fungi introduced as food.

To say the least, we want further and extensive researches from this point of view into the ætiology of Acrodymia in Mexico, Algeria, &c., and of the Colombian Pelade, of the "trembles" of cattle and sheep, and of the "milk sickness" of the North American prairies, and even diseases like beri-beri, &c.

The conclusions, the lecturer pointed out, to which we are driven may be thus summarised:—

(1) Fungi, like animals and other plants, including bacteria, excrete enzymes, and utilise them in the same way and for the same purposes.

(2) The poisons of the fungi are toxins, not only similar in character to the poisonous alkaloids, toxalbumens, &c., of the bacteria, and of the higher plants, the venenenes of the snakes, &c., but their poisonous actions in the paralysis of nerve-ends, &c., are essentially the same.

(3) These poisons, &c., introduced into the blood of animals, call forth the activities of antitoxins and anti-enzymes, as do the toxins of animals, bacteria, &c., in similar circumstances.

(4) The presumption is, therefore, justified that the action of the enzymes and toxins of parasitic fungi on the proteid cell-contents of their plant-hosts is similar in principle to that on animal proteids, and that the host reacts by means of anti-enzymes and antitoxins.

The lecturer then adverted to the difficulties of obtaining the toxins and antitoxins from sap, and concluded by showing in specific cases—the rusts of wheat and grasses—how probable it is that, since no anatomical features explain the facts of predisposition and immunity, and the latter cannot be referred to climatic conditions or to peculiarities of soil, &c., the above considerations will be found to apply, a matter dealt with elsewhere by the lecturer.

TRYPANOSOMIASIS AND EXPERIMENTAL MEDICINE.[1]

THE greater portion of the first Report deals with the subject of human trypanosomiasis, particularly in the Congo district. The trypanosomata are flagellated protozoa, which have been found to be parasitic in many animals, sometimes causing no symptoms, as in the rat, but sometimes associated with serious effects, as in the tsetse-fly disease of the horse. During the last few years trypanosomata have been found to be parasitic in man in various districts of West and Central Africa. If the infected person shows irregular fever without other marked symptoms the condition has been termed trypanosomiasis; if in addition there is somnolence and stupor, and later wasting, convulsions, and fatal coma, the condition is the

1 "Reports of the Trypanosomiasis Expedition to the Congo, 1903-1904." Liverpool School of Tropical Medicine. Memoir xiii. Pp. 111. (1904.) Price 15*s*.

"The Thompson-Yates and Johnston Laboratories Report." Vol. vi. (New Series), Part i., January, 1905. Pp. 205. (University Press of Liverpool; London: Williams and Norgate.) Price 12*s*. 6*d*.

dreaded sleeping sickness which has destroyed tens of thousands of lives in Central Africa. Much of the matter in the volume under review deals with the relationship between these two diseases.

The first article is a report by Messrs. Dutton, Todd, and Christy on an expedition into the Congo Free State, undertaken at the request of the King of the Belgians. At the hospital at Boma, and during a journey into the cataract region, a number of patients were seen who were regarded by the district medical officers as cases of sleeping sickness, but in whom the somnolence, so characteristic of the disease in Uganda, was completely absent. Nevertheless, trypanosomes were found in the blood both of those cases in which the diagnosis of sleeping sickness was certain and of those which were atypical. But in addition trypanosomes were frequently seen in the peripheral blood of apparently healthy individuals.

In the next article, the relationship of human trypanosomiasis to Congo sleeping sickness is discussed by

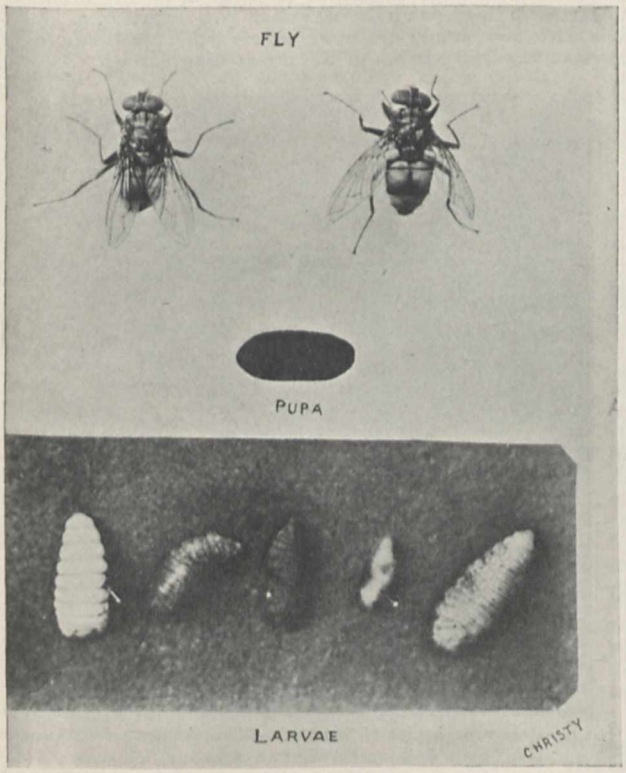

FIG. 1.—Flies, pupa and larvæ (nat. size) of the Congo Floor Maggot.

the same observers. The conclusion is arrived at that the *Tr. gambiense* of the first-named condition is the probable cause of Congo sleeping sickness; but it must be admitted, in spite of the positive statements which have been made on the subject, that something remains to be cleared up. This view is confirmed by Dr. Christy's researches on the cerebro-spinal fluid in sleeping sickness. He considers that all that can definitely be stated is that (1) on the whole the presence of the trypanosome parasites in the cerebro-spinal fluid tends to increase the gravity of the case, (2) in many cases trypanosomes never find their way into the cerebro-spinal fluid, and (3) in the vast majority of cases death is the result of complications, mainly bacterial infections.

The identity or non-identity of the various trypanosomes of man has been investigated by Dr. Thomas and Mr. Linton, who conclude that the parasites found (*a*) in the cerebro-spinal fluid of Uganda sleeping sickness, (*b*) in that of Congo Free State sleeping sickness, (*c*) in the blood of Uganda trypanosomiasis cases, and (*d*) in the blood of Congo Free State trypanosomiasis cases, are all identical in morphology and animal reactions with the *Tr. gambiense*.

In an interesting paper, Messrs. Dutton, Todd, and Christy describe the Congo floor maggot, a blood-sucking dipterous larva extensively found in various parts of the Congo Free State, and identified by Mr. Austen as the *Auchmeromyia luteola*, Fabr. These larvæ seem to lurk in the cracks and crevices of the mud floors of the native huts, from whence they emerge at night and attack the persons sleeping there. The volume concludes with a note by Mr. Austen on tsetse-flies. Since his monograph on the tsetse-flies was issued, further observation has convinced Mr. Austen that the *Glossina tachinoides*, regarded by him as a variety of *G. palpalis*, must be reckoned as a distinct species.

The volume of the Thompson-Yates and Johnston Laboratories Report contains the reports on trypanosomiasis, &c., described above, and several additional papers of interest. Dr. Stephens describes a new hæmogregarine from an African toad, two cases of intestinal myiasis (fly larvæ) observed in children in Liverpool, a note on swellings of uncertain ætiology in a tropical patient, and a note on non-flagellate typhoid bacilli. The last named were from an old laboratory strain which had been subcultured for some years, and seemed completely to have lost their flagella and motility. Mr. Shipley describes a new human trematode parasite from German West Africa, and Mr. Dutton defines the intermediate host of a lymph worm (filaria) of an African swift; this is found to be the louse which infests these birds. Prof. Moore and Mr. Roaf contribute an important experimental study of the physical chemistry of anæsthesia, from which they conclude that chloroform forms an unstable chemical compound or physical aggregation with proteid and hæmoglobin, and is carried in the blood in such a state of combination, the compounds so formed limiting the chemical activities of protoplasm and inducing anæsthesia. Mr. Edie describes the action of chloroform on serum proteids and hæmoglobin, and, lastly, Mr. Roaf and Mr. Edie describe a simple method for the preparation and determination of lecithin which seems to be a great improvement on the methods hitherto in use. Both volumes are beautifully printed and illustrated, and appear in a new cover, which, artistically, is a great improvement on the old one. R. T. HEWLETT.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The General Board of Studies has appointed Mr. T. S. P. Strangeways, St. John's College, Huddersfield lecturer in special pathology, from Lady Day, 1905, until Michaelmas, 1909, and the appointment has been confirmed by the Special Board for Medicine. Mr. R. P. Gregory, of St. John's College, has been appointed senior demonstrator in botany for four years, until June 24, 1909.

The list of successful candidates for open scholarships at Downing College is so far unusual that all the winners are natural science students. It is as follows:—A. W. Bourne, Rydal Mount School, Colwyn Bay, 50*l.*; A. C. Johnson, Merchant Taylors' School, 40*l.*; W. G. Stevens, The Leys School, Cambridge, 40*l.*; I. K. Matthews, Merchant Taylors' School, Crosby, Liverpool, 40*l.*

OXFORD.—The university has resolved to contribute a sum not exceeding 1000*l.* towards the printing of that portion of the British section of the International Astrographic Catalogue which has been executed at the university observatory.

By a statute passed in 1904, the university established a "diploma in scientific engineering and mining subjects," and the committee appointed to arrange the details of the scheme has now issued the regulations concerning the diploma. Members of the university will be eligible for the diploma who have passed at the examinations required for the degree of B.A., and have satisfied the examiners in certain special subjects mentioned in the following list, after an approved course of study in those subjects extending over two years, and have also gone

through an approved course of practical training lasting four months, either at a mine or in engineering works. The subjects that may be offered are:—(*a*) mathematics for applied science; (*b*) physics and chemistry; (*c*) French and German translation; (*d*) engineering principles and machine drawing; (*e*) surveying; (*f*) geology; (*g*) mineralogy; (*h*) mining and engineering, hygiene and mine-ventilation; (*i*) electricity; (*j*) assaying. For the ordinary diploma candidates will be required to pass in (*a*), (*b*), and (*c*), and in not less than three of the remaining subjects, provided that (*f*), (*g*), and (*i*) are not taken together without one or more of the others. Candidates who propose to become colliery managers and desire to obtain exemption from two of the five years' underground work required by the Home Office as a qualification for a certificate as colliery manager, must obtain a special diploma by passing in the subjects (*a*), (*b*), (*c*), (*h*), and three (not being *f*, *g*, *i*) of the remainder, and by taking their four months' course of practical training at a mine.

PROF. W. JAMES, of Harvard University, has accepted, *Science* reports, the acting professorship of philosophy at Stanford University. He will lecture at Stanford during the second half of the next academic year, and will organise a department of philosophy for the university.

A GENERAL meeting of the Association of Teachers in Technical Institutes will be held on Saturday, March 25, at the Regent Street Polytechnic, London, when an address, to be followed by a discussion, will be delivered by Mr. W. J. Lineham, head of the engineering department, Goldsmiths' Institute, entitled "Technical Training—a Teacher's Views."

IN connection with the International Exposition to be held at Liége, Belgium, from April to November during the present year, it is proposed to hold an International Congress of Childhood on September 17–20. The congress will be organised in four sections, as follows:—(1) education of children; (2) study of children; (3) care and training of abnormal children; (4) parents' associations, mothers' clubs, and other supplementary agencies for the improvement of youth.

THE council of Liverpool University has accepted an offer from the president, Mr. E. K. Muspratt, to provide for an extension and equipment of the chemical laboratories at an estimated cost of 10,500*l*. The following contributions for the extension and maintenance of the chemical department have also been acknowledged by the council:—100*l*. per annum for five years from the United Alkali Company, Ltd., 100*l*. each from Mr. George Wall, West Kirby, and Mr. T. Threllfall, London.

A NEW technical college and secondary school at East Ham was opened by the Prince and Princess of Wales on Saturday. The building has been erected and equipped at a cost of about 24,000*l*., towards which the Essex County Council has contributed 6000*l*., and the remainder has been made up by the East Ham Corporation. The accommodation includes a botanical room, chemical class-room and laboratory, physics laboratory, carpenter's shop, and provision for the pursuit of various crafts—plumbing, metal-work, brickwork, &c. In replying to the address presented by the Mayor of East Ham, the Prince of Wales said:—It is difficult to realise that only ten years ago these crowded streets were green lanes, that your population has multiplied nearly twentyfold in the last thirty years, and that within your borough one industry alone employs more than 10,000 men. You have very rightly recognised that this remarkable growth carries with it serious responsibilities. The vast and rapidly increasing population of the borough necessitates the provision of suitable secondary and technical education, and in this institution you are furnishing that educational equipment for the rising generation which is indispensable if we intend to maintain our place in the great struggle for commercial supremacy. My heart is with you in all such undertakings as that which we are about to inaugurate, and I trust that every success may attend your useful and patriotic efforts.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 16.—"Further Observations on Slip-Bands.—Preliminary Note." By Walter **Rosenhain**. Communicated by Prof. Ewing, F.R.S.

The paper describes what the author believes to be a novel method of investigating the micro-structure of metals, and some preliminary results obtained by its aid. The method was devised in order to throw further light on the true nature of slip-bands, and the preliminary results relate mainly to this question.

A direct means of examining the surface configuration of a piece of metal upon which slip-bands have been produced would be presented by a transverse section of such a specimen, provided that the section could be produced with an absolutely sharp edge, but no useful result can be obtained by cutting the specimen through and simply polishing the exposed section. The edges of specimens prepared by the usual methods of polishing are always rounded off, so that it becomes impossible to focus upon any definite edge with high-power lenses; and even apart from this defect, there would be no guarantee that the edge represented a true section of the pre-existing surface.

FIG. 1.—Transverse Section of Slip-bands. Vertical illumination × 1000 diameters.

The author has adopted the principle sometimes used in optical work of supporting the surface, which in section becomes the edge, by means of an adherent layer of hard material; but the conditions which such a layer must satisfy for the purposes of metallography are very stringent. In order to satisfy them, the author uses a deposit of another metal obtained by electrolytic means, and this method has proved satisfactory.

The specimens used consisted of strips of the mildest steel, and after preparation an electro-deposit of copper was applied to them. By first bending the strips into a flat **U** shape, short portions of their length could be polished in the usual manner for microscopic examination; subsequently the strips could be readily strained in tension. The slip-bands and other features of the specimens having been satisfactorily observed, electro-deposition was proceeded with, care being taken to avoid chemical action on the prepared surface by the preliminary use of a bath of copper cyanide.

The specimens were then cut across. In order to obtain a satisfactory polish, the ordinary method of polishing had to be modified; it was found that polishing with rouge rapidly eroded a deep groove between the copper and iron,

thus defeating the object of the method. A satisfactory polishing medium for this and other purposes where surface erosion is undesirable was found in calcined oxide of magnesium, the magnesia powder being used in the same way as rouge.

The section, when polished by means of magnesia, is not yet ready for examination, as it is found that a considerable amount of metal is smeared or dragged over the surface, more or less obliterating the true boundary line which it is desired to examine. To overcome this obstacle, it is arranged that the last rubbing on emery paper shall be done in a direction approximately parallel to the boundary of the two metals; the direction of rubbing during the final polishing should then be at right-angles to the boundary, the unavoidable tendency to drag or smear then being such as to draw the iron over the copper on the side where the boundary is to be examined.

The film of metal smeared over the boundary in these circumstances is extremely thin, and can be removed by slight etching with picric acid. This treatment leaves a clearly defined boundary line appearing under a certain incidence of "vertical" illumination as a narrow black line, and under other illumination being visible merely by the colour-contrast between the iron and copper.

When a previously polished and etched specimen of iron which has had slip-bands developed upon its surface by strain is treated and examined in this way, the boundary line shows well-marked steps or serrations, readily visible under a magnification of 1000 diameters. To show that these steps were not due to any of the processes gone through by the specimen, such as the initial etching of the prepared surface or the electro-deposition itself, a series of test specimens was prepared and treated in a similar manner, except that either the preliminary etching, or the deformation, or both, were omitted. The stepped boundary was always found in specimens where slip-bands had been produced, but not otherwise.

The author therefore feels justified in concluding that the steps seen in transverse sections of strained specimens are the sectional views of slip-bands. It will be seen that the steps, although very minute, are perfectly distinctive, and that they could not be mistaken for generally rounded foldings of the surface; they possess, in fact, a general geometrical character, which the author regards as conclusive evidence that they are caused by slip on cleavage or gliding planes of the crystals, and not by any folding or crumpling of the metal.

"The Effects of Momentary Stresses in Metals." By Prof. Bertram **Hopkinson.** Communicated by Prof. Ewing, F.R.S.

If a wire be hung from a firm and massive support, and if a falling weight strike a stop at the lower end of the wire, with a velocity V, it is easy to calculate the strain at any point in the wire at any subsequent time, if it be assumed to be perfectly elastic. When the weight strikes, a wave of extension starts up the wire and travels with a velocity $a = \sqrt{E/\rho}$, where E is Young's modulus, and ρ is the density. For steel a is about 17,000 foot-seconds. When the wave reaches the top end, it is reflected down the wire. The history of the strain at any point of the wire is as follows:—When the wave reaches it, the strain, which was zero, suddenly becomes V/a; it then diminishes as the wave passes over it, according to an exponential law, until the reflected wave reaches it, when it again increases by V/a. Each bit of the wire is, therefore, subjected to strain which rises suddenly, and then very rapidly diminishes. The maximum strain at any time or place occurs at the top of the wire, where it is $2V/a$ at the moment when the wave arrives there. For a height of fall of 10 feet, and an iron wire, $2V/a$ is 0·003, and the corresponding stress is about 42 tons per square inch, so that momentary strains greatly exceeding the elastic limit may be produced in this way.

In the experiments described in the paper, the momentary extension in the top 20 inches of the wire, produced by a blow, was measured by electrical means, and compared with that given by the elastic theory. Where the two agree, and not much permanent extension is left, it follows that the theory is correctly applied, and that the material is substantially elastic up to the maximum stress, so calculated, if applied for the time given by the theory. In this way it is proved that a metal wire will stand a load, momentarily exceeding that which (steadily applied) would break it, with but very small permanent extension. In the case of the iron wire, the elastic limit was 17.8 tons per square inch, and the breaking stress 28.5 tons; and it was found that a load reaching 33½ tons, and exceeding the elastic limit for 1/1000 sec., produced very little permanent extension. Similar results were found for copper wire.

February 23.—"On a New Rhabdosphere." By George **Murray,** F.R.S.

The author refers to the interest which the rhabdospheres and coccospheres possess, not only to naturalists, but to geologists and students of deep-sea deposits. He names it *R. Blackmaniana,* after Mr. V. H. Blackman, his fellow author in an exhaustive study of such organisms (*Phil. Trans.*, B., vol. cxc., 1898). It was obtained by Mr. Murray on the outward voyage to the Cape of the *Discovery,* in lat. 28° 25′ S., long. 23° 56′ W., and differs from the only other forms, two in number, known to science in possessing tapering, acute, spinous processes in contrast to the trumpet-shaped and club-shaped processes of the two known species. No sign of the new form has yet been detected in the deep-sea deposits or geological formations, Mr. Murray accounting for this by the minuteness and extreme tenuity of the spines.

March 2.—"Further Researches on the Temperature Classification of Stars, No. 2." By Sir Norman **Lockyer,** K.C.B., F.R.S.

The paper contains a discussion of the more recent photographs obtained with a calcite-quartz prismatic camera. Each negative contained the spectra of two stars, obtained under identical conditions of altitude, exposure and development, the relative temperatures of which were estimated by comparing the relative intensities of their ultra-violet and their red radiations. The term "temperature" is understood to include the possible effects of electrical variations. In a previous paper, communicated to the society in February, 1904, the author showed that by thus comparing the relative temperatures of those stellar genera which were placed on different levels of the chemical classification temperature curve, their arrangement on that curve was vindicated. In the recent research the relative temperatures of the genera placed on the *same* horizons, but on the opposite sides, of the curve were similarly compared, with the result that their equality of temperature, as suggested by the chemical classification, was confirmed. The results also indicate that *specific* differences exist which will necessitate the subdivision of the previously proposed "genera" into "species."

Entomological Society, March 1.—Mr. F. Merrifield, president, in the chair.—*Exhibitions.*—(1) An example of *Oxypoda sericea,* Heer, taken in Dulwich Wood, June 17, 1904, a species new to Britain; (2) *O. nigrina,* Wat., with a type lent by Mr. E. A. Waterhouse, to demonstrate that it is not synonymous with *sericea* as stated on the Continent; (3) *O. exigua,* which is also regarded there as synonymous with *nigrina*: H. St. J. **Donisthorpe.**—Series of *Colias edusa,* with var. *helice,* bred from one ♀ *helice,* sent by Dr. T. A. Chapman from the South of France, to show the proportion of type and variety obtained: H. **Main** and A. **Harrison.** The results of similar experiments with *Amphidasys betularia,* bred from a ♂ var. *doubledayaria,* and a type ♀ taken in cop. at Woodford, Essex, in 1903, were also shown.—Specimen of *Helops striata,* showing an abnormal formation of the right antenna, which was divided into two branches from the fifth joint: R. **Priske.**—(1) Examples of *Hydrotaea pilipes,* Stein, ♂ and ♀, the latter sex being previously unknown; (2) several specimens of *Hydrotaea tuberculata,* Rond, not hitherto recorded as British, captured in various localities; P. H. **Grimshaw.**—Cocoons, and perfect imagines of hybrid Saturniids, including ♀ and ♂ of *S. pavonia,* L., × *S. pyri,* Scheff., with added specimens of both sexes of the parent forms for comparison, the cross product resembling a large *S. pavonia* rather than a small *S. pyri.* The exhibit further included three ♂ ♂ and three ♀ ♀, of which the ♀ parent was *S. pavonia,* and the ♂ parent a

hybrid between *S. pavonia*, ♂, and *S. spini*, ♀, viz. the cross product to which Prof. Standfuss has given the name *S. bornemanni*: Dr. F. A. **Dixey.**—(1) Groups of synaposematic Hymenoptera and Diptera captured by Mr. A. H. Hamm, of the Hope Department, Oxford University Museum; (2) three much worn specimens of *Papilio hesperus*, taken at Entebbe in 1903, by Mr. C. A. Wiggins, to show that the tails of a Papilio, if untouched by enemies, can endure a great deal of wear; (3) Nymphaline butterflies from northern China, apparently mimetic of the male *Hypolimnas misippus*, which is not known to occur in this region: Prof. E. B. **Poulton,** F.R.S.—Examples of *Pyrameis atalanta* and *Aglais urticae*, illustrating the effects of cold season breeding by Mr. Harwood, of Colchester, some of them lent by Mr. R. S. Mitford: the **President.**—*Papers*:—Butterfly hunting in British Columbia and Canada: Mrs. De la B. **Nicholl.**—On three remarkable new genera of Microlepidoptera: Sir George **Hampson.**—Descriptions of some new species of diurnal Lepidoptera, collected by Mr. Harold Cookson in northern Rhodesia in 1903-4. The Lycænidæ and Hesperiidæ described by Hamilton H. Druce: H. **Druce.**—Descriptions of some new species of Satyridæ from South America: F. Du Cane **Godman.**—Additions to a knowledge of the homopterous family of Cicadidæ: W. L. **Distant.**

Faraday Society, March 6.—Recent developments in electric smelting in connection with iron and steel: F. W. **Harbord.** The paper embodies the principal results of the investigations made by the commission sent to Europe last year by the Canadian Government for the purpose of reporting upon the different thermoelectric processes for the smelting of iron ores and the manufacture of steel at work in Europe, together with some additional information bringing the subject up-to-date. The author acted as metallurgist to that commission. The following general conclusions are stated in the paper:—(*a*) Steel, equal in all respects to the best Sheffield crucible steel, can be produced even in this country, either by the Kjellin, Héroult, or Keller proceses, at a cost considerably less than the cost of producing a high-class crucible steel, assuming electric energy to cost 10*l.* per E.H.P.-year. (*b*) At present, structural steel, to compete with Siemens or Bessemer steel, cannot be economically produced in the electric furnaces, and such furnaces can be used commercially for the production of only very high-class steel for special purposes. (*c*) Speaking generally, the reactions in the electric smelting furnace are similar to those taking place in the blast furnace. By altering the burden and regulating the temperature by varying the electric current, any grade of iron, grey or white, can be obtained, and the change from one grade to another is effected more rapidly than in the blast furnace. (*d*) Pig iron can be produced on a commercial scale at a price to compete with the blast furnace, only when electric energy is very cheap and fuel very dear. Under ordinary conditions, where blast furnaces are an established industry, electric smelting cannot compete; but in special cases, where ample water-power is available, and blast furnace coke is not readily obtainable, electric smelting may be commercially successful.

Zoological Society, March 7.—Dr. W. T. Blanford, F.R.S., vice-president, in the chair.—Pictures of the zebra in "Aldrovandus" (1640) and the "Commentarius" of Ludolphus (1691): H. **Scherren.** In the course of his remarks Mr. Scherren said that in the seventeenth century zebras (now known as *Equus grevyi*) had been sent by the ruler of Abyssinia to the governor of the Dutch East India Company at Batavia, and to the Sultan of Turkey, so that the species was seen in Europe two centuries before the type of *Equus grevyi* reached France in 1882. In proof, passages were cited from Philostorgius Ludolphus, Jean de Thévenot, and other writers.—A series of spirit-specimens of fishes from Lake Chad and the Chari River, collected and presented to the British Museum by Captain G. B. Gosling: G. A. **Boulenger.**—Exhibition of hybrid ducks bred at Cambridge: J. L. **Bonhote.** The crosses exhibited dealt chiefly with four species, of which the following were shown:—*Anas boschas*×*A. poecilorhyncha*, *Anas boschas*×*A. poecilorhyncha*×*Dafila acuta*, *Anas boschas*×*A. poecilorhyncha*×*A. superciliosa*, *Anas boschas*×*A. poecilorhyncha*×*A. superciliosa*×*D. acuta*.—Œcology and deposits of the Cape Verde marine fauna: C. **Crossland.** The author pointed out that so far as the Cape Verde group was concerned there was no evidence of any common tropical marine fauna, though certain species were found in both the Atlantic and Indian Oceans. Reef animals were remarkably few in number, the fauna in their place having a considerable subtropical constituent. Rock simulating coral-rag was formed at the low-tide level by serpulid tubes fused together by Lithothamnion, and by the latter and Foraminifera between 5 and 20 fathoms. The absence of reefs might be due in some degree to the remarkably steep coasts of the islands, but it was more especially owing to the extraordinary dominance of boring sponges, worms, and molluscs. Beach sandstone was formed by the deposition of calcareous cement where the fresh water met the salt; it was only found in certain situations, and was everywhere being slowly eroded away by the sea.—A revision of the South-American cichlid genera, Crenacara, Batrachops, and Crenicichla: C. Tate **Regan.** Twenty-three species were described, four of them new to science.—A new antelope from British East Africa: Captain R. **Meinertzhagen.**

Royal Astronomical Society, March 10.—Mr. W. H. Maw, president, in the chair.—Description of the spectroheliograph of the Solar Physics Observatory: Dr. W. J. S. **Lockyer.** The complete instrument consists of a siderostat to throw the solar beam in a horizontal and southerly direction, a lens placed in this beam to form the solar image, and the spectroheliograph itself to photograph in monochromatic light the image thus formed. The apparatus was fully explained and illustrated by photographs on the screen. Specimens of results obtained were also exhibited, the photographs of the sun showing the fine network covering its surface, becoming thicker and more agglomerated in middle and low latitudes to form the calcium flocculi. The sun-spots appear to be closely related to these flocculi, but the prominences bear no relation to them, though they give brilliant images in the "K" or calcium light.—The large sun-spot of January 29 to February 11, and the contemporaneous magnetic disturbances: **Astronomer Royal.** A series of photographs, taken at the Royal Observatory, Greenwich, was shown on the screen.—Spectroscopic observations of the recent great sun-spot and associated prominences: A. **Fowler.** The paper dealt with the reversed lines, the widened lines, &c., and the spectra of the chromosphere and prominences overlying the spot on the western limb.—Observations of the great sun-spot made at Stonyhurst, and photographs of the spectra: Father **Cortie.**—Reply to criticisms of a paper on sun-spots and the associated magnetic disturbances: E. W. **Maunder.**

Physical Society, March 10.—Dr. R. T. Glazebrook, past-president, in the chair.—On direct reading resistance-thermometers, with a note on composite thermocouples: A. **Campbell.** The paper describes two methods by which the reading of a resistance-box in connection with a platinum resistance-thermometer gives directly the actual temperature without the use of any formula or table.—On the stresses in the earth's crust before and after the sinking of a bore-hole: Dr. **Chree.** In NATURE, October 20, 1904, there appeared letters by Mr. G. Martin and the Hon. C. A. Parsons dealing with the size of the stresses in the earth's crust and speculating as to what would happen if a hole were bored to a depth of 12 miles. The present paper discusses the subject, treating the earth as an elastic solid, and points out the various uncertainties that exist. Solutions are presented of a number of mathematical problems having a bearing on one or other of the possibilities discussed. The principal novel case considered is that of a composite earth, consisting of a core of incompressible material and of a crust which may be compressible or incompressible.—On the lateral vibration of bars of uniform and varying sectional-area: J. **Morrow.** Lord Rayleigh has given a method by which the approximate period of vibration of a rod can be calculated without the use of transcendental equations. The question has recently been further discussed by Mr. Garrett and Dr. Chree. The object of the paper is to show that, by assuming a type of vibration consistent with the conditions obtaining at the ends of the bar, the period can be obtained approximately

in a simple manner, and that by a process of continuous approximation the period and the type of the vibration may be determined, in a large number of cases, with great accuracy.

Royal Meteorological Society, March 15.—Mr. Richard Bentley, president, in the chair.—The growth of instrumental meteorology: **President.** After briefly touching on the historic and non-instrumental era of meteorology, reference was made to the seven great weapons of meteorology—the thermometer, and of later years the heliograph, for temperature, the hygrometer and rain-gauge for moisture, the barometer for pressure, and the anemometer and kite for the study of the upper air—and of the great foundation of instrumental meteorology laid by Galileo, Torricelli, Wren and Hooke. The president, in dwelling upon our indebtedness to Italy in science (as well as in art) from Galileo to Marconi, pointed out that the theory of rainfall was correctly enunciated as early as the beginning of th fourteenth century by Dante. He also dwelt on the great services rendered to the community by meteorologists, largely by volunteers at their own expense, and referred to the close observation kept by rain-gauges on the steadily diminishing water supply of the country, by anemometers protecting the traffic over some of our lofty and more exposed railway viaducts, by the use of the barometer for storm warnings and for the safety of miners in our pits, by the heliograph with relation to the ripening of fruits and crops, and regretted how much of the immense mass of information daily accumulating had still to be analysed and put to use. It was disappointing to find in so wealthy a country as this, and where the results could not fail to be of the greatest practical utility to the nation, that the means of digestion of this vast data are so meagre, and the aid given by the Government is so slender as to be a constant source of reproach when compared with the large provision made for the same purpose in other countries for their own benefit.

DUBLIN.

Royal Dublin Society, February 21.—Dr. W. E. Adeney in the chair.—(1) On the transmissibility of tuberculosis of the monkey to the ox and goat; (2) on the use of tuberculin in the detection of tuberculosis: Prof. A. E. **Mettam.** (1) The tuberculous material was obtained from a drill monkey. After passage through guinea-pigs, emulsions of the organs of the latter were inoculated into a bull and into a goat. Both animals have been infected with tuberculosis, though free from the disease prior to injection, local lesions having been established and reaction to tuberculin being pronounced. (2) Experiments were carried out with the object of determining if an increased dose of tuberculin would reveal tuberculosis in an animal which had already a short time previously received a dose of tuberculin, and if any immunity to tuberculin was established as to how long it lasted. It was shown, as Vallée maintains, that a double dose of tuberculin would reveal tuberculosis even if the animal had received a prior dose a few days before, and that the immunity to an ordinary dose was evident for ten days to a fortnight after injection.—Secondary radiation and atomic structure: Prof. J. A. **McClelland.** Every substance gives off a secondary radiation of β particles when acted upon by the β rays of radium. The intensity of this secondary radiation, in the case of elementary substances, depends on the atomic weight; the greater the atomic weight the greater is the secondary radiation. This very general law has been found to hold true for all the elements tested, which were twenty-one in number. The paper further discusses this result from the point of view that all atoms are groups of similar electrons.

Royal Irish Academy, February 27.—Prof. R. Atkinson, president, in the chair.—A list of the Irish jelly-fishes, corals, and sea-anemones: being a report from the R.I.A. fauna and flora committee: Jane **Stephens.** This is a catalogue of all the species of Cœlenterata hitherto recorded for the coast of Ireland. The list, containing about 250 species, includes the fresh-water hydroids. In a prefatory note a short account of the Irish Cœlenterates is given; there is also a bibliography of the papers (which date back to the year 1755) dealing with the subject.—Notes on the homotaxial equivalents of the beds which immediately succeed the Carboniferous Limestone in the west of Ireland: Dr. Wheelton **Hind.** The counties of Clare and Limerick contain the Carboniferous sequence of the west of Ireland in the form of a basin, the western side of which has been cut off by the sea, and consequently the geological structure is well seen in the line of cliffs from Black Head, co. Clare, to Ballybunion, co. Kerry. In the north of Clare the beds dip gradually at 5°, and there are few or no faults. In the south of the county and in co. Limerick there have been stronger earth movements, and faulting is more frequent. The sequence shows Coal-measures (Foynes coalfield), olive grits, flags and sandy shales, black shales with bullions, Carboniferous Limestone without shales or detrital beds. The whole series is conformable and fossiliferous. The Carboniferous Limestone is characterised by the same fossils as occur in the Carboniferous Limestone and Yoredale rocks of England, and at the top of this series is a great faunal change. The black shales with bullions, which overlie the Carboniferous Limestone, contain *Posidoniella laevis, P. minor, Posidonomya membranacea, Pterinopecten papyraceus, Glyphioceras diadema, G. spirale, G. davisi, G. reticulatum, Dimorphoceras gilbertsoni, G. descrepans, Nomismoceras spirorbis,* and many others which characterise the Pendleside series and the Lower Culm of England. The marine bands intercalated in the olive grit and flag series, and the shales, recall the marine bands in the Millstone Grits. Hence it is interesting to find the same faunal sequence in the west of Ireland as exists in the midlands of England, and it is erroneous to classify the beds which succeed the Carboniferous Limestone in the west of Ireland as either Yoredales or Coal-measures, but they are the homotaxial equivalents of the Pendleside series and Millstone Grits.

PARIS.

Academy of Sciences, March 13.—M. Troost in the chair.—On surfaces applicable to the paraboloid of revolution: Gaston **Darboux.**—On the laws of sliding friction. Paul **Painlevé.** A discussion and extension of a paper on the same subject by M. Lecornu.—On the pressures developed at each instant in a closed vessel by colloidal powders of different forms: R. **Liouville.** The work of M. Vieille on the explosion of gun-cotton powders in a closed vessel led him to conclude that the speed of combustion is proportional to a power of the pressure, about 2/3. On account of the difficulty introduced into ballistic calculations, it is usual to consider the speed of combustion as proportional to the pressure. An investigation is given showing the accuracy of Vieille's exponent, and indicating where further experimental work is required.—On the explosive wave: E. **Jouguet.** The numerical data given in a previous note were calculated on the assumption that the combustion was total in the explosive wave, and that the dissociation could be neglected. In the present paper the dissociation is taken into account, the formula of Gibbs being adopted. Figures are given for mixtures of oxygen with acetylene, cyanogen, and methane, and it is shown that the dissociation may be considerable without seriously affecting the velocity of the explosive wave.—On the emptying of systems of reservoirs: Ed. **Maillet.**—On the dangers of atmospheric electricity for balloons and the means of remedying them: A. **Breydel.**—On halation in photographs: Adrien **Guébhard.**—On the atomic weights of hydrogen and nitrogen, and on the precision attained in their determination: A. **Leduc.** The value obtained by the author for the atomic weight of nitrogen from his density measurements was 14·005, but the figure still adopted by the International Committee on Atomic Weights is 14·04. It is pointed out that the lower number is confirmed by the recent experiments of Guye and Bogdan, and Jaquerod and Bogdan.—On dextrorotatory lactic acid: E. **Jungfleisch** and M. **Godchot.** The preparation of *d*-lactic acid in a pure state from its salts is complicated by the tendency to pass over into the inactive acid and by the formation of lactyl-lactic acid. The precautions necessary to avoid both these changes are given in detail, and the properties of the pure acid described.—The action of magnesium amalgam upon dimethylketone: F. **Couturier** and L. **Meunier.** The chief product of the reaction is pinacone. By the dry distillation of the magnesium compound there is produced

acetone, isopropyl alcohol, pinacoline (the principal product), and mesityl oxide. The yield of pinacoline is 21 per cent., and this forms the most rapid and advantageous method of preparing this substance.—On oxyethylcrotonic acid and ethylerythric acid: M. **Lespieau.**—On a method for the volumetric estimation of hydroxylamine: L. J. **Simon.** The method is based upon the conversion of the hydroxylamine salt into the oxalate by the addition of sodium oxalate, and titration in neutral solution by potassium permanganate. The influence of dilution and of excess of the sodium oxalate has been studied.—The glycerophosphates of piperazine: A. **Astruc.** A description of the preparation of the acid glycerophosphate of piperazine, and a method for its estimation based on the use of two indicators, phenol-phthalein and methyl orange.—On the experimental bases of the reticular hypothesis: G. **Friedel.**—The requirements of the tobacco plant in fertilising materials: A. Ch. **Girard** and E. **Rousseaux.** The average amounts of lime, potassium, phosphoric acid and nitrogen required per 1000 kilograms of dried leaves are given.—The genesis of the gametes and anisogamy in Monocystis: Louis **Brasil.**—On the Alpheidæ of the Laccadive and Maldive Islands: H. **Coutière.**—Sterility and alopecy in guinea-pigs previously submitted to the influence of ovarian extracts of the frog: Gustave **Loisel.** The ovarian extracts of the frog contain a poison which acts by causing the atrophy of a certain number of ovules. Other effects of the poison are noted.—On the antidote to nicotine: C. **Zalackas.** Experiments on rabbits and guinea-pigs show that strychnine has not the effects as an antidote to nicotine usually attributed to it. The effects of eserine are more favourable, and an extract of *Nasturtium officinale* led to still better results, the effects of a mortal dose of nicotine being entirely removed by the injection of the latter substance.—On the lowering of the arterial pressure below the normal by d'Arsonvalisation: A. **Moutier** and A. **Challamel.** In certain cases the use of high frequency, high tension currents leads to a lowering of the blood pressure under the normal. It is therefore necessary to measure this pressure with great care when d'Arsonvalisation is being used therapeutically.—A modification of the spectrum of methæmoglobin under the action of sodium fluoride: J. **Ville** and E. **Derrien.**—On the Middle Eocene deposits in Senegal: J. **Chautard.**—On the phenomena of the deviation of water courses dating from the seventeenth, eighteenth, and the commencement of the nineteenth centuries, proved my maps: E. **Fournier.** In a series of five maps of a valley near Lons-le-Saunier, dated 1658, 1748, 1790, 1841, and the present day, the various changes undergone by the water courses can be traced.—The results of a year's study of the electrical conductivity of the water of the Rhone at Lyons: M. **Chanoz.** The water supply of Lyons, obtained from the Rhone, contains mineral matter in relatively constant amounts throughout the year, as indicated by the freezing point and electrical conductivity.

DIARY OF SOCIETIES.

THURSDAY, MARCH 23.

ROYAL SOCIETY, at 4.30.—Bakerian Lecture: The Reception and Utilisation of Energy by the Green Leaf: Dr. Horace T. Brown, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Report of Experiments carried out at the National Physical Laboratory: On the Effect of Heat on the Electrical and Mechanical Properties of Dielectrics, and on the Temperature Distribution in the Interior of Field Coils: E. H. Rayner. —*Discussion*: On Temperature Curves and the Rating of Electrical Machinery: R. Goldschmidt.

ROYAL INSTITUTION, at 5.—The Reasonableness of Architecture: Thomas G. Jackson.

FRIDAY, MARCH 24.

ROYAL INSTITUTION, at 9.—A Pertinacious Current: Sir Oliver Lodge, F.R.S.

PHYSICAL SOCIETY, at 5.—Note on the Voltage Ratios of an Inverted Rotary Converter: W. C. Clinton.—On the Flux of Light from the Electric Arc with varying Power Supply: G. B. Dyke.—The Application of the Cymometer and the Determination of the Coefficient of Coupling of Oscillation Transformers: Prof. J. A. Fleming, F.R.S.—Exhibition of Cymometers and other Instruments.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Wanki to Victoria Falls Section; Victoria Falls Railway: C. T. Gardner.—Design of a Double-Line Plate-Girder Railway-Bridge: H. S. Coppock.

SATURDAY, MARCH 25.

ROYAL INSTITUTION, at 3.—Electrical Properties of Radio-active Substances: Prof. J. J. Thomson, F.R.S.

MONDAY, MARCH 27.

SOCIETY OF ARTS, at 8.—Telephone Exchanges: H. L. Webb.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Liberia: Sir Harry Johnston, G.C.M.G., K.C.B.

INSTITUTE OF ACTUARIES, at 5.—Bonuses in Model Office Valuations and their Relations to Reserves: Dr. James Buchanan.

TUESDAY, MARCH 28.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Coolgardie Water-Supply C. S. R. Palmer.

ROYAL INSTITUTION, at 5.—Vibration Problems in Engineering: Prof. W. E. Dalby.

SOCIETY OF ARTS, at 4.30.—The Manufactures of Greater Britain—Australasia: The Hon. W. H. James.

WEDNESDAY, MARCH 29.

SOCIETY OF ARTS, at 8.—British Woodlands: Sir Herbert Maxwell, Bart., M.P.

THURSDAY, MARCH 30.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On the Observations of Stars made in some British Stone Circles (Preliminary Note): Sir Norman Lockyer, K.C.B., F.R.S.—On the Distribution of Velocity in a Viscous Fluid over the Cross-section of a Pipe, and on the Action at the Critical Velocity: J. Morrow.—The Direct Synthesis of Ammonia: Dr. E. P. Perman.—The Determination of Vapour Pressure by Air Bubbling: Dr. E. P. Perman and J. H. Davies.—Note on Fluorescence and Absorption: J. B. Burke.—The Determination of the Specific Heat of Superheated Steam by Throttling and other Experiments: A. H. Peake.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.

FRIDAY, MARCH 31.

ROYAL INSTITUTION, at 9.—The Scientific Study of Dialects: Prof. J. Wright.

SATURDAY, APRIL 1.

ROYAL INSTITUTION, at 3.—Some Controverted Questions of Optics: Lord Rayleigh.

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