THURSDAY, MARCH 9, 1905.

## THE ORIGIN OF MAN.

*Morphology and Anthropology. A Handbook for Students.* By W. L. H. Duckworth, M.A. Pp. xxvii+546. (Cambridge: University Press, 1904.) Price 15s. net.

*Studies from the Anthropological Laboratory, the Anatomy School, Cambridge.* By W. L. H. Duckworth, M.A. Pp. x+291. (Cambridge: University Press, 1904.) Price 10s. net.

THE publication of Mr. Duckworth's text-book for students, bearing on its title page the rather vague terms, "Morphology and Anthropology," marks the culmination of the remarkable movement initiated by the publication of Huxley's "Man's Place in Nature" in 1863, and quickened in 1871 by the appearance of Darwin's "Descent of Man." At the commencement of this movement the subject of man's origin had its abode in the divinity schools; it was taught by theologians; the opening chapters of Genesis constituted the accepted text-book; now, in 1905, the subject is assigned to the anthropological laboratory; the lecturer on physical anthropology is its custodian, and the text-book is the work now under review.

In a clearly written introductory chapter Mr. Duckworth defines the subject-matter of his book as an inquiry into (1) man's zoological position; (2) the nature of his ancestry. That such a work is needed there can be no doubt. Ever since Darwin and Huxley gave this subject a legitimate place in the hands of biologists, experts have been busy as ants, seeking, collecting, and storing facts in the tome upon tome that annually come to crowd our book-shelves. The embryological history of man, anthropoid and ape have become known; important additions have been made to the geological record; our knowledge of the structure of the Primates has increased twenty-fold; all the additional evidence of thirty years thus lay at Mr. Duckworth's disposal awaiting systematisation. He has every qualification for the task; he has devoted many years to examining and extending the evidence on which our conception of man's origin rests. "Studies from the Anthropological Laboratory," the second work included in this review, containing thirty-six papers dealing with various aspects of primatology, guarantee his industry and first-hand knowledge. He has the advantage, too, of having at his disposal the great anthropological collections accumulated by Prof. Macalister, and free access to one of the best libraries of the world.

It is natural to expect that Mr. Duckworth, having so much additional evidence at his command, is able to define man's position in the animal kingdom with a greater degree of precision than was possible at the time when Huxley and Darwin wrote. Huxley, it will be remembered, restored man to the position originally assigned to him by Linnæus, namely, that of a family in the order of Primates, because, on the evidence he was able to adduce, man differed less in point of structure from the family of anthropoids than the anthropoids from the family of the Old World monkeys. Further, Huxley regarded the chimpanzee and gorilla as the animal forms most nearly related to man. In these two respects Darwin agreed with Huxley. In the classification adopted by Mr. Duckworth, man retains the position assigned to him by Huxley. Mr. Duckworth's style in producing evidence and conflicting theories is open, frank, and impartial, but in setting forth his conclusions he is so eminently non-committal that it is difficult to cite a passage which concisely expresses his conception of the exact position which man holds with regard to other families of Primates. On p. 226 the following passage occurs:—

"But no single example among the larger Simiidæ can be pointed out with confidence, as embodying the characters of the human ancestor at the simian stage of evolution more completely than any other, though there is a slight margin of evidence in favour of the Chimpanzee, rather than the Gorilla or the Orang-utan."

Thus it will be seen that the matter of man's zoological position remains where Huxley left it. Huxley had an incomparable faculty of drawing just conclusions from limited data, but few men who are experts on this matter will agree that Mr. Duckworth has utilised the evidence at his disposal to the fullest extent possible.

Nor has the evidence which has accumulated in the last thirty-three years permitted Mr. Duckworth to make a more definite statement as to the ancestral chain or phylogenetic path of man than was made by Darwin in his first edition of the "Descent of Man" in 1871.

"The Simiadæ," wrote Darwin, "then branched into two great stems, the New World and Old World Monkeys; from the latter, at a remote period, Man the Wonder and Glory of the Universe proceeded" (vol. i., p. 213, 1st ed.).

Mr. Duckworth's conclusions in this matter are summed up at p. 542 as follows:—

"But while it is shown that the Hominidæ have in their evolution passed through a stage which is better reproduced by the Simiidæ (anthropoids) than by any other of the Primates, it is practically certain that the modern Simiidæ did not themselves figure in the ancestry of man and that they are themselves specialised in a high degree, more specialised in many ways than the Hominidæ and more specialised than their own ancestors. As Klaatsch puts it, the ancestors of the modern Simiidæ were more anthropoid than the actual Simiidæ, just as the ancestor of the Hominidæ was more pithecoid than modern Man. And the balance of evidence indicates that the line of human ancestry would, were the material still available, be traceable down to the lowest Primates (Lemuroidea) and even to the lowest Mammals. Moreover, it is undeniable that the Hominidæ have retained in hand and foot some features of an early ancestor, from which they have departed less in type than have the (modern) Cercopithecidæ and Simiidæ. But detailed information on these points is still lacking."

Leaving out of account the oracular statement quoted from Klaatsch, there can be no question that Mr. Duckworth's inference as to man's line of ancestors is much less definite than that of Darwin, and certainly, in the opinion of many well qualified to judge, less in keeping with the evidence at our disposal. What the peculiar primitive characters of the human hand and foot may be the writer cannot guess, but it is certain that there are numerous characters in the human hand and foot which can be accounted for only on the supposition that at one time they were used functionally as are now the hands and feet of anthropoids. Mr. Duckworth states his opinion guardedly, but it is evident from the statement just quoted that he believes the line of ancestors that connect modern man with a primitive lemuroid (Eocene) stock is extinct and unknown, and that this line of ancestry runs an independent and parallel course to the ancestral stock of the anthropoids. Now man shares with the chimpanzee and gorilla some three hundred structural features which are not possessed by any lemuroid form of which we have any knowledge, nor can the common possession of these characters be accounted for except on the supposition that man and these two anthropoids are derived from a common stock. A full investigation of the evidence will show that Darwin was not far from the truth when he supposed that the gorilla, the chimpanzee, and man have their origin from a common stock. Modern man differs from the Miocene anthropoid Dryopithecus in structure no more than does the modern horse from its Miocene ancestor. In Dryopithecus, characters are recognisable which link it with the gibbon on the one hand and the chimpanzee on the other. Palæopithecus, a Pliocene anthropoid, in the characters of its teeth and jaw, which are the only parts yet found, links the chimpanzee to the orang. The modern gibbon differs in an incredibly small degree from its Miocene ancestor, and shares many characters in common with the great anthropoids, man, the Old World monkeys, and New World monkeys, and is by far the most generalised form of higher Primate now extant, in spite of many adaptive features. In short, the evidence points to the common origin of man and the great anthropoids from a gibbon (Hylobatian) stock; this in turn, with monkeys, must be traced to a lemuroid origin.

Mr. Duckworth deals very justly with the evidence yielded by embryological investigation. Thirty years ago, when it was believed that the embryo recapitulated its ancestral stages *in utero*, it was thought that the history of man could be written when his development became known. "Palæontology is good but Embryology is better," wrote Kitchen Parker, but now we know, and Mr. Duckworth states the case fully, that the embryological phases are so obscure that they can only be construed by the help of comparative anatomy and palæontology. It has come to be recognised that every mammal is adapted to two separate lives—an intra-uterine life and an independent life; the features of the one existence mask those of the other. Yet Mr. Duckworth makes the important fact stand out that the intra-uterine life of man is exactly similar, so far as we yet know, to that of the anthropoids, and in that, while it resembles in most points the lower Primates, yet differs from all other mammals.

It must be admitted that Mr. Duckworth's task was not an easy one; yet no essential or important contribution has been passed unnoticed by him. His statements are clear and impartial; he has even a kindly word to say for some notions, such as the temporary fissures of the brain, which most anatomists, in common with himself, now regard as *post-mortem* artefacts. In another edition, which this work is certain to attain, the statements made in the following sentence (p. 201) will require some amendment:—

"Selenka thus regards the syncytium (a peculiar tissue) as derived neither from the chorion-entoderm (Kollmann), nor from the submucous uterine decidual connective tissue cells (Minot, 'Human Embryology,' pp. 13 and 375) nor from the fœtal ectoderm (Robinson, 'Hunterian Lectures,' *Journal of Anatomy and Physiology*, vol. xxxviii. p. 493), but from the epithelial lining of the uterus."

Mr. Duckworth unwittingly does the late Prof. Selenka a double injustice; in the first place he reproduces an acknowledged modification (Fig. 148, p. 203) of a figure by Selenka, in which the syncytium is made to appear as a continuation of the lining epithelium of the uterus, whereas in Selenka's figure it is clearly shown not to be continuous; secondly, Selenka ("Studien ueber Entwickelungsgeschichte," Heft viii., pp. 190, 193) expressly states that he is uncertain of the origin of the syncytium, but that the evidence is rather in favour of its origin from the cells of the uterine glands. Expert opinion regards it as settled that the syncytium does not so arise, but springs from the ectoderm of the embryo, a conclusion which seemed to Selenka not improbable. He does Kollmann also an injustice, for in his text-book (p. 201) that author expressly states that it arises from the lining epithelium of the uterus—the opinion ascribed by Mr. Duckworth to Selenka. Nor will Minot acknowledge the opinion ascribed to him, for on p. 322 of a text-book on human embryology he states that he is convinced that the syncytium is derived from the embryonic (chorionic) ectoderm, the opinion here ascribed to Prof. Robinson. Nor will Prof. Robinson be willing to accept priority for the theory of the ectodermal origin of the syncytium; probably Hubrecht has the greatest claim to be accounted the pioneer in this matter.

It would not be just to close this review without acknowledging the number of original facts and fresh opinions that mark the pages of this work. The opening chapters are perhaps too condensed; the long lists of characters enumerated are rather apt to lead to mental dyspepsia even in the pages of a text-book, and one misses a statement of their functional meaning, which would greatly assist the memory in ranking them together. The chapters on

the cerebral organisation are specially well done, and contain the best exposition yet published of our knowledge of that part of the Primate organisation. Special prominence is deservedly given to the brilliant work of Prof. Elliot Smith. There can be no doubt, too, that this work will lead to a renewed vigour in the search for evidence bearing on the origin and relationships of the higher Primates.

A. K.

## *CHEMISTRY FOR YOUTHS: MRS. MARCET REDEVIVA.*

*Die Schule der Chemie.* By W. Ostwald. Zweiter Teil—Die Chemie der Wichtigsten Elemente und Verbindungen. Pp. viii + 292. (Brunswick: Vieweg and Son.) Price 7.20 marks.

ABOUT a year ago, the first volume of Prof. Ostwald's dialogues on chemistry was noticed in these columns. We have now the second volume, written in as lively a strain as the first, and conveying the author's views, which bid fair to become in the main everybody else's views, as regards the presentation of the elementary facts of chemistry. It would be wrong to say that in this volume, consisting of 292 pages, there is more system; but in it we come to a discussion of chemical facts and theories which are generally treated in school text-books. The pupil is introduced to chlorine, its preparation and properties; its behaviour with water; acids and bases, and elements; combining weights, and multiple proportions; the atomic hypothesis, and the laws of volume combination; electrolysis and salts. Chlorine is again considered as regards its compounds with oxygen, and then follow bromine and iodine; sulphur and its compounds; nitrogen, ammonia, phosphorus, and so on through the commoner elements and their compounds.

Throughout the volume we find neat remarks which sustain interest, at least, when it is glanced through, for I do not think that anyone who is already a chemist will read the volume as carefully as he may have read the first volume. For example, on the first page is an aphorism, too often neglected, but none the less true:—"When much has been learnt, time must be given for digestion." In English "cramming doesn't pay in the long run."

Everyone knows that Prof. Ostwald does not hold by the atomic theory. Yet he does not escape from it. His presentation of it is, however, ingenious, as indeed are all his methods. Discussing the facts of multiple proportion he gives the following illustration:—

"Think of a collection of coins, where German marks, English shillings, French francs, Russian roubles, and other coins are to be found. You can combine these coins in twos and threes; each combination, however, has the value of the sum of the individual value of the coins, and you cannot obtain any other values, combine them as you will. Similarly, no other compounds can be formed but those obtained by bringing the elements together according to their combining weights."

The pupil then draws the required conclusion:—

"That is as if each element consisted only of equal pieces, just as all francs or marks are equal among themselves." "Yes," answers the teacher; "that is the picture which has represented the state of affairs to men's minds for long. It is supposed that each element consists of minute particles, named atoms," and so on. When the boy asks, "Is all this true?" the teacher replies, "No one has seen an atom, nor weighed one. This is therefore a hypothesis, but a very convenient one, because the various applications of the laws of combining proportions can be better realised (merken) when the picture of atoms is simple and clear." "But we can do without it!" says the pupil. "Certainly," says the teacher. "But just as you found it easier to count on your fingers than in your head, so it is easier to think of atoms, than of the abstract and general laws of combination." So we have to teach by means of atoms. Indeed, few of us would go further, especially in these later days, when even atoms are failing us. The hypothesis is, however, ignored a little later, when it is stated that "the rule has been made never to write fractional parts of combining weights." The doctrine of the indivisibility of atoms would appeal more readily to a young mind. Yet in fairness, it must be acknowledged that the writer makes the pupil suggest that each chemical symbol stands for an atom, and acknowledges, in the mouth of the teacher, that "the atomic theory can be easily grasped" ("etwas sehr eingängliches hat").

When electrolysis is discussed, the author's ingenuity in devising analogies is at its best. The pupil has difficulty in picturing a positive and a negative current going in opposite directions through the same wire. He is reminded of waves crossing each other in a pond, and of the upper and under parts of a driving-belt travelling in opposite directions.

Heats of combustion, discussed under the heading "carbon," are measured in kilojoules, instead of calories. This is perhaps logical, but it appears to the reviewer that the older unit might have been retained until a later stage. It is easy to make the reduction when required; and it is easier to realise heat as heat than as work, at first, at least.

While acknowledging that the subject of chemistry is here well treated, and that the author has maintained his lively style and faculty of lucid presentment, it may be questioned whether this method of discussing chemistry should have precedence over the ordinary text-book. A youth who advances so far as to grasp the contents of volume I., will, I think, tire of the plan of question and answer. Yet perhaps there are some who prefer to take their food, as they do medicine, in spoonfuls, and to whom the form of dialogue has its attractions. In old days "Pleasant Pages" was widely read, and no doubt conveyed valuable lessons. And at any rate, teachers of chemistry may learn much from this volume in hints as to how best to present the very numerous facts of the science to their students, whose digestive powers are as a rule limited.

W. R.

## FLORAL MORPHOLOGY.

*Praktikum für morphologische und systematische Botanik.* By Dr. Karl Schumann. Pp. viii+610. (Jena: Gustav Fischer, 1904.) Price 13 marks.

THE morphology of the flower, although an important item in the curriculum of the advanced student of botany, is not infrequently compressed into a period quite insufficient for obtaining a knowledge of more than a few cohorts or families. But the relegation of this branch of botany to an uncertain stage is easily explained, since, as a course for training students, and this is the first object of a scientific curriculum, floral morphology does not offer the same scope as vegetative anatomy or physiology. Nevertheless, the art of discovering all the essential points of a flower is by no means easily acquired, while the ability to distinguish between critical genera and orders requires intuition, based upon experience and practice.

Dr. Schumann has prepared his book, in the first instance, for botanists who are dependent upon their own unaided efforts, thereby providing for that large class of enthusiasts who can only devote their leisure time to botany; but he had also in view the much higher object of leading those who use his book on to the plane, if not to the work, of systematists, and the final chapters deal with determination of species and the essentials of floral monographs.

The book contains two courses, of which the first is the easier, but it includes certain types, such as Phaseolus and Iris, which require some experience to explain thoroughly; the arrangement is according to the order of flowering. There are approximately 130 types of flowers, most of them common varieties, or easily obtainable, and these represent about 80 orders, which are, for the greater part, indigenous to Europe. There is a natural tendency to form a misleading conception of the importance of those orders which preponderate in the flora of one's own country, and for this reason it would have been advantageous to include representatives of more exotic orders, but since the aim of the author has been to present specific instances of floral variation and not systematic types, the choice seems to be very suitable. The keynote to the book lies in the author's inspiring enthusiasm for the study of foliar and floral morphology, and those who use the book will regret that Dr. Schumann did not live to see it completed. To Dr. Max Gürke was entrusted the responsibility of completing the book and of seeing it through the press. The discussion of each type includes general foliar arrangement, branching, inflorescence, floral parts, and methods of pollination, and each chapter has been made self-complete; in addition the author has contrived in a number of cases to derive from the specimen an illustration of some special theoretical point; thus the examination of the pine and fir cones introduces phyllotaxis, the balsam flower leads to the consideration of empirical diagrams, and the origin of double flowers is discussed in the case of the chrysanthemum. In dealing with questions for which different explanations have been offered, Dr. Schumann has carefully avoided dogmatic statements, and, as a rule, gives the arguments, but leaves it to the student to form his own conclusions. There are several allusions to the rules of botanical nomenclature adopted in various countries, and the author inclines towards English practice in the matter; but the instances which he quotes, *e.g. Succisa pratensis* and *Ampelopsis hederacea*, are not the names adopted in the Kew lists for the plants in question. Mention is made of the botanical congress which will be held in Vienna this year, when the subject will be again under discussion.

It has hitherto been a difficulty to obtain a thoroughly trustworthy and full presentation on the subject of floral morphology except in Eichler's "Blutendiagramme"—copies of which are few and expensive—so that teachers and students will do well to note this book, since it contains a number of careful analyses of every-day types with a particularly clear account of inflorescences and bracts, and it may therefore be used for reference to confirm or correct the deductions based upon personal examination. The illustrations were drawn by Dr. Schumann's daughter, and these, like the descriptions, may well be taken as models which the student should emulate.

## SCIENTIFIC ASPECTS OF LAWN TENNIS.

*Lawn Tennis.* By J. Parmly Paret. Edited by Caspar Whitney. American Sportsman's Library. Pp. xiv+419. (London: Macmillan and Co., Ltd., 1904.) Price 8*s.* 6*d.* net.

*Great Lawn Tennis Players: their Methods illustrated.* By George W. Beldam and P. A. Vaile. Pp. xxix+403. (London: Macmillan and Co., Ltd., 1905.) Price 12*s.* 6*d.* net.

IN the first of the above books we have an excellently illustrated and interesting volume dealing with the early history, development, and present condition of lawn tennis, the author having produced a treatise which will be heartily welcomed by all lovers of this healthy game.

The author quite rightly deals only with the play of those who have attained a very high order of execution, and are past masters as regards the manipulation of a rapidly moving ball. A plan of campaign, quick decision, and still quicker action on the part of the player are necessary for success, and when these are accompanied by accuracy of execution, steadiness, easiness of style, and good condition, greater achievement is attained. Modern lawn tennis is undoubtedly a combination of skill and science of a high order, and the reader will find described in these pages the different ways in which well-known players employ these fundamental desiderata. By an ingenious application of photography it has been possible to record the start, stroke, and finish of individual strokes on one plate, to illustrate the positions of the body, hand, wrist, and racket during the movement. Many illustrations of this kind are given, serving as valuable guides to correct action. Numerous other snapshots of positions of play taken singly or on three plates with brief intervals form a special feature of this volume.

The physiological side of the game is not lost sight of, and is dealt with by the author in three short chapters, while Part iv. is devoted to "lawn tennis encyclopædia," containing much miscellaneous information useful to players, including a bibliography of the literature on the subject, which, by the way, is very considerable.

The volume concludes with an account of the history and growth of the game of lacrosse, by William Harvey Maddren.

The very complete index adds considerably to the utility of this publication, which should form a welcome addition to any sportsman's library.

In the second of these volumes, which is the combined work of Messrs. G. Beldam and P. A. Vaile, we have another valuable contribution to the literature of lawn tennis. Mr. Beldam presents us with 229 of his action photographs, all of which are here beautifully reproduced. In his book on "Great Golfers" he showed how much could be learnt by closely studying action-photographs, and in the present volume on great lawn tennis players a similar attempt is rewarded with equal success in spite of the greater difficulties involved, since both player and ball are in rapid motion. The photographs here given are not casual snapshots, but taken specially to illustrate the positions occupied by players for particular strokes. Mr. Vaile, writes, so to speak, round these pictures, and in his breezy and straightforward style points out which in his estimation are the good or bad points. This author is of the opinion that the true science of the game is but dimly appreciated in this country, and it is his main endeavour throughout these pages to indicate in which direction progress can be made. The lawn tennis reader will find, therefore, much to think over in these pages, and particular attention is drawn to the first chapter, in which the racket, *per se*, and the methods of holding it are discussed. Mr. E. G. Meers contributes an interesting chapter on "Advanced Tactics of the Single Game," while "The Half-Volley" is treated by Mr. G. A. Caridia.

## OUR BOOK SHELF.

*New Streets: Laying Out and Making Up.* By A. Tayler Allen. Pp. 175. (London: The Sanitary Publishing Company, Ltd.) 3*s*. net.

THIS is not the sort of book that anyone but a proof-reader could read straight through, not even a reviewer or a surveyor or architect, for whom especially it is written. This statement is not made by way of disparagement, quite the reverse, and the author would be the first to agree to it.

In these days, with a multiplicity of petty and of local bye-laws and regulations, all put together primarily and ostensibly to prevent scamping of different kinds, but often, and the more so the more petty the authority, used as weapons to compel public spirited parties to go to unnecessary and extravagant expense so that the members of the petty body or their friends may be the more prosperous, it is above all essential that the surveyor or architect or engineer or even private individual, who has occasion to make a new street or a cottage or a side-walk or a retrospective drain should act warily, and have before him the several acts and bye-laws that regulate or hamper, as the case may be, the particular work he has in hand. The author, judging by this, and by the titles of his previous works, seems to be a good Samaritan and to take pleasure in pointing out the numerous pitfalls that must be avoided by the man who would, if possible, live at peace. The present book is largely filled with a recitation of laws and of district council requirements which no one would wish to read unless under compulsion. The latter part contains examples of work in very full detail and with illustrations.

However, the author has not, as might have been expected, lost all interest in the progress of his subject in wrestling with these dismal details. For instance, on p. 2 he says:—

"The author is one of a few surveyors who believe that all wide carriageways (where traffic is considerable), should have the channel in the centre instead of at the sides, thus obviating the tendency of vehicles to slide down the haunches of the road towards the kerb. The gradient to the centre channel from the kerb need not exceed 1 in 40."

Whatever advantages or the reverse there may be in this plan, spectators on the pavement would no doubt prefer to see this sliding in the direction desired by the author, especially if the vehicles happened to be quick motor-cars going in opposite directions.

The author is to be complimented on performing a tedious and uninteresting task for the general good.

C. V. B.

*A Popular Guide to the Heavens.* By Sir Robert S. Ball, LL.D., F.R.S. Pp. xii+96; 83 plates. (London: George Philip and Son, Ltd., 1905.) Price 15*s*. net.

THIS is a new edition of the "Atlas of Astronomy," by the same author, which appeared in 1892, the revision having extended even to the title of the book. As before, star maps and pictures of the heavenly bodies are the chief feature, but in many cases drawings have been replaced by admirable reproductions of some of the finest celestial photographs at present available. The star charts, comprising twelve maps indicating the aspect of the heavens in the different months, and twenty others showing much greater detail, are excellent in every respect, and will meet the needs of those making a first acquaintance with the stars as well as of those who may wish to observe interesting objects with telescopes of moderate aperture. A valuable feature in connection with the maps is an index to the planets, whereby the positions of these bodies in each month during the next fifty years may be approximately ascertained. A very complete guide to observations of the moon is also provided by the maps and catalogues of lunar formations. So far, the book justifies its title, but the remaining parts give the impression of a scrap-book with pages still remaining to be filled, and pages which would have been filled differently by different owners. The sun, for example, is inadequately represented; the only photograph of a sun-spot which is given conveys no indication of the dimensions of the spot, and there are no illustrations of faculæ or photographs in monochromatic light. A more serious omission, in a book which is styled a "guide," is the absence of all reference to the modes of observing the sun, although careful drawings of the paths of spots at different times of the year are included. Again, there is an elaborate chart of the planet Mars, but nothing to show what the planet looks like in an ordinary telescope.

The text amounts to little more than a description of the plates and is too scrappy to give a connected view of the subject. The book, however, is well produced, and will be valued for its excellent star maps and examples of celestial portraiture.

*Denkmäler mittelalterlicher Meteorologie.* No. 15 (Schlussheft). Neudrucke von Schriften und Karten über Meteorologie und Erdmagnetismus herausgegeben von Prof. Dr. G. Hellmann. Pp. lviii+269. (Berlin: Asher and Co., 1904.)

THIS is the final volume of a valuable series of publications which we owe to the energy of Prof. Hellmann. In them we have had brought before us the more interesting abstracts and reprints of early works dealing with meteorology and terrestrial magnetism. Prof. Hellmann has thus made available to those interested in these subjects, the records of ancient times, which to many would have remained unread and possibly unknown.

In the present volume, which deals more especially with meteorology, we have presented to us a set of twenty-six separate parts ranging from the seventh to the fourteenth century. Many others have been taken from printed works, but some of them, as we are told in the preface, are here published for the first time.

Further, many of these old texts have here been translated into German so that those who are not familiar with old Saxon, old English, old Norwegian, or Arabic will still be able to gain a good insight into the ideas of the Middle Ages.

In the introduction to this volume Prof. Hellmann gives a brief sketch of the character of meteorology at these periods, and adds a short and interesting summary of biographical facts relating to the writers of the texts to which reference is here made. An appendix contains additions and corrections to the earlier numbers.

For the labour involved in bringing together and preparing this collection of old texts a large debt of gratitude is due to Prof. Hellmann, and it is hoped that from time to time, when further ancient writings are brought to light, he will render them in like manner so conveniently available.

*The Birds of Calcutta.* By F. Finn. Second edition. Pp. vi+136. (Calcutta: Thacker, Spink, and Co; London: Thacker and Co., 1904.)

THE fact of a work reaching a second edition may generally be taken as an indication that it has received the seal of public approval, and that it accordingly needs no commendation from us. In the present instance, a ready reception would seem to be assured to the new edition, since many additions and improvements have been made. The most important addition is undoubtedly the series of life-like cuts of Indian birds, which adds very largely to the interest of the little volume; but it is also satisfactory to find that the arrangement and nomenclature have been revised so as to bring the work into harmony with the volumes on birds in the "Fauna of British India," to which it may serve in some degree as an introduction. Mr. Finn has a vivacious, if sometimes flippant, style, which removes his works from the "dry-as-dust" category; but in some cases, as in the application of the term "disreputable" to the babbler, we venture to think some of his epithets might be better selected. To a former resident the omission of the adjutant stork from the list of Calcutta birds seems strange, but it appears that for many years these weird birds have ceased to visit the city of palaces. R. L.

*Toning Bromide Prints.* "Photography" Bookshelf Series, No. 16. By R. E. Blake Smith. Pp. xv+104. (London: Iliffe and Sons, Ltd., 1904.) Price 1s. net.

INSTEAD of producing a black and white bromide print it is often desirable to change the normal tone to suit the subject photographed. There are many methods by which this change of tints can be obtained, and these pages are devoted to describing the various processes that are available. The material on which this book is based first appeared in a series of articles in *Photography*, but in the present handy form it will be found more convenient for workers. The author gives a good detailed account of each case, and discusses the probable effect of the different processes on the permanence of the finished picture. Workers with bromide papers will find this book of considerable service.

## LETTERS TO THE EDITOR.

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

### Charge on the α Particles of Polonium and Radium.

WITH reference to the interesting letter on this subject by Prof. Rutherford in last week's NATURE, I should like to point out that in my paper "On the positive electrification of α rays and the emission of slowly moving kathode rays by radio-active substances" (*Proc. Camb. Phil. Soc.*, xiii., p. 49) I have described experiments which demonstrate the communication of a positive charge of electricity to bodies struck by α rays from polonium or radium. I had considerable difficulty in disentangling this positive charge from the copious streams of slowly moving negatively electrified corpuscles which I found were given out by these substances, and the experiments in which I finally succeeded in doing this were not completed until a few days after the reading of the paper on November 14, and are not referred to in the abstract quoted by Prof. Rutherford. A description of them will be found in the paper which has lately been published. I may take this opportunity of saying that I have recently found that uranium also gives out slowly moving corpuscles, so that this effect seems a general property of radio-active substances. The velocity of these corpuscles is very small compared with that of the β rays, and is more nearly of the order of the velocity of the corpuscles emitted by metals when exposed to light. J. J. THOMSON.

Cavendish Laboratory, Cambridge, March 4.

A CONVERSATION I had with Prof. Bragg, of the Adelaide University, in passing through Adelaide last summer suggested some thoughts in regard to the nature of the α rays which may be of interest in view of Prof. Rutherford's letter in last week's NATURE. Prof. Rutherford announces that he has at last succeeded in detecting the positive charge carried by the α rays of radium by using a magnetic field to deflect and remove the slow-moving electrons present with the α particles. He says, "I think these experiments undoubtedly show that the α particles do carry a positive charge, and that the previous failures to detect this charge were due to the masking action of the large number of slow-moving electrons emitted from the plates." These results, while they afford a welcome confirmation of the conclusions drawn from the evidence of the magnetic and electric deviation suffered by the α rays, do not, to my mind, finally settle the question.

It must be admitted that the α particles in ordinary circumstances do carry a positive charge. Certain evidence, however, seems to point to the conclusion that the α particle at the moment of its expulsion from the parent atom is uncharged, and that it derives its positive charge from secondary causes, independently of, and subsequent to, the expulsion process. To devise a crucial experiment which

would decide between the two views would be far from easy, but as I interpret Prof. Rutherford's letter, the results there given do not definitely disprove the view that the α particle is initially uncharged.

I recently directed attention ("Radio-activity," p. 181) to the importance of the fact that in certain well-established cases there appeared to be a simultaneous production of two positive charges in the disintegration of an electrically neutral atom. Thus in the disintegration of the emanation atom a positively charged α particle is expelled, and the residue of the atom—the matter causing the excited activity—is also positively charged, and is concentrated on the negative electrode in an electric field. In a recent paper by Bragg (*Phil. Mag.*, December, 1904, p. 721), the following sentence occurs :—"It is easy to see that even if the α particle is uncharged when it leaves the parent body, it must immediately become positive, since in traversing an atom it is just as likely to lose one of its own electrons as to take one away from the atom traversed." As I am unaware that this consequence has received the attention it deserves, perhaps I may be allowed to direct attention to its bearing on the present question. There is a fundamental distinction between the ionisation of the atom of a gas molecule by radiant *electrons* or β particles, and radiant *atoms* or α particles. For in the latter case, if the atom struck suffers ionisation, the radiant atom is just as likely to be ionised in the process also. The ionisation of a neutral atom consists in the detachment from it of an electron which forms the negative ion, the atom thereby becoming positively charged and forming the negative ion. Hence the radiant α particle, if uncharged initially, will become positively charged on collision with the atoms of the gas or other obstacle in its path, and at the same time will lose an electron. The "slow-moving electrons present with the α particles," which Rutherford describes as "emitted from the plates," may therefore in reality be derived from the α particles themselves in the act of becoming positively charged. The fact that they, unless deflected by a magnetic field, exactly neutralise the charge carried by the α particles seems to point in the same direction.

In further support of the view that the positive charges on both the radiant particle and the residue of the atom after disintegration are derived by collision with the gas molecules, Prof. Rutherford's results on the distribution of the excited activity in an electric field at low pressure may be cited (Rutherford, "Radio-activity," p. 282). If the excited-activity-matter particle gains its positive charge in its recoil by collision with the gas molecules, it is to be expected that at low pressures it will not become charged, and will not, therefore, be concentrated on the negative electrode, as is, in fact, the case.

FREDERICK SODDY.

## The Pressure of Radiation.

THE success of Lebedeff and Nichols and Hull in recognising and measuring the pressure of radiation has aroused much interest in radiation pressure generally, real or apparent. It has some interesting and sometimes somewhat difficult theoretical aspects. In the first place, if the ether is really absolutely at rest (this rigidity is a very difficult idea), the moving force on it has no activity, and its time integral V**DB** can only be called momentum out of compliment. The force becomes active in a moving ether, with interesting consequences not now under examination. The present question is rather how to interpret the pressure of radiation on the assumption of a fixed ether, in the measure of its effects on matter which is either fixed or moving through the ether.

The following is striking in what it proves. Let plane radiation fall flush upon a perfect reflector moving in the same direction at speed $u$, a case considered by Larmor. Let the energy density $p=p_1+p_2$, the incident being $p_1$, the reflected $p_2$. Assume, which seems reasonable at first, that $p_3$, the pressure in the reflector, is zero, then the moving force $p_1+p_2-p_3$ reduces to $p_1+p_2$. Therefore

$$p_1(v-u)-p_2(v+u)=(p_1+p_2)u, \qquad (1)$$

because the left side is the rate of loss of energy from the waves, and the right side the activity of the force on the reflector. So

$$\frac{p_2}{p_1}=\frac{1-2u/v}{1+2u/v}=s^2, \text{ say}, \qquad (2)$$

and $s=H_2/H_1$ is the ratio of magnetic forces in the electromagnetic case. Now (2) asserts that the reflected wave gets smaller as the mirror goes faster, and vanishes when $u=\frac{1}{2}v$. Or if the mirror be pushed against the radiation, the reflected wave gets stronger, and the resisting force stronger until $u=-\frac{1}{2}v$, when it is infinite. The mirror could not be pushed against the radiation faster than $\frac{1}{2}v$.

An immediate objection is that when $u$ has risen to $\frac{1}{2}v$, if it be maintained at that speed it acts like a perfect absorber to the incident energy. Moreover, since there is the pressure $p_1$ left, why should it not accelerate the mirror? But, if it does, $p_2$ becomes negative, and $s$ becomes imaginary. Considered mechanically only, say by $F=m\ddot{u}$, the motion of $m$ is quite determinate when $u>\frac{1}{2}v$, up to $v$, in fact. But electromagnetically it means that the energy in the reflected wave is negative. Now although there is nothing to object to quantitatively in a continuous transition from a Maxwellian stress consisting of a tension along an axis combined with equal lateral pressure, to its negative, a pressure along the axis with equal lateral tension, still the negativity of the energy in the reflected wave causes difficulty. The stress for both the electric and magnetic energy becomes of the gravitational type. That is, like imaginary electrifications attract, and unlike repel, or matter is imaginary electrification in this comparison. The moving forces and energies are real. But let a real charge and an unreal one co-exist, the energy density becomes imaginary. That is out of all reason in a real universe.

We should, I think, regard (2) as a demonstration that (1) is untrue, in that $(p_1+p_2)u$ is not the activity of the force on the mirror, although $p_1+p_2$ may be actually the pressure of the radiation. In fact, in the electromagnetic case, the variation of $p$ constitutes a force on the ether itself. We must find the force on the mirror in another way. Let radiation fall flush upon the plane surface of a dielectric, which call glass, moving the same way at constant speed $u$, and let the circuital equations in the glass be

$$-d\mathrm{H}/dx=c\dot{\mathrm{E}}+\partial\mathrm{I}/\partial t, \quad -d\mathrm{E}/dx=\dot{\mathrm{B}}=\mu\dot{\mathrm{H}}\,; \qquad (3)$$

that is, the same as for the ether, with the addition of the electric current of polarisation $\partial\mathrm{I}/\partial t$. The reference space is the fixed ether, and $\partial/\partial t$ is the moving time differentiator. Now if the relation between I and E is such as to permit of an undistorted plane wave, we shall have

$$\underset{\text{(incident)}}{\mathrm{E}_1=\mu v\mathrm{H}_1}, \quad \underset{\text{(reflected)}}{\mathrm{E}_2=-\mu v\mathrm{H}_2}, \quad \underset{\text{(transmitted)}}{\mathrm{E}_3=\mu w\mathrm{H}_3}, \qquad (4)$$

if $v$ is the speed in the ether, and $w$ the wave speed referred to the ether in the glass. This $w$ is a function of $u$. Also, the boundary conditions,

$$\mathrm{E}_1+\mathrm{E}_2=\mathrm{E}_3, \quad \mathrm{H}_1+\mathrm{H}_2=\mathrm{H}_3, \qquad (5)$$

combined with (4), give

$$\mathrm{H}_2/\mathrm{H}_1=(v-w)/(v+w), \quad \mathrm{H}_3/\mathrm{H}_1=2v/(v+w). \qquad (6)$$

An incident pulse of unit depth is stretched to depth $(1-u/v)^{-1}$ in the act of reflection; the reflected pulse is of depth $(v+u)(v-u)^{-1}$, and the transmitted pulse of depth $(w-u)(v-u)^{-1}$.

The rate of loss of energy from the waves in the process of reflection is

$$p_1(v-u)-p_2(v+u)-p_3(w-u), \qquad (7)$$

where the $p$'s are the energy densities. But, by the above,

$$p_1v=p_2v+p_3w\,; \qquad (8)$$

therefore the rate of loss of energy is

$$(p_3-p_1-p_2)u, \qquad (9)$$

and the moving force on the mirror is

$$\mathrm{F}=p_3-p_1-p_2. \qquad (10)$$

This is, in its expression, exactly the *negative* of the previous pressure difference. It is in the direction of the rise of energy density. Its amount is

$$\mathrm{F}=2\mu\mathrm{H}_1\mathrm{H}_2=2p_1(v-w)/(v+w)=\tfrac{1}{2}\mu\mathrm{H}_3^2-\tfrac{1}{2}c\mathrm{E}_3^2=\mathrm{U}_0. \qquad (11)$$

The first form in terms of $H_1, H_2$ is useful. The second is in terms of the wave speeds. The third is in terms of the ethereal energy inside the glass. All these come out of the ratios $H_2/H_1$, &c. Now the electric energy equals the magnetic energy in the transmitted wave. Consequently $U_0$ means the energy of the polarisation I. And the activity is $U_0u$, the convective flux of energy.

These properties are true for various relations between I and E. The first approximation is $I=c_1E$. The second, introduced by Lorentz, is $I=c_1(E-uB)$, that is, the polarisation is proportional to the moving force on a moving ion. Other forms allowing of undistorted pulse propagation may be proposed. All give special relations between $w$ and $u$. In Lorentz's case,

$$U_0=\tfrac{1}{2}c_1E_2^2(1-u/w)^2. \qquad (12)$$

To pass to perfect reflection, reduce $w$ to $u$, its least value. $U_0$ does not vanish, but has the value given by (10), (11) still, with $w=u$. But the transmitted wave is reduced to a surface film, moving with the glass. The moving force on the glass is now

$$F=2p_1(w-u)/(v+u), \qquad (13)$$

and finally, if $u=0$, $F=2p_1$.

Here we come right back to the pressure of radiation. It does measure the force on the glass when at rest, when it reflects perfectly, and it looks as if (13) were merely the form $p_1+p_2$ a little modified by the motion. But appearances are very deceitful here, for (10) above is the proper formula.

As regards the distribution of F. With an actual transmitted wave consisting of a pulse of uniform intensity all through, F is entirely at the wave front. So, with total reflection, it is just under the surface of the glass. Again, if $E_2$ varies continuously in the transmitted wave, F is distributed continuously, to the amount $B(\partial I/\partial t)$ per unit volume. What F means in (11) now is the total of this volume force, *i.e.* the integral from the surface up to the wave front, expressed in terms of the momentary surface state.

After a pulse has left the surface there is an equal opposite force at its back, so there is no further loss of energy or moving force on the glass. The obscurities and apparent contradictions arise from the assumption that the ether is quite motionless. If we treat the matter more comprehensively, and seek the forces in a moving ether, with moving polarisable matter in it as well, if this is a complication one way it is a simplification in another, viz. in the ideas concerned. There is harmony produced with the stress theory. To illustrate, $(\partial/\partial t)\mathrm{V}\mathbf{DB}$ is the moving force per unit volume when the ether and polarised matter have a common motion, **D** and **B** being the complete displacement and induction. (The variation of **u** is ignored here.) But if we stop the ether, a part of this force becomes inactive. If the matter is unmagnetisable, the only active part is that containing the polarisation current, for that is carried along.

Besides this electromagnetic force, there is also a force due to a pressure of amount $U_0$. But it does not alter the reckoning of the moving force on the glass, because the pressure acts equally and oppositely at the front and back of a pulse.

Some other illustrations of the curious action between electromagnetic radiation and matter can be given. For example, two oppositely moving plane pulses inside moving glass. Say $E_1=\mu w_1H_1$ one way with the glass, and $E_2=-\mu w_2H_2$ against the glass. If $H_1=-H_2$, work is done upon the glass when they cross, ceasing the moment they coincide, so that the energy of the momentary electric field is less than the wave-energy. On separating, the loss is restored. If, on the other hand, $E_1=-E_2$, work is done by the glass on the waves when uniting, so that the momentary magnetic energy, together with the polarisation energy, is greater than the wave energy. In this second case, too, it is noteworthy that the solitary waves are of unequal energy, whereas they are equal in the first case. But details must be omitted, as this communication is perhaps already too long. OLIVER HEAVISIDE.

February 21.

## Secondary Röntgen Radiation.

IN a paper read before the Royal Society on February 16, I described experiments demonstrating the partial polarisation of Röntgen radiation proceeding from an X-ray bulb, and at the same time verifying the theory previously given of the emission of secondary X-rays from gases and light solids subject to Röntgen radiation.

Later experiments have shown that beams of X-radiation may be produced exhibiting a greater amount of polarisation than there was evidence of in the original experiments.

This discovery has proved useful in the investigation of secondary radiation proceeding from solids.

It has been found that while the intensity of secondary radiation from light substances varies considerably in different directions owing to the partial polarisation of the primary radiation, the amount of this variation diminishes with an increase in the atomic weight of the radiator, and ultimately is inappreciable. The radiations from air, carbon, paper, aluminium, and sulphur vary in intensity in different directions by a considerable amount. From calcium the variation is much less, while from iron, copper, zinc, and lead it is inappreciable. This must be connected with the fact that the radiation from light substances differs in character only very slightly from the primary, while the heavier substances emit radiations differing more from the primary producing them. The radiation from the heavier metals was found not to consist of an easily absorbed radiation superposed on a radiation such as proceeds from light substances, and of intensity given by the law found for that from light substances, but is as a completely transformed radiation. This is strong evidence that the freedom of motion of the electrons which permits what may be called a simple scattering in substances of lower atomic weight is interfered with in the heavier atoms, for we find from them a more absorbable radiation *in place of, not simply superposed on*, a more purely scattered radiation.

With this change in character, the polarisation effect disappears. No special absorption of the radiation proceeding from a substance by plates of the same substance has been observed.

A considerable variation in the penetrating power of the primary radiation incident on heavy substances is accompanied by a smaller change in that of the secondary (measured by change of absorbability).

Radiation from compounds appears to be merely a mixture of the radiations which proceed from the separate elements in the compound, both the absorbability and polarisation effects being what would be given by such mixtures. Atomic weight, not molecular weight or density, thus seems to govern the character of the radiation produced by a given primary.

These results may be accounted for by considering the electrons constituting the atoms as the radiators. In light atoms the electrons are far enough apart, and have sufficient freedom to move almost entirely independently of one another, under the influence of the primary pulses, consequently to emit a secondary radiation similar to the primary, but the intensity of which depends on the direction of propagation with regard to that of electric displacement in the primary beam. In heavier atoms considerable inter-electronic forces are probably brought into play by small displacements, and the resultant acceleration of motion of an electron is then not in the direction of electric displacement of the primary beam, and evidence of polarisation of that beam vanishes. Also there ceases to be a simple connection between the time for which the electron is accelerated and that of passage of the primary pulse.

In atoms of greater weight we would expect appreciable inter-electronic forces to be called into play sooner, and to attain a much greater intensity than in lighter atoms.

The precise connection between the atomic weight of the radiator and the absorbability of the radiation is being investigated. CHARLES G. BARKLA.

University of Liverpool, March 1.

## Dates of Publication of Scientific Books.

I HAVE just bought a copy of "A Treatise on Slate and Slate Quarrying, Scientific, Practical, and Commercial," by D. C. Davies, F.G.S., fourth edition, dated 1899 (Crosby Lockwood and Son).

To my astonishment, I find no statistics of later date in it than 1876, *e.g.* p. 33, statistics of 1872 and 1873, p. 58, list of quarries in 1873, p. 59, production in 1876, p. 64, production last year (1876), p. 170, prices of slates in London last year (1876).

As the Home Office publishes annually a general report and statistics of mines and quarries, and also a list of mines and quarries, there is no excuse for the book being so out of date in its statistics. B. HOBSON.

The Owens College, Manchester, February 21.

## SOME SCIENTIFIC CENTRES.

### VII.—THE PHYSIOLOGICAL RESEARCH LABORATORY OF THE UNIVERSITY OF LONDON.

THE seat of the University of London was transferred to the Imperial Institute in 1900, and in the same year the University received a new constitution, and commenced its career as a teaching university. In May, 1902, a laboratory devoted to research physiology was housed within the same Imperial building, and the secretariat of the University of London was for the first time brought into contact with one of the sources of knowledge, which it had been newly arranged not only to control but also to foster.

The laboratory occupies the upper floor of the eastern wing of the Imperial Institute, and has already been described in the pages of this Journal (NATURE, vol. lxvii., pp. 441, 442). It covers a space of about 3000 square feet.

There are special rooms for experimental psychology, experimental physiology, electrical and chemical work, a lecture theatre fitted up for the delivery of the special courses of lectures in advanced physiology, and a departmental library. The work carried on has been of the double character indicated in the scheme originally adopted by the University Senate. In the first place courses of lectures have been given by a large number of the physiologists who form the professorial staff of the University in this subject. It should not be forgotten that this cooperation has been obtained without an offer of the most trifling award. The professorial staff, by this free gift of its labour, has once more shown its loyalty to interests which are really wider than the interests of any local scheme, but which, nevertheless, are well expressed as the interests of the University of London.

All these lectures, as was originally intended, have been of a peculiarly living type—lectures delivered upon subjects on which each lecturer was actually engaged in research at the time. After submission to referees, they are published for the University by Messrs. Murray; a volume entitled "Signs of Life," by Dr. Waller, and another on the "Biochemistry of Muscle and Nerve," by Prof. Halliburton, have already appeared, and a volume on the Blood, by Dr. Buckmaster, is in the press.

In the second place, room and facilities are afforded to workers in the prosecution of research whether for their doctoral theses or for other purposes. The researches carried on since May, 1902, have resulted in thirty published papers; among them, and specially noteworthy as regards their immediate practical bearing, are the contributions of Captain Leonard Rogers, I.M.S., to our knowledge of the physiological action of the poison of the Hydrophidæ and the physiological action and antidotes of colubrine and viperine snake poisons; of Waller and Plimmer on the physiological action of a ptomaine extracted from commercial beet sugar; and of Waller on the quantitative estimation and graduated administration of chloroform. In physiological psychology, work is continuously carried on by Miss Edgell, who has published a paper on time judgment, and whose work on memory and grasp of the meaning of words is opening out a most important subject.

The output of work from most laboratories bears the stamp of the Director, for in his hands mainly lies the attraction of workers, and their useful employment in the earlier stages of their career. It is his constant patient interest in the problems under investigation in the laboratory which largely determines their direction, and serves to weld them into a solid phalanx of advancing facts. An examination of the list of papers shows the presence of such an influence here, an influence which has already started several workers upon paths of independent inquiry. Acknowledgments of this fact may, for instance, be found in the papers of Drs. Alcock, Collingwood, Legge Symes, Wells, from all of whom valuable contributions have come. Dr. Alcock has carried out several excellent researches upon the electrical response of mammalian medullated and non-medullated nerve. Boldly selecting material offering, as it was thought, almost insuperable difficulties, he has been able to make many observations of value, and in doing so has also extended the general field of inquiry. Dr. Collingwood has designed an apparatus for the exact dosage of chloroform, and elaborated a method for the estimation of percentage of chloroform vapour in expired air. Mr. Legge Symes has published work on the respiratory quotient, estimation of chlorides in blood, and is carrying on work on the physiological action of chloroform and betaine. Mrs. Waller has continued the work upon the distribution and meaning of "blaze currents."

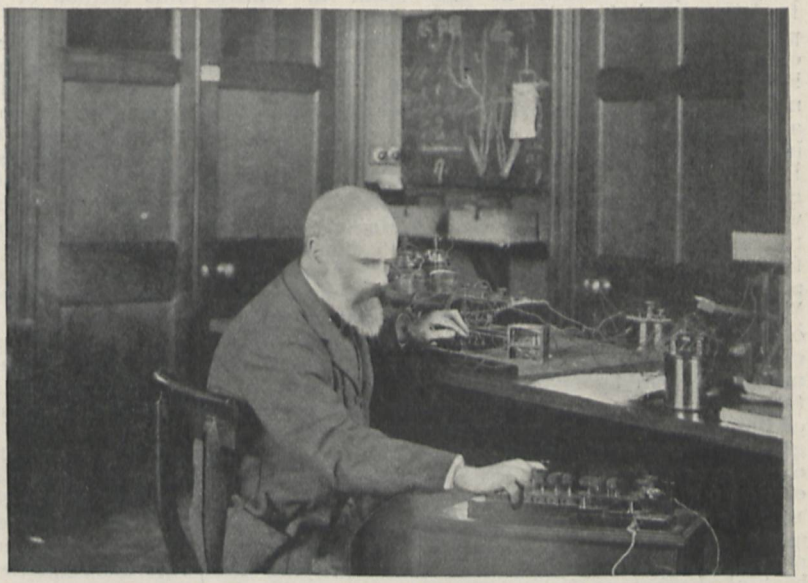

FIG. 1.—Dr. Augustus D. Waller, F.R.S., Director of the Laboratory.

That the many-sided industries of this laboratory are by no means completely stated in the last paragraph is at once seen from the fact that its walls have also looked out upon the work of several investigators who have obviously been attracted by its conveniences and equipment alone. It is sufficient to mention the names of Drs. Brodie, Buckmaster, Goodall, Locke, Macdonald, Mummery, Seemann. Dr. Pavy is engaged in work on the metabolism of the carbohydrates, and will give a course of three lectures in the summer on the results of his investigations. Dr. George Oliver is now working in the laboratory on the effects of various organic pro-

ducts on the blood-pressure of animals and man, and on the improvement of blood-pressure apparatus for physiological and clinical observation on man. He will shortly also be engaged with Dr. Samuel Rideal in investigating the influence of various gases on the blood-pressure in man. Some of this work has already found expression in this term's course of lectures by Sir Lauder Brunton. Mr. G. P. Mudge is engaged in work which will bear on the theory of transmission of acquired characters. The laboratory is, in fact, not only a consistent school making its influence rapidly felt in work of a particular character, but also a laboratory offering highly appreciated advantages to independent workers.

The laboratory owes no small share of the fact of its existence and present energetic life to the director, Dr. Augustus Waller. His prescience and alertness, and the confidence felt by the authorities and by his colleagues and friends in a scheme which had obviously enchained the full measure of his personal interest, must in this connection remain accountable for many things. The value of his services is best assessed after a consideration of the indefatigable years which he has spent in fruitful furtherance of the science of physiology. His first paper, a contribution to the study of cardiac and vascular innervation, was published from Ludwig's laboratory in 1878. His remaining contributions, many and all well known, have been published as a consequence of work carried out within London itself; and with the scientific life of this city Dr. Waller has been identified since 1879. "The graphic record of the propagation rate of the pulse wave," "The recurrent pulse," "Measurements of the length of systole and diastole with different pulse frequencies," are titles of some of these earlier papers, reminding us of our indebtedness to Dr. Waller for valuable contributions to our knowledge of the circulation. In 1881 he secured the thanks of all workers upon the phenomena of the central nervous system by his contributions to the study of tendon-reflex. In 1881 he devised and first made use of the method, now generally adopted, for the photographic record of electrical currents. His work upon electrotonic currents in the nerves of the human body, carried out with the assistance of Dr. De Watteville, 1882, forms one of the foundation-stones of the art of electro-therapeutics. This and his subsequent record of the electrical changes accompanying the beat of the human heart, 1887, serve to render the first decade of Dr. Waller's experimental work ever memorable in the annals of "Animal Electricity," and were made the basis of two ceremonies of mutual honour. Dr. Waller was invited to Berlin by Du Bois-Reymond to demonstrate the electrical changes due to the heart-beat, and the Academy of Science at Bologna—the birthplace of animal electricity—presented him with the award of the Premio Aldini sul Galvanismo. The Academy of Science of Paris also showed its recognition of the interest of these observations by its award of the Prix Montyon.

In 1885, Dr. Waller laid a basis for the study of "fatigue," by recording his discovery of the site of peripheral fatigue. He again facilitated the study of this phenomenon by the invention and use of the "dynamograph," and contributed important papers upon the "Sense of Effort." In these papers Dr. Waller dealt with matters on the border-line between physiology and psychology, and here also is placed other work of his of admitted importance upon colour contrast, hearing, weight discrimination, the functional attributes of the cerebral cortex. In 1891, Dr. Waller published his "Text-book of Human Physiology." This book marked an era in the methods of physiology classes throughout the country, and served as a standard for the increased extent of scientific training rendered possible by the changes then taking place in physiological staffs and laboratories. In writing this book Dr. Waller rendered an important service not only to physiology but also to medical education.

In 1895 began a series of researches based on the Weber-Fechner law, the electrical response of the retina to the stimulus of light, the mechanical response of muscle to electrical stimulation, the electrical response of medullated nerve to electrical stimulation, leading to the general conclusion that where we can plot physical cause along an abscissa, and physiological effect along ordinates, an S-shaped curve is the result.

The foregoing experiments involved an examination of the electrical response of nerve under the influence of anæsthetics, and led to the systematic employment of nerve to gauge the activity of a large number of reagents, a method having been devised for exciting the nerve at regular intervals and recording its negative variation by photography.

Three mainly important conclusions resulted from this method of work—that $CO_2$ is evolved in nerve during tetanisation, that the inexhaustibility of nerve and retina is due to an extremely rapid disintegration and reintegration in their tissues, that the effect of anæsthetics on nerve may be taken as a measure of their effect on the human subject, and the method may therefore be employed for studying the limits of safety of chloroform dosage. The important fact was educed that safe anæsthesia requires the continuous administration of a mixture of chloroform and air at an average percentage of 1·5—not below 1 per 100 and not above 2 per 100. Many of the facts of physiological interest made known by these researches are to be found in a course of lectures delivered by Dr. Waller at the Royal Institution, and published in 1897 under the title of "Animal Electricity." Short, and freed from technicalities as it is, this book is unique and permanent, and, as a classic, needs no commendation. The "Characteristic of Nerve," "Veratrine and Protoveratrine," are titles of other papers of physical and physiological interest.

From a study of the electrical response of the eyeball (retina) to the admission and exclusion of light Dr. Waller passed to a consideration of its response to electrical stimulation. This very marked and vigorous response he named the retinal blaze, and this led to a general study of the "blaze-currents" of the eyeball and of other living plant and animal tissues; the importance of this phenomenon as an exact and critical measure of the processes occurring in living tissues can scarcely be overestimated. As a sign of life, its observation (*e.g.* for vitality of seeds) may be of practical advantage.

Within recent years Dr. Waller's energies have also been largely directed towards the problems connected with chloroform anæsthesia, and the apparatus designed and inspired by him promises to lead not only to a further knowledge of the subject, but also to check the lamentable waste of human life so often caused by faulty and inaccurate methods of chloroform administration.

The little that has been said may serve to show that in this Institution and its officers the University has already much upon which it may be congratulated. It is surprising to examine the financial basis upon which this scheme has already been carried to such a pitch of usefulness. When the scheme was first mooted, in March, 1901, no funds were available for its support. The only asset was the promise made by the foremost physiologists in London to deliver courses of lectures, without emolument, upon the branches of physiology with

which they were most conversant. The Senate favoured the scheme, and Sir Walter Palmer, by a timely gift of 2000*l.*, rendered available the space which the Senate had assigned for the laboratory. The University supported the scheme with a grant of 500*l.*, and has since provided an annual grant of 400*l.* for five years, conditional upon the acquisition of 600*l.* per annum from other sources. Upon this annual subsidy of 1000*l.*, it is estimated that the present activity of the laboratory can be sustained. So far the support obtained from outside sources, the 3000*l.* required for the five years, 1904–1909, is represented by 2000*l.* subscribed by Mr. G. W. Palmer and Mr. A. Palmer. The sum asked for has therefore not yet been collected; when collected, it should be noted, it will not serve to maintain the laboratory upon a scale commensurate with its activity and promise. Thus the estimated expenditure of 1000*l.* per annum includes no provision for the honoraria of lecturers, or for additional assistants, or for research scholarships. The sum of 50,000*l.*, it is estimated, would suffice for the accomplishment of this greater object.

## *THE MONTE ROSA AND COL D'OLEN INTERNATIONAL LABORATORIES.*

SOME time ago (NATURE, April 17, 1902, vol. lxv. p. 568) I directed the attention of the readers of NATURE to the international laboratory, the Capanna Regina Margherita, which had been established on the Gnifetti peak of Monte Rosa by Prof. Mosso, of Turin, through the generous aid of the Regina Madre of Italy. Already much valuable work has been done in that laboratory, and if this has been chiefly of a physiological kind, though provision is made in the laboratory for physical and meteorological as well as other investigations, the reason is to be sought partly in the fact that Prof. Mosso is a physiologist, partly in the special interest attaching to the physiological problems presented by living beings at high altitudes.

In August and September, 1903, two physiological expeditions were carried out at the Capanna Regina Margherita, one under the direction of Prof. Zuntz, of Berlin, the other by Prof. Mosso, several observers taking part in each. The records of some of (not of all) the results obtained in these two expeditions are now brought together by Prof. Mosso in a volume [1] of some 300 pages, elegantly bound in such a way as to be easily itself carried to high altitudes, and appropriately dedicated to that Mæcenas of science M. Ernest Solvay, who has so freely given back to science of the good things which science has given to him.

I do not propose, in this notice, to deal in detail with the twenty-one memoirs which make up the volume. One, that by Durig and Zuntz, is given in German; all the others, though written by Italian observers, with that generous abnegation of their own tongue which it is to be hoped will not be considered necessary for them in the coming years, appear in French. I may here perhaps be allowed to express my regret that no memoir by any English observer, either in his own or any other language, is to be found among them. All of them treat, more or less directly, with one or other of the many problems of metabolism which are presented by life at such a high altitude as 4560 metres. At that height the responses which internal chemical, metabolic, processes and the expenditure of energy make to changes in the environment are so different from those which take place at lower levels as to raise great hopes that persistent researches in such Alpine laboratories may carry us far towards solving the intricate problems of the relation of chemical and physical changes of living substance to the energies of life. It may be added that such researches may be expected to explain, and so to afford practical guidance as to, the beneficial sanitary effects of life at high altitudes on many diseases.

Most of the memoirs, as might be expected, record studies on the respiratory exchange and on the condition of the blood at the high altitude as compared with what is found at an ordinary low level; and in some of them the effects of artificially lowering barometric pressure at Turin are compared with the effects of the natural low pressure on Monte Rosa, accompanied as the latter is with other conditions. All these are of great interest to the physiologist, and to him chiefly; but one memoir may perhaps attract the attention of the general reader, and that is the one by Mosso and Galeotti on the physiological effects of alcohol at high altitudes. These observers found that a dose of alcohol, 40 c.c. of absolute alcohol adequately diluted, which at Turin brought about a condition bordering on drunkenness produced, on Monte Rosa, so far as subjective sensations were concerned, hardly any effect at all. I may add that the present volume does not record all the observations made in the expeditions of 1903, a second volume being about to appear shortly. Nor are physiological researches the only ones which have been carried out; important meteorological and physical inquiries have also been conducted.

In spite of every effort to make the accommodation at the Gnifetti laboratory as complete as possible in the circumstances, those circumstances offer many obstacles to continued successful observations. The period during which study is possible is short, and the hardships of living and working at such a high altitude are such as cannot easily be borne by many persons otherwise capable of carrying out fruitful investigations. Hence Prof. Mosso conceived the idea of establishing in connection with the Gnifetti laboratory a supplementary laboratory at a lower but still high level, where work could be carried on in connection with the higher laboratory, but under easier conditions, and for a longer period of the year.

Visitors to the southern slopes of the Monte Rosa group probably know well the little wooden inn at the Col d'Olen at the height of about 3000 metres, reached by a long but easy walk or mule ride from Alagna, and most admirably kept by the well known enterprising hotel proprietors Guglielmina. From it one may, when the air is clear, see afar off the Duomo of Milan, while at one's feet alongside the path to Gressonay lies an Alpine garden which Kew may envy, brilliant in late summer with sheets of gentian and other lovely flowers. Close by the inn, Prof. Mosso has secured a plot of ground on which he is building the new laboratory; this he hopes to have finished next autumn, but it will not be ready for actual use until the summer of 1906.

It is to be a laboratory fully equipped for researches in physiology, meteorology, physics, and botany; but in addition to this it will have sixteen comfortable bedrooms, so that sixteen workers carrying on investigations will have each a bedroom to himself; and if the number of observers should happen at any time to exceed sixteen, accommodation can be obtained at the inn close by. At such altitudes success in investigation is largely dependent on personal comfort; including suitable food; and probably there are not a

[1] Laboratoire Scientifique International du Monte Rosa. Travaux de l'année 1903. Publiés par A. Mosso. (Turin: Loescher, 1904.)

few to whom research at the high Gnifetti laboratory would be impossible, but who could do solid work at a somewhat lower level provided that the life was not too rough, and especially if they had no fear of being hampered by indigestion caused by too rude or monotonous a diet. For these especially is the Col d'Olen Laboratory intended; and unless things have altered sadly in the last few years, such need have no fear for their stomachs. I still have a vivid recollection of a stay at the inn at Col d'Olen during which the efforts of a talented cook produced results which would have satisfied tastes of a far higher epicurean level than my own.

The new laboratory, like the old, is to be carried out as an international institution. It received warm support from the International Physiological Congress at Turin in 1901, and again at Brussels this year. After the plan of the Stazione Zoologica at Naples, its maintenance is to be provided by subsidies which will give the right to occupy working places. Already the Italian Ministry of Instruction has secured accommodation for two investigators, the Italian Alpine Club for one, and the German Government for two. M. Solvay, who has otherwise been a lavish benefactor to the whole enterprise, has taken two places for Belgium, and, through the generosity of Dr. Ludwig Mond, our own Royal Society has the right of nominating two investigators. The undertaking, therefore, is well on the way to success; but much remains yet to be done. Prof. Mosso informs me that though he has obtained 70,000 lire, he still needs some 50,000 lire in order that everything should be on a safe basis, and especially that an annual income should be provided sufficient to ensure at the laboratory adequate service and assistance, which, as might be expected from the circumstances, have to be well paid. The existence of such a laboratory offers unusual opportunities for investigation, not only to those who are interested in the general problems of physiology, of meteorology, and of the physics of the earth, but also to the perhaps larger class who desire a wider and more exact knowledge of the manifold fascinating phenomena of the High Alps. Is it too much to hope that Prof. Mosso will find no great difficulty in obtaining the further funds which he needs?

M. FOSTER.

## *NEOLITHIC DEPOSITS IN THE NORTH-EAST OF IRELAND.*

THE recent changes of level in the north-east of Ireland attracted a considerable amount of public interest during the year 1903, in consequence of the lawsuit, known as the "Gold Ornaments Case" (Attorney-General *v.* the Trustees of the British Museum). A golden boat, collar, and other objects were found in ploughing at Broighter, on the extensive flat that stretches around Limavady Junction in county Londonderry. They were buried eighteen inches deep in stiff clay soil, at a spot which is four feet above ordinary high-water mark. The British Museum authorities rested their claim to the retention of the objects in part on the theory that the ornaments in question constituted a votive offering, which was

FIG. 1.—Wind excavated Pit in Portstewart Sand-dunes, showing "black-layers." From *Proceedings* of the Royal Irish Academy, December, 1904.

deposited in Lough Foyle about the beginning of the Christian era, the spot where the objects were sunk having since become dry land, owing to upheaval of the coast-line. The claim of the British Museum was, however, not sustained.

In connection with this contention, Messrs. George Coffey and R. Lloyd Praeger made special investigations into the evidence of recent geological changes, and these they have brought forward in an essay on "The Larne Raised Beach: a Contribution to the Neolithic History of the North of Ireland" (*Proc.* R. Irish Acad., vol. xxv., December, 1904). To this essay we are indebted for the preceding statement. After dealing generally with the phenomena indicative of changes of level in Glacial and post-Glacial times, the authors treat particularly of the post-Glacial history, which began with a long period of emergence, and a land-level at least 30 feet higher than at present. The evidence obtained near Larne and Belfast tells of subsequent submergence, re-elevation (the amount of which increased northward), and of a final slight movement of submergence in recent times that has left the surface as we now find it. The raised beach of the Curran at Larne was accumulated over estuarine muds during the period of submergence, and it is of peculiar interest owing to the occurrence in it from top to base of worked flints of Neolithic type. A detailed account, with figures of the flints, is given. The evidence is taken to indicate that man was on the ground during the submergence that allowed of the continued laying down of 20 feet of gravels in shallow water or between tides. Moreover, the abundance of flint flakes in the surface-layers renders it probable that Neolithic man persisted after that movement of elevation had set in which made the top of the gravels a land-surface. Attention is directed to further evidence at Whitepark Bay, east of the Giant's Causeway, and again in the neighbourhood of Portstewart, which lies only 13 miles E.N.E. of Broighter. At Whitepark Bay, Neolithic "black layers" or land-surfaces occur at various levels among the sand-dunes, while near Portstewart old surfaces with Neolithic remains are found in deep wind-excavated hollows in the dunes. (see Fig. 1). This evidence proves conclusively that the ground on which the gold ornaments were found has been a land-surface, with an elevation at least as great as at present, since Neolithic times, the whole of the movement of elevation, which formed the post-Glacial raised beach of the north-east of Ireland, having been accomplished during Neolithic times.

## NOTES.

THE president of the Royal Society, and Lord Rayleigh, chairman of the general board of the National Physical Laboratory, have issued invitations to a visitation of the laboratory on Friday, March 17, when the various departments will be on view and apparatus will be exhibited.

THE thirteenth "James Forrest" lecture of the Institution of Civil Engineers will be delivered by Colonel R. E. B. Crompton on Monday, April 10, upon the subject of "Unsolved Problems in Electrical Engineering."

PROF. W. J. SOLLAS, F.R.S., has been elected a member of the Athenæum Club under the rule which empowers the annual election by the committee of nine persons "of distinguished eminence in science, literature, the arts, or for public services."

MR. J. E. S. MOORE has been appointed director of the Cancer Research, which is carried out in connection with the Royal Infirmary.

IT is stated that the Madras Government has sanctioned the establishment of an experimental garden in Malabar for the investigation of pepper vine disease.

THE second annual dinner of old students of the Royal College of Science, Ireland, will be held on St. Patrick's Day, Friday, March 17, at the Holborn Restaurant, London.

PROF. K. MÖBIUS has retired from the directorship of the Berlin Museum of Natural History. The position has been offered to Prof. H. H. Schauinsland, director of the museum at Bremen.

SIR WILLIAM BROADBENT will preside at a medical conference on the teaching of hygiene and temperance, to be held at the Examination Hall, Victoria Embankment, on Friday, March 24.

THE *British Medical Journal* states that Prof. E. A. Minchin, F.R.S., has undertaken to conduct—on the spot—further investigations, under the auspices of the Royal Society's Committee, into the causation of sleeping sickness in the Uganda Protectorate.

THE fifteenth German Geographentag will be held at Danzig on June 13–15. The chief subjects of papers and discussions will be south polar exploration, vulcanology, coast morphology and formation of dunes, and school geography.

AFTER a pause of many years France has again entered the list of gold-producing countries. In December, 1904, the first gold mill in France was started at the La Lucette antimony mine, near Laval. A 10-stamp mill is running steadily, the daily production amounting to about 1 kilogram of gold in the form of a rich concentrate.

WE learn from the *Chemist and Druggist* that two prizes, one of 5000 francs (200*l.*) and the other of 3000 francs (120*l.*), have been offered by Dr. Henri de Rothschild to the Scientific Society of Alimentary Hygiene, Paris, for the best treatises written in French on the rational food for man. The prizes will be awarded in 1906, and the papers must be sent in by December 31, 1905.

THE experiments with wireless telegraphy between Diamond Island and the Andamans are, says the *Pioneer Mail*, giving most satisfactory results. A recent message transmitted from Port Blair reached Calcutta in nineteen minutes, though it had to come over the land-lines after being received at Diamond Island.

THE Paris correspondent of the *Times* reports that a telegram has been received from M. Jean Charcot, the explorer in command of the French Antarctic expedition, dated Puerto Madryn, March 4. It is stated that scientific work was carried on under good conditions while wintering on Wandel Island. Several parts of Graham Land hitherto unknown have been explored, and by following the coast continuously its outline has been determined.

THE *Times* states that the French Ministry of Public Works has commissioned M. Jacquier to project plans for a railway between Chamonix and Aosta. It is considered that the difficulty would not be so great as with the Simplon tunnel; the tunnel would be 4½ miles shorter, and the rock gives no indication of subterranean reservoirs of water. The tunnel would commence at Chamonix, 3415 feet above sea level, and end at Entrèves (4550 feet), a distance of 8½ miles. The Dora Baltea would give ample water power for the boring work, and afterwards for locomotion.

THE preliminary programme has been issued for the International Congress of Botany to be held at Vienna in Whitsun week, June 11–18. The formal opening of the congress will take place on Monday, June 12, in the large hall of the University of Vienna. A conference on the nomenclature question will be opened on the same day, and will be continued on other days. The chief subject of papers on June 13 will be the development of the European flora since the Tertiary period. On June 14 a general meeting of the botanical societies assembled for the conference will be held, as well as a conference of agricultural botanists. The subjects of discussion for the scientific meetings on June 14 will be (1) the present condition of the theory of the assimilation of carbonic acid, and (2) regeneration. Among the papers to be read on Friday, June 16, may be mentioned one by Dr. D. H. Scott, F.R.S., on the fern-like seed-plants of the Carboniferous flora. The organising committee has arranged for excursions before, during, and after the congress, and these will afford visitors an opportunity of learning to know botanically interesting regions under the guidance of specialists. In connection with the conference, too, an international botanical exhibition has been arranged, and will take place in the orangery of the Imperial Chateau at Schönbrunn. Full particulars of the conference can be obtained by intending visitors on application to the general secretary, Dr. A. Zahlbruckner, I., Burgring, Vienna.

A SHORT time ago we chronicled the death of Prof. Emilio Villari, of Naples. Some interesting biographical details relating to this well-known physicist have now been published by Prof. A. Ròiti in the *Memorie* of the Italian Spectroscopists' Society (Catania, December, 1904) and the *Atti* of the Lincei Academy, xiv. (i), 1. As in the case of the late Prof. G. F. Fitzgerald, there can be no doubt that Villari's death was largely due to overwork, a result in both instances brought about by the great amount of teaching work which these physicists were required to undertake in their professorial duties, and which, when combined with research work, left them no time for rest. From his birth, in 1836, Villari suffered from epilepsy, and, partly in consequence of this, his early education was obtained at private schools. He graduated in medicine at Pisa. In 1860 he taught in the medical school of Naples; the next year he returned to Pisa as professor of physics and chemistry; in 1864 he studied in the laboratory of Magnus at Berlin. From 1865 to 1871 he occupied chairs at Florence; he was then, by competition, appointed to the chair at Bologna, which he held until 1889, when he went to Naples. His duties at the latter place involved the conducting of three separate University courses of lectures, and it is not surprising that in the session 1902–3 he broke down under the stress of work, and after a long and painful illness died on August 20 of last year. In the forty years from 1865 to 1904, Villari produced a long series of papers, which might advantageously be collected and published in a volume. His most recent work refers to the properties of air and gases which have been rendered radio-active by Röntgen rays, and to which he gave the name "aria ixata," or, literally, "X'd air." He was an honorary member of our Royal Institution and the Physical Society of London, and for some time previous to his death was president of the Lincei Academy.

THE usual prize announcements of the Royal Lombardy Institution are given in the *Rendiconti*, xxxviii., 1. The triennial gold medal for industry is awarded to Messrs. Vermot and Rejna for carriage springs and axles. The Cagnola prizes for velocity of kathode rays, steering of balloons and prevention of forgery, as well as several other prizes, remain unawarded, while for cure of pellagra a premium is awarded to Dr. Carlo Ceni, of Reggio (Emilia), and for miasma and contagion the full prize and a gold medal are conferred on Dr. Adelchi Negri, of Pavia. As usual, there is keen competition for the Brambilla industrial prize, and the institution has awarded three first prizes with gold medals and four second prizes with gold medals to Lombardy manufacturers. Under the Fossati foundation an award is made to Dr. Giuseppe Pagano for a thesis on cerebral localisation. The Kramer prize for an essay on electric traction is awarded to Giovanni Giorgi, engineer, of Rome, and three awards under the Ciani prize are given for books on modern Italy.

THE following list of prize subjects now issued by the Lombardy Institution for 1905 and following years includes the announcements made last year. Institution prizes, for 1905, on the ophiolitic formations of the Apennines; for 1906, on modern psychiatry. Cagnola prizes, for 1905, on phenomena of catalysis; for 1906, on pathology of suprarenal capsules. Fossati prizes (open to Italian subjects), for 1905, on our present knowledge of neurology; for 1906, on visual centres of higher vertebrates; for 1907, on nuclei of cranial nerves; for 1908, on the central nervous system. Kramer prize, for 1905, on the resistance of cement structures. Secco Comneno prize for a discovery on the virus of rabies. In addition, the triennial medals, Cagnola, Brambilla, Pizzamiglio, Tommasoni, Zanetti, and Ciani prizes are offered under the usual conditions, which have been referred to in previous years in the columns of NATURE.

IN the West India Committee *Circular*, Mr. Kenrick Gibbons suggests that mosquitoes are largely destroyed in Barbadoes by swarms of small fish, locally known as "millions," which prey on the larvæ.

IN the February number of the *Zoologist* Mr. E. Bergroth, of Tammerfors, Finland, gives a list of generic zoological names not included in the supplement to the "Index Zoologicus" compiled by Mr. C. O. Waterhouse and published in 1902. While the number of names in the latter is about 250, no less than about 300 are recorded by Mr. Bergroth, all dating before 1901.

SOME months ago Schaudinn published some interesting observations on the development of trypanosome forms from Halteridium, a protozoan blood parasite of birds. Novy and MacNeal now criticise Schaudinn's work, and ascribe his results to a double infection with Trypanosoma and Halteridium, and not to the development of the former from the latter.

WE have received the *Transactions* of the Epidemiological Society for the session 1903–4 (vol. xxiii.). It contains a paper by Prof. Simpson on the epidemiology of plague, in which he shows that the domestic animals and birds may contract plague by feeding on plague-infected offal, and important discussions on sleeping sickness, the etiology of scurvy, industrial anthrax, and enteric fever and cholera in Hamburg, together with an obituary notice of the late Sir John Simon.

SOME interesting notes on the habits of Natterer's bat (*Myotis nattereri*) are contributed by Mr. T. A. Coward to the *Zoologist* for February. From these it appears that in certain habits this bat is to some extent intermediate between other members of the Vespertilionidæ and the horse-shoe bats (Rhinolophidæ). It has, for instance, the habit of turning in the air, characteristic of the latter. Again, whereas in the horseshoe-bats the short tail is carried bent over the back, while in most British Vespertilionidæ this

appendage is usually carried beneath the body, in Natterer's bat, despite the fact of its being used as a pouch to contain the insect-food, it is borne extended in the line of the body.

To the complex subject of nuclear changes is devoted the greater portion of the February issue of the *Quarterly Journal of Microscopical Science*, Messrs. Farmer and Moore discussing the "maiotic" phase (reduction divisions) in animals and plants in the first article, while in the second Prof. Farmer and Miss Shove describe the structure and development of the somatic and heterotype chromosomes of Tradescantia. The term "maiotic" phase is a new one, proposed to cover the whole series of changes formerly known as heterotype and homotype; as being derived from μείωσις (reduction) its orthography should apparently be "miotic." Of the other two articles, one, by Messrs. Moore and Robinson, describes the behaviour of the nucleolus in the spermatogenesis of Periplaneta, while the other, by Mr. G. Wagner, is devoted to certain movements and reactions of Hydra.

FROM a letter which Mr. P. Olsson-Seffer has written to *Science*, we learn that a Danish botanist, Mr. M. P. Porsild, has sought the help of his Government in founding an Arctic laboratory, which it is proposed to establish near Godhavn (lat. 69° 15′ N.), on Disko Island, North Greenland. Such a laboratory would be the first institution of its kind for investigating Arctic problems, and would form a counterpart in the cold regions to the tropical stations at Buitenzorg and Ceylon. The power of plants to withstand intense cold, and their nutrition under the peculiar conditions of light, will probably be among the earliest researches.

MR. J. H. MAIDEN has contributed to the *Proceedings* of the Linnean Society of New South Wales (August, 1904) an account of the plants collected by Mrs. David on Funafuti, one of the Ellice group of coral islands. The list agrees very closely with those of collections made on similar islands, notably Samoa, Fiji and Keeling Islands, and consists of fifty flowering plants representing thirty-three orders. The native names are very similar to the Samoan. Although the plants include various edible products, such as the almonds of *Terminalia Catappa*, the sword-bean, and fruits of Pandanus, the islanders subsist chiefly on taro and bananas.

THE second part of Prof. E. C. Jeffery's treatise on the comparative anatomy and phylogeny of the Coniferales claims attention not only for the facts which he has observed in examining various genera of the Abietineæ, but more especially on account of the deductions which, evolved from the consideration of certain formulated canons of comparative anatomy, by their evident consistency go far to establish the validity of these canons. It is possible to trace in the Abietineæ a sequence from forms such as Tsuga and Cedrus, in which resin-canals are absent from the wood of all normal stem parts, through certain species of Abies, in which the resin-canals occur only in the wood of the reproductive axis, to Picea, Larix, and Pinus, where they are formed normally in the wood of the vegetative axis. Among the former, resin-canals are freely produced in the vegetative shoots as a result of injury. From these and other facts Prof. Jeffery concludes that the Abietineæ are a very ancient order, older than the Cupressineæ, and by the possession of a double leaf-trace are allied to the Cordaitales. The treatise forms the first number of vol. vi. of the *Memoirs* of the Boston Society of Natural History.

WE have received the report of the Meteorological Commission of Cape Colony for the year 1903. A comparison of the number of ordinary stations shows a fair increase over that for 1902, except in the case of purely rainfall stations, where there is a decrease of 31. This is partly due to the fact that owing to severe drought many farmers have had to trek with the remains of their cattle to adjoining territories, leaving their homesteads entirely unoccupied. The report contains useful monthly and yearly average rainfall data, for districts, over Cape Colony for the ten-year period 1894–1903.

PROF. H. HERGESELL, president of the International Aëronautical Committee, has favoured us with a summary of the monthly ascents made during the last six months of the year 1904 for the exploration of the upper air by means of manned and unmanned balloons and kites. The average number of ascents per month was eighteen, and some remarkable altitudes were attained by the unmanned balloons, seven of them exceeding 15,000 metres, and eighteen exceeding 10,000 metres, the extremes being 24,970 metres, at Strassburg, and 19,750 metres, at Pavlovsk, both in the month of September. Special mention may be made of some important kite ascents from the yacht of the Prince of Monaco last autumn, during which a height of 4510 metres was attained to the north-west of the Canary Islands, and 4360 metres south of the Azores. We hope shortly to refer to some valuable results obtained from the discussion of these observations in the region of the trade winds.

WE have received a copy of the fifth edition of Jelinek's excellent "Instructions for taking Meteorological Observations," issued under the superintendence of Dr. J. M. Pernter, the present able director of the Austrian Meteorological Service. The first two editions (1869 and 1876) were written by Dr. Jelinek, the third and fourth (1884 and 1893) were revised by Dr. J. Hann, who is justly recognised as the foremost of living meteorologists. Not forgetting the excellent meteorological instructions issued in Russia by the late Dr. H. Wild, in France by M. Angot, and in Germany by Dr. van Bebber, nor the useful handbooks of smaller pretensions by Dr. Scott (late of the Meteorological Office) and Mr. Marriott (Royal Meteorological Society), we can have no hesitation in asserting that the work now under notice is second to none among works of a similar kind. It is thoroughly up-to-date, and contains all that is necessary to be known in connection with the recent considerable advances made by the introduction and more general use of various self-recording instruments, and with the more systematic observations of clouds. It contains good representations of eight of the principal forms of clouds, reproduced from the International Cloud Atlas, and 37 other illustrations, with sound advice in the choice of necessary instruments and the establishment of stations of all classes, whether first-order observatories or stations intended to record merely rainfall and temperature. Any observers in our own country who may be conversant with the German language would, we think, be much interested by a careful perusal of this very instructive work.

THE current number of the *Fortnightly Review* contains an article by M. A. Santos-Dumont on "The Future of Air-Ships." The difficulties against which the nagivator of the air has to contend are explained, and the means adopted by various aëronauts to overcome these obstacles are described. The two great obstacles to ballooning, M. Santos-Dumont points out, are contraction and expansion. To counteract contraction ballast must be thrown out, to compensate for expansion, gas must be allowed to escape. The skill of the aëronaut of a spherical balloon consists in maintaining his desired altitude with the greatest economy of gas and ballast. But in any case repeated contractions

must mean the loss of the last lot of ballast, and repeated expansions must result in the loss of so much gas that the balloon sinks eventually to earth. The latest plan proposed to overcome this weakness is described at length in the article. Steam circulating in a long aluminium worm will be used to heat the gas of the balloon, and contraction will mean merely the condensation of so much steam into water, while expansion will be brought about by its reconversion into steam. The difficulty consists in preventing any loss of water, and M. Santos-Dumont explains how he proposes to effect this. The successful use, at an early date, of air-ships in Arctic exploration is predicted, and the part that air-ships will take in the warfare of the future is outlined.

We have received from Messrs. A. Gallenkamp and Co. specimens of some new spectrum tubes which we have tested with very satisfactory results. The tubes, three in number, contained argon, helium, and a mixture of argon and helium, and the trial showed that they are a great advance on any other forms that have previously been examined. For spectroscopic work they should be of the greatest service, for the exceeding brilliancy of the gases, when only a small coil, with or without a jar in circuit, is used, will render them particularly useful in research work. The tubes themselves are of rather novel construction, the main point being the insertion of a short capillary tube in a tube of larger dimensions, the latter being connected with two other tubes fixed at right angles, and containing the electrodes. The current passing from one electrode to the other has to pass through the capillary, and the gas in this space is rendered very brilliant. When placed end on to the slit of a spectroscope, the bulb end of the tube containing the capillary being on the slit side, a method first adopted by Monkhoven to obtain the maximum of brilliancy of the illuminated gas on the slit, the result is a brilliant concentration of light which can be examined with large dispersion. The tubes are strong, compact, and well made, and can be strongly recommended both for student and research use.

Prof. A. H. R. Buller, writing from the University of Manitoba, describes some striking electrical effects due to the dryness of the atmosphere at Winnipeg. The air during the winter months contains so little water-vapour that bodies charged with electricity lose their charges relatively slowly. When the thermometer is low, ranging as it often does for a week or more at a time from 0° to −40° F., very little friction, such, for instance, as may be produced by walking along a carpet, causes a person to become charged with sufficient electricity to produce a visible and audible spark on touching an iron bedpost, the radiator, the gas-tap, or any other conductor. It is a favourite amusement of some children to take sparks from each other's noses after running about a carpeted room. In the Manitoba Hotel, now burnt down, there was a ball-room with some iron pillars in it. Prof. Buller was told by a trustworthy eye-witness that after a dance dancers on several occasions have been "severely stung" by accidentally coming into contact with one of the pillars. Many ladies have considerable difficulty in combing their hair; for during the process it becomes so charged with electricity that it stands out in the most astonishing manner. Even the short hair of a man, when being combed, often "crackles," "stands on end," and in the dark produces a display of sparks. It is quite easy to light the gas with a spark from the finger when matches are not handy by merely shuffling a few paces over the carpet and then holding a finger to the burner. On February 6, at 1 p.m., when a thermometer in the shade out of doors registered −5° F. and indoors 62° F., Prof. Buller found that a spark half an inch long could be obtained between his finger and an earth-connected iron pipe after sliding his feet smartly for twenty paces along the maple-wood floor of his laboratory. In the chemical laboratory calcium chloride may be exposed to the air for some weeks without showing the least apparent signs of deliquescence. In order to demonstrate the deliquescence of this substance to the students, the professor of chemistry is obliged to use a damp-chamber.

No. 2 of vol. ii. of *Le Radium* contains an account by M. J. Danne of the deposits of pyromorphite containing radium which have recently been discovered at Issy-l'Evéque (Saone et Loire), and the first part of a study of phosphorescence by M. L. Matout. A description is also given by Dr. Robert Abbe, of St. Luke's Hospital, New York, of several cures of external tumours and cancerous growths which were effected by means of radium.

An investigation of the effect of temperature on the magnetisation of steel, nickel and cobalt by Prof. H. Nagaoka and S. Kusakabe constitutes article 9 of vol. xix. of the *Journal of Science of the University of Tokio*. The most interesting results were obtained with cobalt and with tungsten-steel. The former is characterised by undergoing several remarkable changes of magnetisation as the temperature is raised, whilst with tungsten-steel, between the temperature of disappearance of magnetism on heating and that of its reappearance on cooling, there exist at least five corrugations in the curve of magnetisation in a constant field. When once the magnetisation has disappeared it cannot be recovered until the temperature has been lowered by about 240° C., and the cooling curve again exhibits peculiar sinuosities. In addition to these peculiarities, tungsten-steel shows a very pronounced recalescence at 660° C., this temperature practically coinciding with that at which magnetism reappears in the cooling metal.

In No. 3 of vol. vi. of the *Physikalische Zeitschrift* Messrs. Elster and Geitel describe further investigations of the highly radio-active muds from the thermal springs of Nauheim and Baden. These sediments are completely soluble in hydrochloric acid, and on adding dilute sulphuric acid to the solution, a precipitate of radio-barium sulphate is obtained having an activity many times as great as that of an equal quantity of the original mud. The oxides precipitated by ammonia from the filtrate of the barium sulphate are also radio-active, the character of the emanation indicating the presence of thorium, although this substance could not be separated by chemical methods. Prof. G. Vicentini and M. Levi de Zara, in the *Atti* of the Royal Venetian Institute (vol. lxiv., ii., 95), also deal with the question of radio-active sediments. The radio-activity of the mud and of the incrustation formed by the thermal springs of Battaglia, Abano, Montegrotto and the Lake of Lispida has been measured. The Cittadella spring at Montegrotto is particularly noteworthy on account of the high value of its radio-activity and of the fact that this appears to be due to radium only. The air in the vicinity of the springs was in all cases found to contain notable quantities of a radio-active emanation.

The latest addition to the Philosophische Bibliothek published by the Dürr'schen Buchhandlung, Leipzig, is a translation of Spinoza's "Ethics," with an introduction and notes, by Dr. Otto Baensch. The volume is No. 92 of the series of philosophical manuals in which it is published, and its price is three marks.

WE have received from Mr. A. C. Cossor, of Farringdon-road, E.C., an illustrated catalogue of Röntgen ray tubes, electrical instruments and fittings, and small electric lamps for all purposes. The catalogue should be of interest to physicists, medical men and others interested in high vacuum work.

THE fourth part of the second volume of "The Fauna and Geography of the Maldive and Laccadive Archipelagoes: being the Account of the Work carried on and of the Collections made by an Expedition during the years 1899 and 1900," edited by Mr. J. Stanley Gardiner, has been published by the Cambridge University Press. This part contains reports on the Alcyonaria of the Maldives by Prof. S. J. Hickson, F.R.S.; on marine crustaceans by Major Alcock, F.R.S., and Prof. H. Coutière; on hydroids by Mr. L. A. Borradaile; on Rhynchota by Mr. W. L. Distant; and notes on parasites by Mr. A. E. Shipley, F.R.S.

MESSRS. TEUBNER, of Leipzig, have just issued a fifth edition of Schlömilch's "Uebungsbuch zum Studium der höheren Analysis," part i., of which the first edition appeared in 1868, and a second edition of Dr. A. Föppl's "Einführung in die Maxwell'sche Theorie der Elektrizität," the first edition of which appeared in 1894. Of these, the former, which in England would be called a "treatise on the calculus," has been revised by Prof. E. Naetsch, of Dresden, and several new paragraphs on transformation of coordinates have been added. The work of editing Dr. Föppl's treatise has been undertaken by Dr. M. Abraham, who is preparing a second volume dealing with "theory of electromagnetic radiations."

## OUR ASTRONOMICAL COLUMN.

JUPITER'S SEVENTH SATELLITE.—*Circular* 74 from the Kiel Centralstelle confirms the telegram received last week concerning the discovery of a seventh satellite to Jupiter.

It contains a message from Prof. Campbell in which he states that the object was discovered by Prof. Perrine, using the Crossley reflector. The position previously given, viz. position angle=62°, distance from Jupiter 21′, was that occupied by the satellite on February 25.6 (G.M.T.). The apparent motion was direct, and the orbit is considerably inclined to the ecliptic. This latest satellite has been under observation, with the Crossley reflector, since January 2, but no particulars of the observations, other than those for January 25, are given in the circular.

LONGITUDE OBSERVATIONS OF POINTS ON MARS.—*Bulletin* No. 14 from the Lowell Observatory contains the results of the longitude determinations of nearly sixty features on the surface of Mars made at Flagstaff during 1903. For each point the times of the several observations and the resulting longitudes are given, and these are followed by the mean value for the longitude and its probable error; the mean value for the latitude of each point is also given.

The longitudes were determined by noting the time of transit of each marking across the micrometer thread when the latter was placed parallel to the position angle of the polar axis, as given in Mr. Crommelin's ephemeris, and passing through the polar cap. As the thread obliterated the markings it became easier in practice to record the time at which the marking and the cap were equidistant from the thread. Mr. Lowell has allotted a number to the result of each determination showing the relative weight to be attached to the value obtained.

OBSERVATIONS OF COMETS.—The comets 1904 *e* (Borrelly), 1904 *d* (Giacobini), and 1904 *a* (Brooks) have been regularly observed, at Lick, by Dr. R. G. Aitken, and the results are published in No. 69 of the Lick Observatory *Bulletins*.

Observations of comet 1904 *e* were made during the end of December and the beginning of January, and two sets of parabolic elements were computed from the results. Subsequent observations did not confirm these, and consequently Dr. Aitken computed elliptic elements from his observations of December 31, 1904, January 17 and 27, 1905. When the observational values were compared with the places calculated from these elements, the agreement was found to be satisfactory, and it seems probable that the comet is moving in an elliptical orbit with a period of about 7.3 years. An ephemeris based upon these elements and extending to March 31 is given, and shows that on March 11 the comet will be only 0.27 as bright as at the time of discovery, when it was variously estimated as being of the tenth or eleventh magnitude.

Comet 1904 *d* was observed on January 28, and the observation showed that the orbit published in *Bulletin* No. 67 needs very little correction. From the comet's appearance on that date it is evident that this object will soon be beyond the reach of all but the most powerful telescopes. An ephemeris extending to April 3 is given.

Observations of comet 1904 *a* were made with the 12-inch refractor by Messrs. Maddrill and Aitken during the period June 21–September 4, 1904, and the results are given in the same circular. A footnote by Dr. Aitken states that the comet was still visible in the 12-inch telescope on January 26, and an observation made on that date showed that Prof. Nijland's ephemeris is very nearly exact.

THE GOVERNMENT OBSERVATORY AT VICTORIA.—We have received the annual reports of the board of visitors and the director of the Victoria (Australia) Observatory for the years ending March 31, 1903, and 1904.

The reports show that the routine work connected with the meridian observations, the time service, the meteorological, magnetic, and seismological observations, and instrument testing was carried out as usual.

On the later date the taking of the catalogue plates for the astrographic chart, to the number of 1149, had been completed, whilst satisfactory progress had also been made with the other sections of the work. The measurement of both the Sydney and the Melbourne plates is being carried out at Melbourne, and on March 31, 1904, 239 Sydney plates containing 137,812 stars, and 522 Melbourne plates containing 151,343 stars, had been completely measured. A new measuring machine designed by Mr. H. C. Russell was finished, and its fitness was being investigated when the report was issued.

The director, Mr. P. Baracchi, states that the work of measuring the magnetograph curves and reducing all the magnetic observations made since 1868 is progressing satisfactorily, and that he hopes the results will be published within the next two or three years.

OBSERVATIONS OF SATURN'S SATELLITES.—The results of a series of observations of the relative positions of the seven inner satellites of Saturn are published in *Bulletin* No. 68 of the Lick Observatory. The observations were made by Prof. Hussey with the 36-inch refractor between August 3 and December 2, 1904, and in each case the position angle and distance of the satellite in regard to one of the other satellites are given.

BRIGHT METEORS.—Mr. R. L. Jones, writing from 3 King's Bench Walk, Temple, E.C., refers to three bright meteors observed on the nights of February 27 and 28. All the three appear to have started from the constellation Monoceros, and to have tracked thence in a north-westerly direction. A brilliant meteor was also seen at 12.10 a.m. on March 1, its brightness far exceeding that of Venus.

## THE MAGNETIC SURVEY OF THE UNITED STATES.

THE report for the year ending June 30, 1904, on the magnetic survey of the United States and its outlying territories has lately been issued by the authorities of the Coast and Geodetic Survey, and contains a long list of field observations of the magnetic elements made with the usual completeness, supported by results obtained in five fixed observatories. Two of the latter are at Porto Rico and Honolulu respectively.

The new feature in the present report is that the survey has been extended to the neighbouring seas both on the Atlantic and Pacific sides of North America, and it records the successful observation at sea of thirty-four values of

the Dip, and thirty-two of the Intensity, with fifty-two of the Declination.

The observations of the Declination were made with the ship's standard compass in the process of "swinging." Those for Dip and Intensity at the same time with the Lloyd-Creak (shortly L.-C.) dip circle, an instrument originally designed for sea observations of those elements, but which in field work on land has also been found to give results hardly inferior to those of the specially designed land instruments. The degree of accuracy hitherto obtained at sea as compared with land observations with the same instrument is also given.

The accompanying illustration shows the L.-C. circle mounted for observations on land and fitted on top with an arrangement proposed by the U.S. C. Survey for observing the Declination, but which also serves the purpose of placing the circle in the magnetic meridian. At sea the circle is mounted on a gimbal stand with the declination fitting removed, as the angle between the direction of the ship's head and the magnetic meridian is then obtained from the ship's standard compass.

A detailed description of the L.-C. circle is given in the

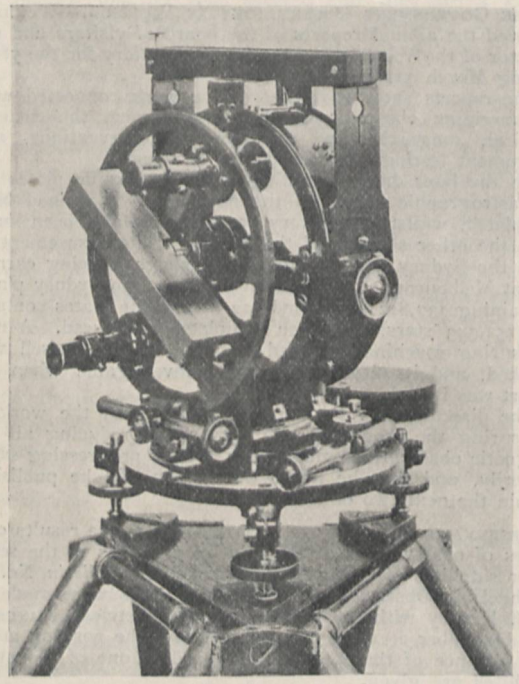

FIG. 1.—Lloyd-Creak Dip Circle, mounted for Observations on Land.

report with the methods adopted for observing therewith at sea in the U.S. surveying vessels, which are, however, not specially adapted to the work. A wood-built vessel, specially designed and devoted to magnetic work as a primary object, is required to obtain the full value from this instrument, and it is therefore pleasant to record that the magnetic survey of the North Pacific Ocean in such a vessel will be commenced this year by the United States.

## *THE NEST OF THE FIGHTING FISH.*

IN most, if not in all, the members of the group of Oriental fishes typified by the so-called climbing perch (*Anabas scandens*), the males take charge of the eggs as they are extracted from the females and place them in a "nest" of mucus-covered bubbles, which they have previously prepared. A well-known representative of the family is the "fighting fish" (*Betta pugnax*), which takes its name from the circumstance that a semi-domesticated breed is kept by the Siamese for the sake of the sport offered by the combats of the males. Of this fish living specimens from Pinang have recently been in the possession of Mr. E. H. Waite, of the Sydney Museum, who has published an illustrated account of their nesting habits in the *Records* of the Australian Museum for December last (vol. v. No. 5). Mr. Waite has obligingly sent us a copy of his original photograph of the nest, which is herewith reproduced.

Mr. Waite states that he received these fish early in April last year, and that the male almost immediately proceeded to blow bubbles, which it produced by rising periodically to the surface and taking in gulps of air. A circular mass of mucus-clad bubbles, about 3 inches in diameter, was soon produced; and in course of time several other layers were formed, which resulted in the final production of a large dome-shaped structure, as shown in the photograph. The structure was completed on the third day, when the female commenced to lay her eggs, which were received between the pectoral and ventral fins as they were extruded, and were then suffered to sink slowly in the water. Here they were collected by the expectant male, decked in his resplendent breeding colours, and placed, after being coated with mucus, below the mass of bubbles, to which they adhered. From three to seven eggs are extracted at a time, and the process is continued until there are from one hundred and fifty to two hundred. When the laying is over, the female is kept away from the nest to prevent her devouring the eggs, which are carefully tended by the male, being constantly moved and from time to time re-coated with slime.

On the third day the eggs hatched, the larvæ remaining beneath the shelter of the bubbles. From time to time some fell off, when they were immediately replaced by the watchful male, but in a day or two the numbers which became detached were too many for him to secure, although he frequently had seven or eight in his mouth at once. Some were, however, recovered from the bottom of the tank and returned to the shelter of the nest, but many were devoured by the female. Eventually all the larvæ died, and, although the fishes bred on two other occasions, none of the offspring were reared.

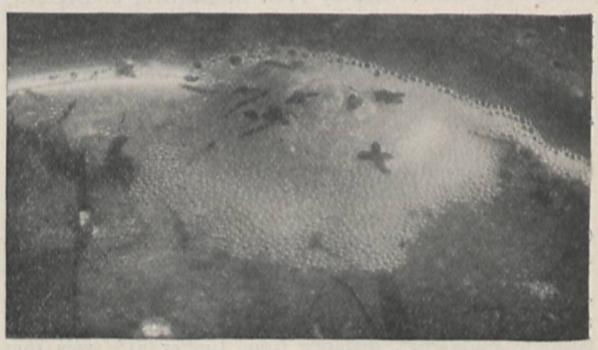

FIG. 1.—Nest of the Fighting Fish. About two-thirds natural size. From a photograph by Mr. Waite.

## *SOME RECENT WORK OF THE U.S. GEOLOGICAL SURVEY IN THE WESTERN STATES.*[1]

IF it be possible for envy to lurk in the breast of the scientific worker, then surely might we look for it in the geologist of these islands when he regards the lot of his fellow-worker across the Atlantic. In the breadth of field open to research, in the freshness of the land, and in the public support accorded to his labours, the geologist of the present day in the United States may justly claim preeminence. In the four memoirs before us, a mere random selection from the recent publications of the U.S.

1 "Zinc and Lead Deposits of Northern Arkansas." By G. I. Adams and others. Pp. 118; with 17 plates and 6 figures.

"The Copper Deposits of the Encampment District, Wyoming." By A. C. Spencer. Pp. 107; with 2 plates (maps) and 49 figures.

"Economic Resources of the Northern Black Hills." By J. D. Irving and others. Pp. 222; with 20 plates and 16 figures.

"A Geological Reconnaissance across the Bitterroot Range and Clearwater Mountains in Montana and Idaho." By W. Lindgren. Pp. 123; with 15 plates and 8 figures.

Being "Professional Papers" Nos. 24, 25, 26 and 27 of the U.S. Geological Survey. (Washington, 1904.)

Geological Survey, all these stimulants are conspicuous. The memoir on the Bitterroot Range alone deals with an area of about 12,000 square miles, respecting which our scientific knowledge has been hitherto of the scantiest; while the other three, though professedly more limited in scope, treat in detail of areas ranging from about 450 to 560 square miles which may be taken as selected illustrations of parts of the vast region west of the Mississippi.

Of course, it is not area only that counts in geology; and in considering the magnificent distances of the Great West, we may take heart in that our own shreds of land have not been carved out of some wide monotonous tract covered by a single formation within which it might be the fate of an ardent geologist of limited means to find himself hopelessly tethered! It is, indeed, fortunate that in the geological map of the world the British Isles lie, as it were, athwart the index.

It is less easy to find consolation when we compare even the most presentable of our British geological publications with these beautifully printed and liberally illustrated memoirs, wherein the native asperities of the technical treatise are so smoothed and adorned that they are hardly perceptible. Take, for example . . . . but comparisons are proverbially odious, and, moreover, the one in mind has been frequently made, with no good result, so let it pass!

It is noteworthy that all four treatises give the results of investigations which, although essentially scientific in scope, have centred around the economic resources of the specified districts. In all cases, also, the prospector and miner, working more or less at haphazard, had made considerable progress in developing the metalliferous deposits before the advent of the geologist, whose function has been to explain the general principles deducible from the discoveries already made, and to indicate the lines along which further exploration may proceed with the best chance of success. This is the proper course, for it is not until the average "practical man" begins to feel the need for professional advice that he is likely to pay much heed to such advice if it be proffered him. All the memoirs, and more especially that on the northern Black Hills, give full descriptions and many illustrations of the principal mine-workings, to which we need not further refer.

First on our list stands the description of the zinc and lead deposits of northern Arkansas, by G. I. Adams, assisted by A. H. Purdue and E. F. Burchard, with a palæontological appendix on the correlation of the formations by E. O. Ulrich. Though occurring mainly at a lower stratigraphical position, these metalliferous deposits appear to be very similar in mode of occurrence and in character of vein-stuff to the lead-ores of the Carboniferous Limestone of the north of England.

The principal locus of the deposits is in "the Yellville formation," a dolomitic limestone of Ordovician age; but they also range upward, less abundantly, into Lower Carboniferous Limestones. The Silurian system appears to be absent from the district described, and the Devonian is represented only by impersistent sandstone and shale, of which the maximum thickness does not exceed 40 feet. The region has been little disturbed; igneous rocks are absent; and the Ordovician rocks still maintain their nearly horizontal position. Nevertheless, there has been in some places much differential movement among the strata, probably as the result of compressive forces, whereby the thinner and more brittle beds have been brecciated and the fragments made to rotate or to shear past each other, producing the structure that in this country has been termed "crush-conglomerate." These breccias have permitted the percolation of the ore-bearing solutions, and are sometimes enriched by metalliferous deposits, though usually only in the vicinity of the nearly vertical fissures which appear to have formed the principal channels of the mineralised waters. It is suggested that the ores represent the concentration of minerals originally disseminated in the country rock, and more especially in the Mississippian (Carboniferous) limestones, this concentration having been effected by waters which, after circulating through the upper belt of weathered rock, have passed downward to the "belt of cementation."

The next memoir carries us some 700 miles north-westward, to the southern border of Wyoming, and to a geological province of utterly different character. "The Copper Deposits of the Encampment District," by A. C. Spencer, describes a hilly region on the Continental Divide, ranging in altitude from about 6650 feet to 11,007 feet, occupied for the most part by a complex mass of pre-Cambrian rocks, broken into and altered by igneous intrusions, with Mesozoic formations lying upon the flanks of the ancient massif as foot hills and dipping away beneath the surrounding prairie. The pre-Cambrian group

FIG. 1.—Trapper Peak, showing gradual slope of Gneiss Zone to the left and Glacial Amphitheatre in Granite at centre.

includes hornblende-schists derived from bedded volcanic rocks, limestones and shales, quartzite and slate, and a thick conglomerate, with intrusions of quartz-diorites, granites, and gabbros in great variety. The structure of the sedimentary rocks of this group is interpreted as a synclinorium, striking east and west, with its component strata dipping invariably to the south. With respect to the conglomerate, it is noted that though locally almost unchanged from its original condition, it is more frequently metamorphosed, and that this metamorphism, both mechanical and chemical, has often been carried so far that the contained boulders and pebbles have been mashed into disc-like plates, and the rocks, by re-crystallisation, converted into a gneiss the origin of which would be entirely indeterminate except through the study of its gradual passage from the unaltered condition. Certain mineral transformations described in the gabbros are assigned to dynamic pressures insufficient to inaugurate actual crushing, and also unaccompanied by a notable degree of hydration. The copper-ores which constitute the chief mineral wealth of the district occur under diverse conditions, which are carefully described and classified. It is believed that a large part, though not all, of the metalliferous deposits had their original source in the gabbros, of which eighteen samples, representing various phases of the rock, were tested in the laboratory of the survey, and in each case yielded traces of copper.

In the richest lodes the ores appear to have been concentrated by ascending solutions.

In the third memoir we are transported some 500 miles north-eastward to consider the economic resources of the northern Black Hills of South Dakota. A brief sketch of the general geology of the district is given in part i. (28 pages) by T. A. Jaggar, jun., and the rest of the volume, forming part ii., by J. D. Irving and S. F. Emmons, deals fully with the economic resources. The dome-like structure of the Black Hills, with their laccolitic intrusions of igneous rock, is already well known. "They rise like an island in the midst of the Great Plains, with culminating peaks of pre-Cambrian granite intrusive in Algonkian schists, and these same schists and granite may be followed outward from the centre of the Hills to an encircling escarpment of Palæozoic rocks dipping away on the northern, southern, and eastern sides, and mantling over the schists to form an extensive forested limestone plateau on the west." The limestones have been crushed in places into "pseudo-conglomerates," and Dr. Jaggar suggests a similar origin for many supposed conglomerates or "intraformational breccias" that have been described in other parts of the continent.

The picture of the region presented in the first few pages of part i. is remarkably clear and impressive. The Cambrian series of shales, quartzite, sandstone, and thin limestones, 200–400 feet thick, which rest in bold unconformity upon the upturned edges of the Algonkian schists, include at their base an irregular conglomerate, evidently an ancient beach-deposit. This basal Cambrian conglomerate contains detrital gold, derived from the erosion of auriferous lodes in the Algonkian rocks, and, according to the present authors, has been further enriched by later infiltration. It thus constitutes in favoured localities a gold-producing ore second only in importance to the lodes in the underlying Algonkians. The last-mentioned lodes are usually fissured belts of rock along which the precious metal, accompanied by other minerals, has been more or less irregularly deposited by permeating solutions. Another important source of gold is described under the heading of "Refractory Siliceous Ores." These ores represent the replacement of portions of the Cambrian dolomitised limestones by silica and other minerals, including gold, that appear to have been carried upward in solution by waters ascending along vertical joints. These waters, when checked by a comparatively impervious bed, tended to spread out laterally along the dolomites, which were partially dissolved and replaced by other substances. This part of the memoir is illustrated with some beautiful plates of microscopic slides. Besides gold, the district has yielded ores of silver-lead, wolframite, and a little copper, with some traces of tin.

FIG. 2.—Upper Valley of Mill Creek, Bitterroot Range, looking East from Main Divide. Notice pronounced U-shape of Valley narrowing toward the lower part. The prevailing rock is granite.

The last memoir of our series, which takes us again 900 miles to the westward, is the description of a geological reconnaissance across the Bitterroot Range and Clearwater Mountains in Montana and Idaho, by Waldemar Lindgren, and is in some respects the most instructive of the series; but unfortunately we have no space in which to do it justice. It deals with a vast tract of mountainous country, for the most part exceedingly difficult to traverse, and as yet very imperfectly explored. A huge "batholith" of granite or quartz-monzonite 300 miles in length from north to south, and 50 to 100 miles in width, occupies the central part of this region, and has been locally pressed and deformed, especially along its eastern margin, into gneiss. Sedimentary rocks are comparatively restricted in their range, and the age of most of those which are exposed is doubtful, as no well defined fossils have been found; but it is believed that, along with complexes of pre-Cambrian age, the Triassic, Carboniferous, and possibly older Palæozoic systems are represented. In the west the country is overspread by the great Columbia River lavas of Tertiary age. The physiographic features of the region are of extreme interest, and are carefully discussed. It is shown that the Clearwater Mountains had already acquired a sharply accentuated topography before the outpouring of the Columbia River basalts, and that the lower portions of the principal valleys were flooded and dammed by the lava-flows. The most important structural feature of the region, however, is the great fault by which the Bitterroot Mountains have been elevated on the west and the Bitterroot valley carried down on the east. This fault-plane is described as being remarkably flat, though apparently normal. It is supposed to represent a twofold movement, by which the foot-wall has been raised and the hanging wall depressed. It indicates a vertical movement of from 4000 to 6000 feet, and the horizontal component is estimated to be at least two miles. The schistose belt of the granite underlies this plane, and the structure is considered to be an outcome of the disturbance. Movement appears to have continued along the fault up to recent times.

G. W. L.

## ANTHROPOLOGICAL NOTES.

AN interesting paper by A. L. Kroeber on the types of Indian culture in California is to be found in vol. ii. of the *Publications* of the University of California—"American Archæology and Ethnology, 1904." Ethnologically, California is characterised by the absence of agriculture and pottery, by the total absence of totemism or gentile organisation, by an unusually simple and loose social organisation in which wealth plays a rather important part, by the very rude development of all arts except basketry, by the lack of realism in art, by a slight development of fetishism and by the conspicuous lack of symbolism and ritualism, by the predominance among ceremonials of mourning and initiation rites, and by a considerable development of true conceptions of creation in mythology. The natives are of an unwarlike nature, and lack intensity and pride. It will therefore be seen that in almost every instance the Californian Indians are among the least characteristic of the Indians of North America, being lacking in the typical qualities of that race, and thus they are the most generalised of the peoples of that continent. In the same volume Dr. Kroeber gives an account of the languages of the coast of California south of San Francisco.

Drs. A. Bloch and P. Vigier have re-examined the hair

follicles of negroes (*Bull. et Mém.* Soc. d'Anth., Paris, 1904, p. 124), and have obtained interesting results. The follicle forms at least half a spiral and is not flattened; the distribution of hair on the scalp is uniform, but all the hairs of the same spiral tuft have the intradermic portion of their curves orientated in nearly the same direction, and it is apparently this uniformity of the neighbouring follicles that determines the formation of spiral tufts; a semi-circular oblique crest ridge of fibrous tissue constricts the upper portion of the hair bulb, and thus causes the flattening of the hair and its spiral twist.

Mr. E. H. C. Walsh, in an illustrated note on stone implements found in the Darjeeling district (*Journ.* As. Soc. Bengal, lxxiii. p. 21), states that all the implements he found were polished "celts," with the exception of a dumb-bell shaped hammer head. The general belief of the people is that these axe-heads are thunderbolts which have fallen from heaven; they are chiefly found with the medicine men, who use them as charms in their incantations to drive out or cure disease, and also on account of their reputed medicinal properties when mixed with water; on several specimens the scraping or rubbing on stones to obtain medicine is very noticeable. Numerous references to other papers dealing with the subject are given. On p. 27 of the same *Journal* P. O. Bodding describes some shoulder-headed and other forms of stone implements in the Santal Pargans; it is not yet clear who were the makers of these distinctive implements—possibly they were Mon-Kmer and Munda peoples. The *Journal* also contains some interesting folklore.

Some time ago M. Verneau directed attention to some skulls from Palæolithic interments at Mentone with a remarkable negroid aspect, and M. Hervé has noted two somewhat similar Neolithic skulls from Brittany. Prof. Manouvrier points out in the *Bull. et Mém.* Soc. d'Anth., Paris (1904, p. 119), that all these "negroid" characters occur in European or other non-African skulls, but they are very rarely found in conjunction. All the skulls of this type are female; in following out this hint Dr. Manouvrier discusses the "negroid" characters, and comes to the conclusion that in a dolichocephalic population in which the prognathism of the men is so marked, a corresponding degree of prognathism in the women, combined with other characters that are characteristic of female skulls, would give a negroid appearance without any need to conclude that there was a negro element in the population. The same author describes (p. 67) a remarkable trepanned Neolithic skull, and (p. 101) some senile Neolithic skulls.

As the result of a long and careful comparative study of the skeletal variations of the foot in primates and in the races of man, Th. Volkov (*Bull. et Mém.* Soc. d'Anth., Paris, 1903, 1904) arrives at the following conclusions:—The skeleton of the foot of the prosimians bears many traces of the primitive type of foot of the ancient mammals, and presents many intermediate forms between this type and that of the foot of monkeys. The skeleton of the foot of the lower primates appears to be the result of adaptation to arboreal life of ancestors whose foot resembled that of existing rodents. The skeleton of the foot of anthropoids represents the extreme of this adaptation, but at the same time (among the hylobates and partly in the gorilla) the beginning of adaptation to standing and to bipedal progression. The skeleton of the foot in the lower races of man presents as a whole, and for each bone in particular, evident and numerous traces of adaptations characteristic of climbers antecedent to the assumption of the erect attitude and bipedal progression. The ethnical characters range from the oblique and flat foot to the straight and arched foot. Consequently the arch of the foot represents the most essential character from an anthropological point of view. The index of curvature, that is to say, the relation between the height and length of the foot, or especially the tarso-metatarsian length, should be considered as a very important anthropometric datum. The skeleton of the foot of the new-born infant reproduces primitive and transitory forms in the development of the human foot in general, and thus its study possesses a very great anthropological importance.

## UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The following is the speech delivered by the Public Orator, Dr. Sandys, on Thursday last, in presenting Dr. E. B. Tylor, F.R.S., professor of anthropology in the University of Oxford, for the degree of Doctor in Science *honoris causa*:—

Adest vir et propter aetatis dignitatem et propter studia in rerum originibus primis exquirendis praeclare posita inter primos merito numerandus, quem iamdudum admirati, nunc demum honore diu debito decoramus. Abhinc annos quinque et quadraginta consuetudines Mexicanas antiquas diligenter exploravit. Deinde de prisco hominum cultu, opere in maximo et doctrinae variae plenissimo, plus quam semel disputavit. Illo vero in opere, animarum praesertim in regno perlustrando aliorum antecursor constitutus, successoribus omnibus facem splendidam praetulit. Denique de anthropologia universa egregie disseruit, hominum ipsorum studium hominibus imprimis proprium esse iure optimo arbitratus. Nemo fortasse magis merito liberalitatem illam Terentianam prae se ferre potest:—

"homo sum, humani nil a me alienum puto."

The proposals forwarded by the Studies Syndicate have been rejected by the Senate by, roughly speaking, three to two. The poll taken was the largest on record, and on the Grace affecting Greek the "non-placets" were 1559 and the "placets" 1052. The result is extremely disappointing to all those who wish to see Cambridge take its rank as a leading university in the Empire. There is, however, a strong consensus of opinion that the matter should not be allowed to rest where it is. Perhaps a consultation between the two opposing bodies might lead to some plan acceptable to the more moderate members of both parties.

The Vice-Chancellor announces that he has appointed Colonel Sir Frank Younghusband, K.C.I.E., to the office of reader on Sir Thomas Rede's foundation for the present year.

Mr. E. H. Hankin, Fellow of St. John's College, and analyst and bacteriologist to the North-West Provinces and Oudh, has been approved by the general board of studies for the degree of Doctor in Science.

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MR. H. O. ARNOLD-FORSTER, M.P., Secretary of State for War, has consented to give away the prizes to the students at the Woolwich Polytechnic on April 1.

THE Huxley lecture of the University of Birmingham will be delivered by Prof. E. B. Poulton, F.R.S., in the large lecture theatre of the Midland Institute, on Thursday, March 23.

IN the *Engineering and Mining Journal*, Mr. G. S. Raymer gives an illustrated description of the Simpkins laboratory at Harvard. It is designed for the study of continuous ore-dressing operations on a considerable scale, the plant consisting of a 5-stamp battery and additional apparatus of the most recent type.

THE formal opening of the new building of the École polytechnique of Montreal, in affiliation with Laval University, took place on January 28. This school was founded in 1874 to give French-Canadian youths an opportunity of obtaining a training in practical science. Its sphere has been limited, but with the new building and improved equipment better results are anticipated.

MR. CHARLES H. HACKLEY, of Muskegon, Mich., has made, we learn from *Science*, a bequest of 50,000*l.* to the Hackley Manual Training School of Muskegon, which, added to 72,000*l.* already given by Mr. Hackley, makes the school's total endowment 122,000*l.* Mount Holyoke College will receive, we learn from the same source, 34,400*l.* as the residuary legatee of the late Mr. Edmund K. Turner.

IN an article entitled "The Lesson of Coopers Hill," the *Indian Daily Telegraph* of February 1 institutes a comparison between the methods of government in the cases of Coopers Hill and the City and Guilds of London technical colleges. The success of the latter is traced to adaptation in them of the methods followed in the great German polytechnics which is shown by their senates or college boards

responsible for their educational systems. The article proceeds to direct attention to the Thomason Civil Engineering College at Rurki in connection with a proposal at a recent meeting of the Allahabad University to abolish the faculty of engineering, and favours the introduction in the college at Rurki of the method of government which has assured the success of the colleges of the City and Guilds.

THE Berlin correspondent of the *Times* states that in the course of a debate on the estimates for the Ministry of Education in the Prussian Chamber on March 2, an official of that Ministry, Geheimrath Reinhardt, gave some interesting information with regard to the success of the so-called "reform schools," in which the study of the classics is begun at the age of twelve, and Greek not until the age of fourteen. One great advantage of this system is that the decision to assign a pupil to the modern (Realschule) or to the classical school (Gymnasium) can be postponed to a stage when his abilities and tastes can be better estimated. Geheimrath Reinhardt stated that the system of this "reform school" had hitherto been adopted at three classical Gymnasia, and the result was that of 123 pupils in the highest form who presented themselves for the leaving examination only four failed to pass, and of these four three succeeded six months later. Experience had shown that as a result of beginning Latin and Greek at a later age than was customary, the interest of the pupils in their work was rendered keener, and their diligence was certainly in no wise inferior to that of the pupils of the ordinary Gymnasia.

THE fourth annual report of the executive committee of the Carnegie Trust states that sums amounting to 38,114*l.* have been claimed and handed over to the four Scottish universities during the year. The grants for library purposes and for provisional assistance in teaching, amounting in all to 6400*l.*, have been fully paid. The grants for buildings and permanent equipment available for 1904, including a balance of 12,635*l.* unexpended in 1903, amount to 33,035*l.* Of these, the sum of 20,146*l.* has been claimed. Claims for grants towards teaching endowments amount for the year to 11,568*l.* These include contributions to the foundation of two chairs—that of history in the University of Aberdeen, and that of geology in the University of Glasgow. The scheme of endowment of post-graduate study and research has now entered upon its second year. The total expenditure for 1903–4 under the scheme was 3386*l.* The estimated outlay for the current academic year is 5177*l.* Applications for fellowships, scholarships, and grants for 1905–6 must be lodged on or before May 1 with the secretary to the trust, from whom application forms and regulations can be obtained. In the research laboratory of the Royal College of Physicians, the purchase of which was announced in the previous annual report, the superintendent reports that the past year has been one of steady and satisfactory work in all departments. Thirty-five workers have held places in the laboratory, and have been engaged in forty-seven investigations.

THE twenty-seventh annual general meeting of the Institute of Chemistry was held on March 1. In the course of an address Mr. David Howard, the president, referred to the steady growth of the institute, saying that he thought there was still a wide field for those possessing the highest chemical knowledge and skill, and that those who had to call in the aid of such knowledge and skill were becoming more and more alive to the importance of employing only the properly trained and competent. He emphasised the importance of requiring all candidates to produce evidence of a high standard of general education. The professional chemist should be a professional man as well as a chemist, and must, therefore, possess that general culture which is essential if he is to deal with his work in a professional spirit. Referring to the position of the institute in connection with the Sale of Food and Drugs Acts, he mentioned that 94 per cent. of the public analytical appointments were held by fellows of the institute. The president alluded to the action of the Board of Agriculture in encouraging provincial technical and agricultural colleges to undertake professional chemical work gratuitously, or at purely nominal fees. In the endeavour to help dairy farmers, the board has induced the colleges, which are maintained by grants for technical education, for the benefit of a particular class, to compete with professional chemists, particularly those retained by the agricultural associations, at the expense of the general public. The president held that the colleges need the grants for the promotion of the education of farmers in the science and practice of agriculture, without diverting them to other purposes. It is for them to instruct the farmers in agricultural chemistry.

## SOCIETIES AND ACADEMIES.

### LONDON.

**Royal Society**, February 2.—"The Theory of Photographic Processes: on the Chemical Dynamics of Development." By S. E. **Sheppard** and C. E. K. **Mees**.

If a photographic plate be exposed to light and developed, the transparency to light of the silver deposited is related to the mass thereof by the equation $D = -\log_{10} T$, where D (termed the density) is proportional to the mass of silver per unit area. This relation has been confirmed with great care for densities varying from 0.5 to 3.5, and for the plates and developer used a density of 1.00 corresponded to 0.01031 gram of silver per 100 sq. cm. This quantity is termed P, the "photometric constant" of the deposit.

A study of the relation of the density to the time of development resulted as follows:—

(*a*) The silver deposited increases rapidly at first, then more slowly, and finally tends to a limit.

(*b*) This limit depends only on the exposure.

(*c*) The velocity depends on the concentration of the reducer.

(*d*) A soluble bromide reduces the velocity, but the "slowing off" with time is not so rapid.

A theoretical investigation of development based on the theory of reaction-velocities in heterogeneous systems led under certain conditions to the equation $dD/dt = \kappa(D_\infty - D)$, w $D_\infty$ is the limiting density, D that at the time $t$. On integration this leads to the expression

$$1/t \log D_\infty/D_\infty - D = \kappa;$$

$(D_\infty - D)$ is then the reacting surface.

$\kappa$ was experimentally shown to be constant.

Further, as $\kappa$ is theoretically $\Delta/\delta\ a$, where $\Delta$ is a diffusion-constant, $\delta$ the diffusion path, and $a$ the concentration of the reducer, the velocity should be proportional to this, which was experimentally found.

The addition of alkaline bromides gradually alters the course of the reaction, introducing an induction period, but for the "maximum" velocity $\kappa \times \log Br = a$ constant.

The value of $\kappa$ depends greatly on the physical condition of the plate, diminishing with keeping, probably from lowered diffusivity.

An important deduction from the development formula is that the ratio of the densities due to two exposures is constant and independent of the time of development, which was confirmed.

For a series of increasing exposures for a certain range Hurter and Driffield showed that $D = \gamma(\log E/i)$, where $\gamma$ is development-constant.

Hence as $\gamma$ is proportional to D, and as

$$1/t \log D_\infty/D_\infty - D = \kappa,$$

therefore $1/t \log \gamma_\infty/\gamma_\infty - \gamma = \kappa$, an expression which may be used to compare the velocities of different developers. For ferrous oxalate, citrate and fluoride the following table was obtained:—

| Developer | Relative efficiency |
|---|---|
| Ferrous citrate ... ... ... ... | 1.00 |
| Ferrous fluoride ... ... ... ... | 2.95 |
| Ferrous oxalate ... ... ... ... | 48.7 |

Further communications are to be made on the influence of temperature, of soluble bromides, on the reversibility of the reaction, on the microscopy of, and on the exposure and development, nature and destruction of the "latent image."

The object of the investigation is to make the study of development quantitative and to bring it in line with general physicochemical theory.

**Chemical Society,** February 15.—Prof. W. A. Tilden, F.R.S., president, in the chair.—Nitrogen halogen derivatives of the aliphatic diamines: F. D. **Chattaway.** The compounds ethylenetetrachlorodiamine, ethylenetetrabromodiamine, and other similar bodies derived from diamines or their diacyl derivatives were described.—The nitration of substituted azophenols: J. T. **Hewitt** and V. H. **Mitchell.** The authors have systematically studied the action of dilute nitric acid and of a mixture of concentrated nitric and sulphuric acids on the three nitrobenzeneazophenols.—The estimation of saccharin: C. **Proctor.** The process described by E. Emmet Reid for the estimation of saccharin has been tested and found to be convenient and trustworthy. The paper also described a simple volumetric process by means of which the combined percentage of *o*-benzoicsulphinide and *p*-sulphamidobenzoic acid in commercial saccharin can be determined.—The analysis of samples of milk referred to the Government Laboratory in connection with the Sale of Food and Drugs Acts: T. E. **Thorpe.** This paper contained the results of an inquiry into the changes which occur in the "souring" of milk, and especially as to the effects of these on the usual analytical constants of milk.—The condensation of anilinodiacetic esters in presence of sodium ethoxide: A. T. **de Mouilpied.**—The basic properties of oxygen at low temperatures; additive compounds of the halogens with organic substances containing oxygen: D. **McIntosh.** A continuation of previous work on the combination of organic compounds containing oxygen with the halogen hydrides to form definite compounds.—Organic derivatives of silicon: F. S. **Kipping.** The preparation and reactions of a number of these compounds were described. For the purpose of systematic nomenclature these compounds are regarded as derivatives of *silicane,* $SiH_4$, or of *silicol,* $SiH_3.OH$.—Photographic radiation of some mercury compounds: R. de J. F. **Struthers** and J. E. **Marsh.** The mercury compound $HgC_2N_2,2(NH_2.NH.C_6H_5)$ was found to act on a photographic plate through paper and aluminium foil, and slightly through sheet zinc. Phenylhydrazine and a number of mercury salts were also found to exert a similar action.

**Royal Microscopical Society,** February 15.—Dr. Dukinfield H. Scott, F.R.S., president, in the chair.—The Finlayson "comparascope": Mr. **Finlayson.** The arrangement exhibited provides a means of examining two slides simultaneously.—An optical bench for microscope illumination, microphotography, micro-projection, lantern projection, &c., and a large photomicrographic and enlarging camera, both bench and camera being on rigid iron tables provided with castors and fixing pedestals: C. **Beck.**—Practical micrometallography: J. E. **Stead,** F.R.S. Mr. Stead described the machinery by means of which metals may be cut and polished rapidly, and explained the various operations of cutting, grinding, and polishing. Many specimens shown by means of the epidiascope exhibited clearly the details of the surface, and especially the coloration. The beautiful colours produced by the heating process, by which some portions became oxidized more quickly than others, were very striking, especially in the case of a specimen of a polished section of a meteorite, which almost equalled in brilliancy and colour that well-known microscopic object the wing of *Morpho menelaus.*

**Physical Society,** February 24.—Prof. J. H. Poynting, F.R.S., president, in the chair.—On the curvature method of teaching geometrical optics: Dr. C. V. **Drysdale.** The paper has been undertaken with the two-fold object of giving a systematic exposition of the method of teaching elementary optics which the author has found most suitable, and of giving an introduction to a subsequent paper on the treatment of aberrations by curvature methods.—Dr. Meisling's colour-patch apparatus: R. J. **Sowter.** The apparatus is simple in its principle and construction, and is specially adapted for testing colour-blindness.—A method of illustrating the laws of the simple pendulum: J. **Schofield.** A pendulum is fitted at its lower end with a narrow horizontal framework carrying vertical transverse wires. During the oscillations of the pendulum these wires are caused to cut a jet of mercury, and time signals are sent to the recording mechanism of a chronograph. The distances between the wires are known, and together with the time-measures they yield a displacement-time curve of the motion. From this the kinematical curves and equations of the moving system may be deduced by the usual methods. In the actual apparatus a tuning-fork arrangement with an accuracy of about 1/200 of a second is used as the chronograph, and the results obtained from the pendulum are accurate to about three per cent. The principle has also been applied to torsion pendulums.—String models of optical systems: J. **Schofield.** In these models the lenses and prisms are made of celluloid, so that the paths of rays through them can be shown.

PARIS.

**Academy of Sciences,** February 27.—M. Troost in the chair.—The precautions necessary in the mode of execution of certain researches requiring high precision: M. **Lœwy.** A lengthened study as to the cause of some systematic errors in the circle of a meridian instrument, wrongly attributed to flexure of the circles, showed that these effects were due to bad definition of the images of the lines, and could be remedied by increasing the definition of the reading microscopes and improving the lighting. In the determination of the constant of aberration, and of refraction, by means of a double mirror cut out of one block of glass, a deformation of the image was observed which rendered accurate readings difficult. The form to be given to the two reflecting surfaces to get regular stellar images has been worked out.—On the observation of the partial eclipse of the moon of February 19: M. **Puiseux.** The twelve photographs taken are discussed in detail, and in some respects are not in agreement with descriptions given before 1866. Recent observations render improbable any new changes in the moon's crust.—On an application of the iris diaphragm in astronomy: M. **Salet.** An iris diaphragm, introduced into the plane of the micrometer wires of an eyepiece, has the effect of suppressing diffused light, and thus facilitating observations on faint objects.—Families of Lamy with plane orthogonal trajectories: G. **Carrus.**—On algebraic surfaces: Federigo **Enriques.**—On functions with an infinity of variables: Maurice **Fréchet.**—On some theorems of Riemann: P. **Fatou.**—The theory of the limiting trajectory of an aëroplane: Marcel **Brillouin.**—On the intensity of photographic impressions produced by feeble illuminations: C. **Gutton.** It is shown experimentally that in a photographic negative the contrasts are exaggerated in the faintly illuminated regions and attenuated in the more strongly lighted parts. On a positive, on the contrary, the differences of lighting are faithfully reproduced.—On the kathode rays emitted by the anode: E. **Rogovsky.**—The surface tension of a dielectric in the electric field: Ch. **Fortin.** In an electric field of 20,000 volts per centimetre, normal to the surface, the relative variation of the surface tension of the petroleum, if it exists, is less than 1/450th. If the variation of the surface tension with the strength of the field be regarded as negligible, the arrangement of apparatus described serves as a new method of measuring the specific inductive capacity of the liquid.—On the spectra of the fluorides of the alkaline earths in the electric arc: Ch. **Fabry.**—On the ionisation due to the radium emanation: William **Duane.**—On the purification of gadolina and on the atomic weight of gadolinium: G. **Urbain.** The method of purification adopted was the fractional crystallisation of the double nitrate of gadolinium and nickel from nitric acid of density 1.3. The purity of the product was established by the constancy of the ratio between the crystallised sulphate and the oxide, and the mean atomic weight is given as 157.23 (O = 16). The spark spectrum of this product is being specially studied by Sir William Crookes, and the arc spectrum by Dr. Eberhard, who will publish their results shortly.—On some osmionitrites and on a nitrite of osmium: L. **Wintrebert.**—A special constituent obtained in the tempering of an aluminium bronze: Pierre **Breuil.**—On β-decahydronaphthol and the octahydride of naphthalene: Henri **Leroux.** β-naphthol, reduced by means of the Sabatier and Senderens reaction, gives rise to several substances, from which the decahydride was separated in the pure state. That it is an alcohol was clearly shown by the preparation of the acetate and the phenylurethane, and also by its dehydration to naphthalene octahydride by potassium bisulphate.—On the glycol of anethol: E. **Varenne** and L. **Godefroy.**—The characters of the polygastric muscles: J. **Chaine.**—On the salivary, cephalic and metathoracic glands of some Hemiptera: L. **Bordas.**—The

phagocytic resorption of the reproductive elements in the seminal vesicles of *Lumbricus herculeus*: Louis **Brasil.**—On the practical importance of the determination of the arterial pressure to avoid accidents in anæsthesia: L. **Hallion.** Remarks on a recent note of M. Tissot, and directing attention to a paper published by the author and M. Duplay in 1900 on the same subject.—The influence of the radium emanation on the toxic power of snake poison: C. **Phisalix.** Cobra poison, which is distinguished by resistance to destruction by heat, is readily destroyed by the radium radiations. On the other hand, the poisons from the salamander and toad are unaffected by the emanation.—The application of the vowel siren to the study of deafness: M. **Marage.** Each kind of deafness gives a special curve with this instrument, the form of which is characteristic of the seat of the lesion.—The glandular atrophic action of the X-rays: Foveau de **Courmelles.** The ovaries, the breasts, and the lymphatic ganglions can be atrophied under the action of the X-rays.—On the application of thermometry to water supply: E. A. **Martel.**—The coal formation in the Balkans: L. **De Launay.**—On the uniformity of composition of the Amana meteorites: G. D. **Hinrichs.**

## DIARY OF SOCIETIES.

*THURSDAY*, MARCH 9.

ROYAL SOCIETY, at 4.30.—The Rate of Transmission of the Guatemala Earthquake of April 19, 1902: R. D. Oldham.—Ionic Sizes in Relation to the Conductivity of Electrolytes: W. R. Bousfield.—Explosions of Mixtures of Coal Gas and Air in a Closed Vessel: L. Bairstow and A. D. Alexander.—On some Continuous Observations on the Rate of Dissipation of Electric Charges in the Open Air: C. Coleridge Farr.

ROYAL INSTITUTION, at 5.—Recent Astronomical Progress: Prof. H. H. Turner, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Report on 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: Dr. R. T. Glazebrook, F.R.S.—On Temperature Curves and the Rating of Electrical Machinery: R. Goldschmidt.

MATHEMATICAL SOCIETY, at 5.30.—On the Weddle Quartic Surface: Mr. H. Bateman.—On the Projective Relations between Two Planes: Prof. M. J. M. Hill, Dr. L. N. G. Filon and Mr. H. W. Chapman.—On the Theory of Perpetuants: Mr. P. W. Wood.

*FRIDAY*, MARCH 10.

ROYAL INSTITUTION, at 9.—The Structure of the Atom: Prof. J. J. Thomson, F.R.S.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Theory of the Motion of the Moon. Part IV.: Prof. E. W. Brown.—The Great Nebula of $\psi$ Eridani: Dr. Max Wolf.—Observations of Uranus and Saturn: C. J. Merfield.—Observations of Uranus at Windsor, New South Wales: John Tebbutt.—The Spectroheliograph of the Solar Physics Observatory: W. J. S. Lockyer.—Nebular Photography; a Suggestion: W. S. Franks.—The Late Leonids of November, 1904: Rev. S. J. Johnson.—Magnetic Disturbances and their Association with Sun-spots; a Reply: E. W. Maunder.—*Promised Papers:* On the Large Sun-spot of 1905, January 29–February 11, and the Contemporaneous Magnetic Disturbances, observed at the Royal Observatory, Greenwich (communicated by the Astronomer-Royal).—Notes on the Siderostat and Cœlostat: H. C. Plummer.

MALACOLOGICAL SOCIETY, at 8.—On a Dibranchiate Cephalopod from the Eocene of Arabia: G. C. Crick.—Note on the Horizon and Locality of the Type Specimen of *Pleuronautilus pulcher*: G. C. Crick.—New Marine Mollusca from the Collection of the late Admiral Keppel: G. B. Sowerby.—On the Occurrence of Internal Septa in *Glyptostoma newberryanum*: G. K. Gude.—Note on a Dart found in the Body Cavity of *Helix aspersa*: R. G. Barnes.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Purification of Sewage: F. G. Helsby.—The Purification of Sewage by Hydrolysis and Oxidation: F. O. Kirby.

PHYSICAL SOCIETY, at 8.—On the Stresses in the Earth's Crust before and after the Sinking of a Bore-hole: Dr. C. Chree, F.R.S.—On the Lateral Vibration of Bars of Uniform and Varying Sectional Area: J. Morrow.—On Direct Reading Resistance-Thermometers, with an Appendix on Composite Thermocouples: A. Campbell.

*SATURDAY*, MARCH 11.

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

*MONDAY*, MARCH 13.

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

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Anglo-German Boundary Expedition in Nigeria: Colonel Louis Jackson, R.E.

*TUESDAY*, MARCH 14.

ROYAL INSTITUTION, at 5.—Some Recent Biometric Studies: Prof. K. Pearson, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Shipbuilding for the Navy: Lord Brassey, K.C.B.

AËRONAUTICAL SOCIETY, at 8.—Some Recent Experiments in Aërodynamics: P. Y. Alexander.—The Shape of Navigable Balloons: Eric Stuart Bruce.—Automatic Stability: E. C. Hawkins.—Note on an Aluminium Kite: Alan H. Burgoyne.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—Manners and Customs of the Melanesians; Lantern Illustrations: Rev. W. H. Edgell.

*WEDNESDAY*, MARCH 15.

CHEMICAL SOCIETY, at 5.30.—The Velocity of Oxime Formation in Certain Ketones: A. W. Stewart.—Catechin and Acacatechin; Supplementary Note: A. G. Perkin.—The Action of Ethyl Dibromopropanetetracarboxylate on the Disodium Compound of Ethyl Propanetetracarboxylate; a Correction: W. H. Perkin, jun.—On Glutaconic Acid and the Conversion of Glutaric Acid into Trimethylenedicarboxylic Acid: G. Tattersall.—The Ultra-violet Absorption Spectra of Certain Enol-keto Tautomerides: E. C. C. Baly and C. H. Desch.—Esterification Constants of Substituted Acrylic Acids: J. J. Sudborough and D. J. Roberts.—α-Chlorocinnamic Acids: J. J. Sudborough and T. C. James.—Di-ortho-substituted Benzoic Acids. Part VI. Conversion of Methyl into Ethyl Esters: J. J. Sudborough and T. H. Davies.—Simple Method for the Estimation of Acetyl Groups: J. J. Sudborough and W. Thomas.—Gynocardin, a New Cyanogenetic Glucoside: F. B. Power and F. H. Lees.

ENTOMOLOGICAL SOCIETY, at 8.

ROYAL MICROSCOPICAL SOCIETY, at 8.—A Review of Work done by Metallographers: J. E. Stead, F.R.S.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—On the Growth of Instrumental Meteorology: R. Bentley.

MINERALOGICAL SOCIETY, at 8.—On Some New Mineral Localities in Cornwall and Devon: A. E. I. M. Russell.—On a Crystal of Phenakite from East Africa: L. J. Spencer.—(1) Notes on Various Minerals from the Binnenthal, Switzerland.—(2) A New Oxychloride of Copper from Sierra Gorda, Chili: G. T. Prior and G. F. Herbert Smith.

*THURSDAY*, MARCH 16.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* A Preliminary Note upon the Question of the Nutrition of the Early Embryo: E. Emrys-Roberts.—On Reciprocal Innervation of Antagonistic Muscles. Seventh Note: Prof. C. S. Sherrington, F.R.S.—On the Absence or Marked Diminution of Free Hydrochloric Acid in the Gastric Contents, in Malignant Disease of Organs other than the Stomach: Prof. B Moore, with W. Alexander, R. E. Kelly, and H. E. Roaf.—On the Heterogenetic Origin of certain Ciliated Infusoria from the Eggs of a Rotifer: Dr. H. C. Bastian, F.R.S.

ROYAL INSTITUTION, at 5.—Recent Astronomical Progress: Prof. H. H. Turner, F.R.S.

SOCIETY OF ARTS, at 4.30.—Manipur and its Tribes: T. C. Hodson.

LINNEAN SOCIETY, at 8.—Contributions to the Flora of Liberia: Dr. Otto Stapf.—*Exhibitions:* Penguins and other Birds from the Falkland Islands, and Scratched Rocks from a Rockhopper's Rookery: R. Vallentin.

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