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MIGRATORY BIRDS.

The Book of Migratory Birds, met with on Holy Island and the Northumbrian Coast, to which is added descriptive Accounts of Wild Fowling on the Mud Flats, with Notes on the General Natural History of this District. By W. Halliday. Pp. 258. (London: J. Ouseley, Ltd., n.d.) Price 5*s.* net.

THE obtrusive title of a work should, we think, be more closely descriptive of its contents than that of the volume now before us. "The Book of Migratory Birds"—the title conspicuously appearing on its cover—excites hopes in the ornithologist of a comprehensive contribution to a branch of his science of unquestioned interest. His momentary disappointment, on discovering from the continuation of the title inside, the restriction of its scope to the Northumbrian coast, may perhaps be relieved on his recalling the fact that the district, with its offshore islands and lighthouses, forms a migration-observatory from which a keen and persistent watcher might be expected to make valuable contributions to the question. His annoyance, however, will be acute when, on dipping into its pages, he finds the volume to be only a *mélange* of articles, strung together in the most casual way, and evidently originally contributed to some newspaper or journal in which either science was not a strong point or the editorial supervision was far from exacting.

The first part consists of a score of essays, not one without need of vigorous revision by a competent zoologist, while the second describes a certain number of the species of the Northumbrian coast individually; the book, however, makes no serious contribution to migration data, nor adds anything new to the history of the species observed. The first thirty-seven pages are alone specially devoted to the bird-life of Lindisfarne and the Farne islands, but the short and desultory notes on the species mentioned will hardly repay the reader for his time. The succeeding three essays deal with "wild-fowling" as far removed from Holy Island as North Kent; with "a few comments on sport," and "how I became a naturalist," this last filling eight pages, of which five contributed by another pen, have no connection in the world with the autobiography. With the following two, on "bird migration" and "bird migration from America to Europe," hope rises that at last some new ideas on the subject giving its dominating title to the book are to be disclosed. We are not disappointed by the author.

"Whatever theory is advanced [on this absorbingly interesting question] the idea," writes Mr. Halliday, "baffles the most devoted student of natural history. Yet the query as to the causes of the northern or spring exodus has prompted me to make an effort to explain . . . those laws. . . . Almost without exception . . scientists are agreed that previous to the period termed the Glacial or Ice age, climates were non-zonal—that is, that they were of the same general temperature everywhere from pole to pole. First, that there was an epoch of torrid heat followed by one of tropical heat, and succeeded by one of temperate heat, which gradually passed into one of excessive cold, during which period the higher lands were snow-covered. . . . Since this age the climates have become zonal—a condition which seems to us most natural, because man remembers naught to the contrary.[!] The geological record shows us, however, that everywhere from pole to pole the same life existed during all the periods before the latter part of the temperate Tertiary epoch. Aside from these differences of temperature resulting from elevation . . . there were in the nature of things few reasons for migrations of either fauna or flora . . . when finally the gradual transition from earth-heat control to sun-heat control had taken place, and the Ice age began, these wanderings to and fro become systematic and periodical. The stronger and more active individuals pushed further on than their fellows, as they climbed up further on mountain sides, thereby forming a class apart. They mated and founded new varieties. . . . So here we have, in its earliest and simplest form, the origin of the migratory movements of animals which have developed to such an extent in this day under the present zonal distribution of climates. Thus we may conclude," adds the author, "that, beginning with the first modifications of climate, perhaps at the commencement of the Pleistocene era, the various forms of life being suited to a uniform environment sought in their wanderings to and fro, the continuance of these conditions."

So here at last we have the final word on phenomena which have puzzled generations of ornithologists and others!

After such epoch-making discourses as these, a dozen other essays—evident reprints—follow on a variety of matters unconnected with the subject of the book, yet containing many entertaining observations not to be found in more recent ornithological histories!

The second part of the book describes individually forty-two species only out of the ninety listed on p. 22 as the more or less complete avifauna of Holy Island and region. They are not arranged in any classificatory order, nor, in many cases, do they appear under the generic and specific names which are usually given them by the rules of nomenclature. Fuller and more accurate accounts of these species are to be found in a score of well-known histories of British birds. We are staggered to find in this catalogue of Northumbrian birds the names of the cassowary and the ostrich, sandwiched between the quail and the merlin. We live and learn, however! Of the two final essays, both of which appear under the headline of "The Book of Migratory Birds," the one on North Sea seals may be legitimately included in a work on Northumbrian natural history; but it is a far cry from longshoring on Lindisfarne to "seal-hunting in Greenland," which is the title of the other. The author, however, makes his own apologies in these words:—

"If the able and experienced chroniclers of the migrants in the past have written craving the indulgence of the reader, I feel I am infinitely more in need of such indulgence, and as a man is but mortal . . . his best work is oft-times a sorry attempt."

M

PRINCIPLES OF ANALYTICAL CHEMISTRY.

Theoretical Principles of the Methods of Analytical Chemistry based upon Chemical Reactions. By Prof. M. G. Chesneau. Authorised translation by Prof. Azariah Thomas Lincoln and Prof. David Hobart Carnahan. Pp. x+184. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1910.) Price 7*s.* 6*d.* net.

IN the introduction it is stated that this book represents the reproduction of a series of lectures delivered in the Collège de France on the principles involved in the methods of analytical chemistry. The reversible and irreversible reactions which are involved in analytical processes are discussed, on the one hand, from the point of view of the theory of electrolytic association, and, on the other, from that of the heat changes which accompany these reactions.

It is obvious that the comparative examination of the facts of analytical chemistry from these two points of view represents a theme to which considerable interest would attach if the comparison were made by a chemist thoroughly familiar with both aspects of the question, and yet untrammelled by adhesion to any particular doctrine. Unfortunately this is not the case, and it is perhaps partly due to the author's lack of familiarity with the present position of the ionic theory that his verdict is given in favour of the so-called calorimetric theory. The evidence which leads to this result is very far from convincing, for whereas great stress is laid on the difficulties, real and apparent, which are involved in the adoption of the ionic theory, the improbable consequences which attach to the application of the calorimetric hypothesis are accepted without criticism

Only a brief reference can be made to a few of the many points which call for comment. In terms of the calorimetric theory we find that acids are classified as strong, medium, and weak according to the quantities of heat liberated in the process of neutralisation. The decrease in the activity of a weak base, such as ammonia, on the addition of a corresponding salt, is attributed to the production of acid by hydrolytic decomposition of the salt. An attempt is made to refute the ionic explanation of the similar influence of salts on weak acids by reference to experiments on the rate of solution of zinc in solutions of acetic acid to which various metallic acetates were added. Such experiments are in reality of far too complicated a nature to allow of the results being interpreted in favour of or against any particular theory.

In the discussion of osmotic pressure, the early measurements of Pfeffer and Ponsot are cited, but no reference whatever is made to the work of Morse and his collaborators, or to that of Hartley and the Earl of Berkeley.

Certain generalisations, drawn by Ponsot from transport measurements by Chassy, are brought forward as being more important than all the excellent experimental work done on the subject from the time of Hittorf onwards. Here, as in so many other instances, the lack of the author's knowledge of recent work on the nature of solutions of salts is lamentably apparent.

In the treatment of indicators, Ostwald's long-discarded ionic explanation is the only one which the author sees fit to compare with that based upon the calorimetric theory.

These references suffice to indicate that the author has failed to do justice to his subject, but this review would be incomplete if attention were not directed to the unsatisfactory character of the translation. In view of the fact that the academic title of the second translator is that of associate professor of Romance languages, a rendering of the original into tolerable English might have been reasonably expected. To show that this anticipation is not fulfilled, the first paragraph on p. 4 may be quoted:—

"The processes of analytical chemistry consist, in general, in bringing each element successively to the state of a definite compound in a final system, formed of distinct phases, whose nature lends itself easily to a separation by purely mechanical processes."

This conglomeration would appear to be the result of a too literal translation.

Apart from the publisher's share in the production of the work, the reviewer can find nothing to recommend it, and the translation represents a good deal of misspent time and energy. H. M. DAWSON.

MORE MOSQUITOES.

A Monograph of the Culicidae or Mosquitoes. Mainly Compiled from Collections Received at the British Museum. By Fred V. Theobald. Vol. v. Pp. xv+646+6 plates. (London: British Museum (Natural History), Longmans and Co., B. Quaritch, and Dulau and Co., 1910.) Price 1*l.* 5*s.*

SOME few years ago a critic observed that, owing to the system of classification adopted for the Culicidæ, to describe a new species "and call it a genus" was far easier than to determine its true systematic position. Since then, such has been the activity of genus-makers, the condition of affairs as regards the nomenclature and taxonomy of the known mosquitoes has become infinitely worse. No entomologist of repute will deny that, were characters so trivial as those now employed for the distinction of most of the so-called "genera" among Culicidæ made use of in other orders of insects, or in other families of Diptera, the result would be little short of chaos. Sooner or later the whole question of mosquito classification will have to be reconsidered; meanwhile the subject awaits the advent of a properly qualified systematist, gifted with breadth of view and possessing a sound knowledge of fundamental principles.

The book before us, which is a continuation, and, in some respects, a *résumé* of the previously published volumes of Mr. Theobald's well-known work, is constructed upon the same lines as its predecessors, and certainly bears witness to the industry of its author. We are told in the "Introduction" that, since the appearance of vol. iv. in 1907, the genera of Culicidæ have been increased by twenty-one and the recognised species by no fewer than three hundred and ninety-two, though it would seem that not all of the latter are actually new; thirteen of the genera, however, and eighty of the species are now described for the

first time. Since the first two volumes of the monograph (published in 1901) have long been out of print, the appearance of the present instalment is opportune, and the tables for the determination of genera and species, with which it is copiously provided, will doubtless prove useful to many. The figures are clear and well executed, and misprints are few.

The author's English, however, not infrequently makes the sensitive reader shudder; for instance, the first sentence of the book includes the words, "they tabulate as follows," and this remarkable phrase, in which "tabulate" is used as an intransitive verb, is repeated again and again in the course of the volume. As additional examples of faulty phraseology we may quote:—"It probably comes in *Myzomyia*" (p. 22); "it cannot be said as to what *pictus* really is" (p. 25); "A number of allied genera come around it and they keep on increasing in number" (p. 151). More serious than this is a flagrant error in terminology. Diptera, as is well known, have a five-jointed tarsus, but Mr. Theobald not only employs the objectionable, because etymologically incorrect, term "metatarsus" for the first joint of the tarsus, but calls the second and third joints the "first and second tarsals," and so on; this is confusing as well as wrong, and would lead a novice to suppose that in the Culicidæ the tarsus is four-jointed.

With reference to the disseminator of yellow fever, it may be noted that the author has decided to retain the name *Stegomyia fasciata*, Fabr., instead of regarding the specific designation as preoccupied and substituting for it *calopus*, Mg., as is the practice in the United States. On the ground of common sense as well as expediency, the course adopted in the British Museum monograph, though not in accordance with the accepted rules of zoological nomenclature, is undoubtedly the best. Mr. Theobald should not, however, perpetuate a slip made in his last volume, by stating that "Villiers described a mosquito (1789) as *Culex fasciatus*," the original author of the name in question, which dates from 1764, being O. F. Müller, whose brief description, accompanied by a reference to the work in which it appeared, was copied by de Villers (not Villiers) in 1789.

PHILOSOPHY.

Philosophical Essays. By B. Russell, F.R.S. Pp. vii+185. (London: Longmans, Green and Co., 1910.) Price 6*s.* net.

THE subject-matter of Mr. Russell's book may be gathered from the titles of his chapters—"The Elements of Ethics," "The Free Man's Worship," "The Study of Mathematics," "Pragmatism," "William James's Conception of Truth," "The Monistic Theory of Truth," "On the Nature of Truth and Falsehood." With the exception of the last, all are reprints, with some alterations, of articles which have appeared in the *New Quarterly, Hibbert Journal, Independent Review, Albany Review, Edinburgh Review,* and Proceedings of the Aristotelian Society.

In the first essay the author states his own determinist convictions, and points out that determinism does not interfere with morals, for, as a matter of fact, people never do believe that anyone else's actions are not determined by motives, however much they may think *themselves* free.

"If we really believed that other people's actions did not have causes, we should never try to influence other people's actions." "Most morality absolutely depends upon the assumption that volitions have causes."

In the third essay there is a fine statement of the "supreme beauty—a beauty cold and austere, like that of sculpture," which the mathematician sees in his subject; also some good hints on teaching. But the largest part of the book, and perhaps the most interesting, is that in which the author combats the new philosophy—or some aspects of it—which is mainly represented by Dr. Schiller, now that its great American protagonist is gone from among us, to the regret of all students, whether disciples or philosophical enemies.

Mr. Russell is an empiricist, and therefore agrees with pragmatism's readiness to treat all philosophical tenets as working hypotheses only; but he dissents from its conception of the nature of truth. If utility is to be a criterion of truth, it is not a useful criterion, for it is usually harder to discover whether a belief is useful than whether it is true (*e.g.* papal infallibility). Therefore the pragmatist theory does not "work," and the pragmatists are hoist with their own favourite petard. As to the "will to believe," Prof. James ignores the distinction between believing and entertaining an hypothesis. If a man comes to a fork in the road, and does not know which branch to take, it is a "forced option" from the point of view of action, for he must take one of them if he is to arrive at his destination. But his *belief* is not forced. He neither believes nor disbelieves that he is on the right road, until he finds out by asking somebody, or by sign-posts, or from other sources of information. *The Will to Believe* "assumes that if we do not completely believe an hypothesis, we must either completely disbelieve it or wholly suspend judgment." But the fact is that all experiment, both in science and daily life, implies a state of mind which accepts neither alternative. Actions are based on probabilities.

There is much further acute criticism, but the author expresses his great respect and esteem for William James, and his deep sense of the public and private loss occasioned by his death.

HEREDITY.

Heredity in the Light of Recent Research. By L. Doncaster. (Cambridge Manuals of Science and Literature.) Pp. x+140. (Cambridge: University Press, 1910.) Price 1*s.* net.

MR. DONCASTER has performed a remarkable feat in condensing into so small a space such an admirable introduction to the study of heredity in the light of recent research. He writes clearly, without dogmatism, he treats fairly both the Mendelian and the biometric schools, and shows excellent judgment in what he includes and in what he omits.

The book begins with a discussion on the nature of heredity and variation, showing how the study of one is bound up with that of the other, and how both

bear on the problem of evolution. The different kinds of variation, their nature and their causes, next come in for consideration, and the methods of investigating them are dealt with. Then follows a chapter on the statistical study of heredity, which includes a description of the simplest method of measuring correlation. Chapters v. and vi. treat of the Mendelian form of inheritance, both as it is seen in a single pair of allelomorphs, and when it is complicated, as in the inheritance of coat colour in rats and mice, by the dependence of the character on two separately inheritable factors. This is succeeded by a discussion "on some disputed questions," which range from the apparent incomplete segregation of coat-characters in the descendants of a cross between long-haired (Angora) and short-haired guinea-pigs to the inheritance of acquired modifications. The treatment of these problems is suggestive rather than exhaustive.

The final chapter deals with heredity in man. The more important conclusions obtained by the use of statistical methods are mentioned, and cases are described where the inheritance of particular characters may be explained on Mendelian lines. Among the latter are included the presence or absence of pigment in the front of the iris observed by Hurst, and Nettleship's remarkable pedigree of "night-blindness," which appears to behave as a Mendelian dominant. Finally, the importance of inheritance in the consideration of certain sociological questions is insisted on. Two appendices are added, (i.) "Historical Summary of Theories of Heredity," and (ii.) "The Material Basis of Inheritance."

The excellence of the print and paper are deserving of especial mention. The latter is thin but opaque, with a very smooth, but not an offensively glossy surface. This enables the diagrams of variation and pedigrees, &c., to be reproduced very clearly though on a small scale, while the half-tone blocks are better printed than in many a more expensive work.

E. H. J. S.

EARLY EGYPTIAN REMAINS.

The Tomb of Two Brothers. By Miss M. A. Murray. (Handbook, Manchester Museum.) Pp. 79+21 plates. (Manchester: Sherratt and Hughes; London: Dulau and Co., 1910.) Price 5*s*.

IN 1907, during the exploration of a series of tombs at Der Rifeh, the cemetery of the ancient Egyptian town of Shas-hotep, near Assiut, a concealed and hitherto unrifled chamber was discovered. Prof. Flinders Petrie, recognising the importance of the contents being kept together and scientifically examined, suggested that in consideration of a subsidy towards the work at Memphis, the tomb and its contents should be placed at the disposal of the Manchester Museum. Through the liberality of friends the sum required, with a balance sufficient to defray the cost of the present monograph, was provided. The report has been edited by Miss M. A. Murray, who has secured contributions from experts on the many points of interest connected with the discovery.

The tomb belongs to the twelfth dynasty, and supplies two of the earliest mummies which have hitherto been subjected to scientific examination. They were placed in highly decorated coffins enclosed in elaborate cases, while the viscera were, as usual, deposited in so-called canopic jars. Each of the deceased was provided with a statuette as a home for the Ka, or separable soul, and the chamber also contained two figures of girls bearing offerings for the dead, and boats provided for the journey of the soul to its final rest.

Various novel and interesting questions are discussed by Dr. J. Cameron in his elaborate report on the anatomy of the remains. The inscriptions indicate that the bodies are those of two personages named respectively Nekht-ankh and Knumu-nekht, the former an elderly man, the latter middle-aged, both of small stature, about 5 feet 3 inches high. The slimness, delicate moulding, and faintness of the muscular impressions in the case of Nekht-ankh indicate a feminine type; and Dr. Cameron infers that he was a eunuch, or at least he designates the type as eunuchoid. Further, the extraordinary fact is disclosed that on him the operation of subincision, familiar to all students of Australian native tribes, but hitherto not recognised in Egypt, had been performed. In this connection it is significant that the right lateral incisor of the upper jaw had been removed; and it can hardly be a mere coincidence that the removal of this tooth, possibly as a means of propitiating Nemesis or to subserve some obscure magical purpose, is a part of this rite in Australia. These curious facts deserve, and will doubtless receive, due attention from anthropologists.

It is also remarkable that the skulls of these two brothers, sons at least of one mother, differ widely in structure. That of Knumu-nekht, the younger, is extremely prognathous, with an alveolar or gnathic index of 104·34, while that of his eunuchoid brother is remarkably orthognathous, with an index of 93·8, that of Englishmen being 96. The obvious explanation is that these men were sons of one mother by different fathers, the prognathous type indicating admixture of some negroid stock, such as that which has been recognised by Prof. Eliott Smith in some Nubian cemeteries. It is a proof of the artistic capacity of this early period that the carver of the statues of the brothers clearly indicated these variances of racial type.

Manchester is to be congratulated on the acquisition of a collection of the highest anthropological interest, on the liberality of the citizens who secured its possession, and on the skill and learning which the writers have bestowed upon this admirable monograph.

PHOTOGRAPHIC PRACTICE.

A Primer of Photography. By Owen Wheeler. Pp. vii+202. (London: Methuen and Co., Ltd., n.d.) Price 2*s*. 6*d*. net.

WE have read this volume with much pleasure, because it consists of a plain and straightforward statement, by a man of experience, of those facts that one who has just begun to photograph will find profitable. The author gives no preface or introduc-

tion, relying presumably on the title as a sufficient indication of his aim. He deals with the practice rather than the underlying principles of photography, though these and historical details are not altogether neglected. He does not repeat such instructions as are enclosed in every box of plates or packet of paper, and refers without hesitation to various proprietary articles and to expense. As might be expected, the author regards his subject from the point of view of the present-day beginner, and it is in this that the volume differs from the older primers. There is no attempt to indicate methods of manufacture, because no one at the present time prepares his own sensitive material. There are no tables of exposures necessary in various circumstances, because "here the exposure meter or guide comes into play." Films are not treated of as if they almost needed an apology for their introduction, nor hand-cameras as if they were inferior in almost everything else but price to the instruments supported in a more stable manner.

Although no two teachers would make exactly the same selection of processes as being best suited to the beginner, and making all due allowance for personal preference, we are rather surprised that the common mercury and ammonia method of intensification is not referred to, the two methods recommended being the uranium and the silver cyanide methods, both of which are more troublesome than the other. The statement that plates are made orthochromatic "by bathing ordinary plates in a colour sensitiser" is likely to mislead the beginner in this detail of manufacture. Of course, the sensitiser is added to the emulsion, bathing being quite an exceptional process. There are a few matters, particularly in the optical part, that might be revised with advantage, but these are not of prime importance. The chapter on "Telephotography" explains the manner of using the special lenses constructed for this purpose in a more simple and at the same time complete manner than we have ever seen elsewhere.

STARS IN SEASON.

Round the Year with the Stars. By Garrett P. Serviss. Pp. 147. (New York and London: Harper and Brothers, 1910.) Price 5*s.* net.

THIS volume takes quite a different line from that of "Astronomy with the Naked Eye," by the same author, the points of overlap between the two volumes being infrequent and unimportant. In the earlier work Mr. Serviss described the legends and myths which so profusely surround the old constellations; in the present volume he endeavours to cultivate a personal knowledge with the chief units of the celestial pageant.

In the four principal chapters (i.–iv.), the sky is taken at each of the four seasons—spring, summer, autumn, and winter—and is so described that the beginner may locate, with but little trouble, the constellations and their *lucidae*. This may sound rather a hackneyed procedure, but in the hands of Mr. Serviss, whose poetic enthusiasm for the stars is, on every page, as obvious as his wide knowledge, it becomes most interesting and instructive. For example, he introduces (p. 25) a discussion as to the most suitable season for the commencement of the year, deprecating January, when nature is asleep, as compared with spring, when the glorious re-birth takes place. A reference to Sir Norman Lockyer's researches on the different years would have further elucidated the subject. The fact that our constellation Virgo is similarly named in ten different and ancient languages is the type of fact that makes the work so interesting. But the physical attributes of the individual objects are not neglected; the powder of science is judiciously mixed with the jam of poetic mythology. The description of Spica's magnitude, intrinsic brilliance, and enormous velocity, given on p. 31, should be appreciated by the least scientifically inclined sky-gazer. It is helpful to find the common, countryside names given beside the Arabic names and the Bayer Greek letter.

In discussing the colours of companions, the author is, we believe, rather too dogmatic when he states definitely (p. 89) that the complementary colours are not the effect of contrast. Recent researches rather tend to contradict this, and we look upon the footnote reference to Dr. Louis Bell's work (p. 90) as a negation of the author's dictum. The four seasonal and the six ordinary charts are nicely done, but we fear they are not of sufficient size or contrast to aid the beginner in his actual observations. The appendices are very interesting, and after reading through the first, which gives the Christianised names of the constellations, the beginner will probably shudder at the possibility of having to use the genitive singular of "The Red Sea with Moses Crossing It," Schillerius's "improvement" on Eridanus. W. E. R.

A PAIR OF TIGER BOOKS.

(1) *Anecdotes of Big Cats and other Beasts.* By David Wilson. Pp. viii+312. (London: Methuen and Co., Ltd., 1910.) Price 6*s.*

(2) *The Life Story of a Tiger.* By Lt.-Col. A. F. Mockler-Ferryman. Pp. iv+253. (London: A. and C. Black, 1910.) Price 3*s.* 6*d.*

(1) IT has been suggested that one reason for the greater prevalence of man-eating tigers in India, as compared with man-eating lions in Africa, is due to the superiority in courage of the natives of the latter over most of those of the former country. Whatever may be the truth of this assertion as regards India, it most certainly does not apply to Burma, where, according to Mr. Wilson, it is a common practice for the relatives or neighbours of a person carried off by a tiger to pursue the murderer then and there, armed only with spears, or other primitive weapons, in order to recover the body. Some faint idea of the courage necessary for such a primitive expedition may be gleaned, observes the author, by anyone who tries to take a bone from a savage dog. In one instance recorded in Mr. Wilson's book four old men started to rescue the body of the granddaughter of one of the party, and succeeded in badly wounding the tiger, although with the death of one of the heroic four, and the maiming of a second. But this act of heroism is exceeded in a case where

the first of a party of three young girls walking in single file through the jungle was seized and carried off by a tiger. Nothing daunted, the second girl, seizing a chopper from the one behind her, rushed in pursuit, and actually killed the striped marauder by a rain of blows on its head. It is true that both anecdotes rest on native testimony, but they seem to have the impress of truth.

Mr. Wilson's book is, however, by no means confined to tigers, and will be found to contain a number of more or less interesting observations on the habits and character of many denizens of the Burmese jungles, from meloks downwards to snakes and lizards.

(2) Colonel Mockler-Ferryman's volume, on the other hand, is a "tiger-book" pure and simple, and for those who enjoy animal "autobiographies" is an excellent example of that class of literature, for the author appears to be thoroughly well-acquainted with the habits of the striped tyrant, and records the history, in what are supposed to be the animal's own words, of a member of the race from cubhood to mature age. Incidentally he mentions that there are "castes" among the species, and that the sleek hill-tiger, with a fully-striped coat, is an altogether superior class of animal to its fat, and often sparsely striped, brother of the lowlands. An attractive feature of the volume is formed by the eight coloured plates, reproduced in excellent style by the tricolour process from sketches by Mr. Harry Dixon. Whether when a tiger has knocked over a sambar stag by a vigorous rush, its mate would take a flying leap on to the victim in the manner shown in the plate on the cover of the volume, I am not competent to say, but the action certainly looks like a somewhat unnecessary display of energy. In the plate representing a tiger clinging to the shoulders of a tame buffalo in the arena of a native chief, the horns are of somewhat antelope-like type, but we are told on p. 16 of the text that the buffalo in question, together with its fellows, possessed horns of abnormal shape. R. L.

OUR BOOK SHELF.

Anton Dohrn: Gedächtnisrede gehalten auf dem Internationalen Zoologen-Kongress in Graz am 18 August, 1910. By Prof. Th. Boveri. Pp. 43. (Leipzig: S. Hirtel, 1910.) Price 1.25 marks.

ALTHOUGH the labours and personality of the late Anton Dohrn have been strikingly presented in this journal, the motives that led him to found the "Stazione Zoologica" and the influence he has exerted are matters of great interest, not to be exhausted by a single article. In a wonderfully artistic manner this aspect of Dohrn's life is made clear in a speech delivered by Prof. Boveri during the Graz Zoological Congress last August, and now published by Hirtel, of Leipzig.

In that pure, nervous German to which he has accustomed us, Prof. Boveri sets forth the inspiration that led Dohrn to undertake his life-work, the capacity that enabled him to overcome difficulties of the severest nature, and to win support of the most international character. Now that it is done we are apt to forget the originality, the clear-sightedness, and the zeal which underlaid such a splendid success; and it is well that the man himself should be known who has raised on alien territory buildings that cover 2000 square metres, that enclose 250 rooms, and employ fifty officials. The international value of such a laboratory is immense, and the work is that of one man who faced the forebodings of failure from his father, friends, and colleagues, who strove against misfortune upon misfortune, and who, in spite of this, staked his whole interest in the ultimate success of the scheme. The speech is one of lasting value.

Fly-Leaves from a Fisherman's Diary. By Captain G. E. Sharp. Pp. xi+175. (London: Edward Arnold, 1910.) Price 5*s.* net.

BOOKS about fishing, and above all about dry-fly fishing, are so constantly appearing that the reader tends to become critical, not to say fastidious. Yet we do not think that the most fastidious will complain of Captain Sharp's little book. The writing of it has obviously been a labour of love undertaken by a keen sportsman, and an ardent lover of nature and open-air life. The episodes described are ordinary, and, we had almost written, commonplace, but they are set forth with the charm which is inseparable from the descriptions of the really sympathetic student of the life of a river.

It has been the good fortune of the author to find employment in a country town within bicycling distance of the water that he fishes, and, month by month, he has been able to spend his days and half-days of leisure by the river. Month by month he has described his days, or some of them, for, "Even in fishing there are sometimes evil days, but they are not the days which we remember." The book is illustrated with three really admirable pictures of stretches of a chalk stream and a charming view of a nameless Wiltshire village. L. W. B.

Mating, Marriage, and the Status of Woman. By James Corin. Pp. xii+182. (London and Felling-on-Tyne: Walter Scott Publishing Co., Ltd., 1910.) Price 2*s.* 6*d.* net.

IN an essay of considerable interest, the author reviews the causes which have led to the development of the relations existing between the human male and female.

The phenomenon of a relatively inferior female bound to a relatively dominant male is peculiar to man. The contention is that the marriage system is the cause of human progress while at the same time it affords an explanation of woman's physical and mental inferiority. Progress depends on the birth-rate. If woman is to be a highly developed breeding machine she must occupy an inferior position, being economically dependent on the male. Centuries of selection, for breeding purposes, of the feeblest, most submissive, and patient of women have had a marked effect.

Mating, in which the woman was free, belongs to the first period of human affairs, and marriage to the second. In the opinion of the author, the marriage system, fostered by militarism, has developed from the practice of communal rape, and the relation of victorious soldiers to captive women. According to Skeat, the word wife is allied to vibrare, to tremble; hence wife means a trembling thing, a captive. The essay is interesting and the argument is well sustained.

Mother and Child. Being Letters from an Old Nurse to a Young Mother. By L. M. Marriott. Pp. 126. (London and Felling-on-Tyne: Walter Scott Publishing Co., Ltd., 1910.) Price 1*s.*

IN a small volume of 120 pages much sound advice is given about the management of pregnancy, the health of young mothers, the care of infants, the early training of children, and other domestic matters.

The book is written in the form of letters from a nurse to her patient. It is intended for the laity. The instructions are practical and the teaching is in accord with the modern school of obstetrics.

It is questionable what advantage is gained by presenting medical subjects in this way, but if women are to be supplied with information on these subjects it could not be better given.

The book is of handy size, and it is supplied with an index. The type is good.

The Modern Geometry of the Triangle. By W. Gallatly. Pp. 70. (London: F. Hodgson, n.d.) Price 2*s.* 6*d.*

THE principal novelties in this tract are the chapters on the orthopole (with some original propositions by the author) and on orthogonal projection (mostly after Prof. Neuberg). A pretty theorem in the latter is that all equilateral triangles in a given plane project upon another plane into triangles having the same Brocard angle. The other four chapters discuss various kinds of coordinates, the Lemoine and Brocard points, pedal and anti-pedal triangles, the medial triangle, and the Simpson line. No reference is made to the Tucker circles, or to Kiepert's hyperbola; even the Brocard circle is unmentioned, so the tract is deficient, even as a summary of the most important parts of the subject. A rather irritating feature is that the symbol ∞ is used for two entirely different purposes; this might easily have been avoided. Perhaps the figures will be found as useful as anything in the tract, for although they are not particularly good, they are drawn so that the special points are far enough apart, which is not very easy to contrive when a student is drawing figures for himself. M.

Paul Appell: Biographie, Bibliographie analytique des Ecrits. By Ernest Lebon. Pp. viii+71. (Paris: Gauthier-Villars, 1910.) Price 7 francs.

THIS volume is the latest addition to the excellent series of biographies published under the general title, "Savants du Jour," to which attention has been directed on several occasions in these columns. The brochure maintains the high character of the series.

A biography of Prof. Appell, in which an interesting account of his early experiences during the siege of Strasburg, where he was born in 1855, is followed by an exhaustive list of the academic distinctions, honorary titles, prizes, and decorations which have been conferred upon him during his strenuous life. His work in mathematical analysis was eulogised by M. Charles Hermite in 1889, on the occasion of Prof. Appell's receiving a gold medal at a conference presided over by King Oscar II.; and the appreciation is here printed. M. Gaston Darboux's account of the researches in geometry, for which Prof. Appell received the Bordin prize of the Paris Academy of Sciences, is also included in the volume. A complete list of the papers and addresses of the subject of the biography completes what is a valuable record.

A Flower Anthology. Selected and illustrated by Alfred Rawlings. Pp. iv+163. (London: Philip Lee Warner, 1910.) Price 5*s.* net.

THE quotations in this collection have been selected from the works of many well-known poets, but more especially from Wordsworth, Shakespeare, Herrick, Chaucer, and Keats.

The poems have been classified roughly into those dealing with the seasons of the year, and the changes in the animal and vegetable world associated with them. We are glad to see Edmund Spenser's "The Pageant of the Year," which gives a fine description and picture of nature in the different seasons and months.

The illustrations form a pleasing addition to the volume, which should meet with the approval of all lovers of poetry. The book is, moreover, very tastefully bound.

Hazell's Annual for 1911. A Record of the Men and Movements of the Time. Edited by Hammond Hall. Pp. lix+592. (London: Hazell, Watson and Viney, Ltd.) Price 3*s.* 6*d.* net.

THE twenty-sixth issue of this useful reference annual is so much up-to-date that it contains a biographical list of members of the new House of Commons. So varied are the contents of the volume that it will appeal to workers in most spheres of human activity. The man of science will find, among other useful contents, articles on scientific progress in 1910, aërial navigation in 1910, Imperial research, scientific institutions, higher education, forestry, and afforestation, agriculture, and daylight saving. It is remarkable how much information has been packed into a small space.

Plant Anatomy from the Standpoint of the Development and Functions of the Tissues and Handbook of Micro-technic. By Prof. W. C. Stevens. Second edition. Pp. xv+379. (London: J. and A. Churchill, 1910.) Price 10*s.* 6*d.* net.

THE first edition of Prof. Stevens's work was reviewed in NATURE for July 9, 1908 (vol. lxxviii., p. 219). The present issue has been enlarged by the addition of a chapter on reproduction, and the volume has been revised generally.

LETTERS TO THE EDITOR.

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

The Recent Earthquakes in Asia.

I AM informed by Mr. G. W. Walker, superintendent of Eskdalemuir Observatory, that the records of the seismograph according to the design of Prince Boris Galitzine, which was recently presented by Dr. Arthur Schuster to the observatory, give the positions of the epicentres of the recent earthquakes in Asia as follows:—

January 1, lat. 36½° N., long. 66° E.
January 3–4, lat. 42° N., long. 77° E.

The first place is in the Hindu Kush range of Afghanistan, north-west of Cabul. The second is in the north-east of Turkestan, near its junction with the Chinese and Russian Empires. W. N. SHAW.

Meteorological Office, South Kensington, London, S.W., January 9.

As it is unusual for the Kew magnetographs to be affected by earthquakes, it seems worth mentioning that on the occasion of the Turkestan earthquake, near midnight (G.M.T.) of January 3, both the declination and horizontal force traces show unmistakable effects. The magnets oscillated in a way characteristic of mechanical shocks. According to our Milne seismograph, the preliminary seismic tremors reached Kew about 11.35 p.m., and the large waves about 11.47 p.m., when the limits of registration were exceeded for a minute or so. There was then a comparative lull until about 11.54, when the limits of registration were again exceeded, and these very large movements continued with short interludes for more than fifteen minutes.

The apparent times of commencement of the oscillatory magnetic movements are about 11.53 in the declination and 11.55 in the horizontal force curves, and for four or five minutes the oscillations were so continuous that no

trace is clearly shown. From 11.35 to 11.38 there was a very rapid easterly movement of about 4′ in the declination trace, of a non-oscillatory character. The close agreement in time of this movement with the arrival of the preliminary tremors is very likely a purely accidental coincidence; but the movement is of an unusual character, and it would be interesting to know what was being recorded at the time at other magnetic observatories. The movement may, of course, have been due to some purely local source, *e.g.* abnormal electric-tram currents.

C. CHREE.

Kew Observatory, Richmond, Surrey, January 7.

Singularities of Curves and Surfaces.

THERE is a distinction between *multiple* points and what, for want of a better word, I have called *singular* points. The curve $au_p + u_{p+1} = 0$ has at A a *multiple* point of order p, but not a *singular* point. The latter points are defined in § 169 of my "Geometry of Surfaces," reviewed in NATURE of December 22, 1910 (p. 231), and the definition may be illustrated as follows. Let multiple points of orders p. q, r . . ., where p is not less than q, r . . ., move up to coincidence along a continuous curve; then the compound singularity thereby formed is a singular point of order p. The curve of lowest degree, which can possess a singular point of given order, depends on the way in which the singularity is formed. Thus if four nodes move up to coincidence along a conic, the resulting singular point is of the second order; but a quintic is the curve of lowest degree which can possess such a singularity. Also, if three nodes move up to coincidence along a straight line, the singular point is still of the second order, but no curve of lower degree than a sextic can possess such a point.

The reviewer's statement in the second paragraph is misleading, and calculated to convey a false impression, since the investigations referred to are applicable to surfaces of any degree. The fact is that a quartic surface is capable of possessing most of the simpler singularities. The principal exceptions are triple lines, which cannot be completely discussed without the aid of a surface of the seventh degree, and cuspidal twisted curves, which necessitate the employment of a quintic surface, since a quartic surface, which possesses a cuspidal twisted cubic curve, is a developable surface, and is therefore not sufficiently general for the purpose in question.

As science advances, the introduction of new words is essential. Thus lithotrity, ovariotomy, scleroderma, &c., have been introduced during the last century to designate operations and diseases of which our ancestors were ignorant, whilst algebra has been enriched by such words as catalecticant, evectant, protomorph, &c. The choice of suitable words requires care, but I adhere firmly to my opinion that Latin and Greek are the best languages to employ.

A. B. BASSET.

December 23, 1910.

IT is unfortunately impossible to give a very brief rejoinder to Mr. Basset's letter; and it is perhaps as well to take the opportunity of giving a further statement of my position in reference to singularities on a plane curve.

In the first place, the distinction drawn in Mr. Basset's letter between *multiple* points and *singular* points of order p does not seem to be in agreement with the practice followed in his book, where the two terms appear to be used indiscriminately: thus in §§ 171–4 and § 181 the term *multiple* point is invariably applied to singularities which, according to his letter, he would now call *singular* points. At any rate, the singularities considered in these articles cannot occur (in their general forms) on curves of degree $(p+1)$, and, as I understand Mr. Basset's letter, he intends the use of the term *multiple* points to be restricted to those singularities which do occur on curves of degree $(p+1)$. Naturally such a restriction would justify the assumption made in § 165, which was criticised in my review; but no modification of terminology will answer the question as to whether *all* types of singularity can be obtained by Mr. Basset's treatment of the subject.

The singularities which were in my mind when I raised this question were those considered by Zeuthen (*Math. Annalen*, Bd. x.) and Jordan ("Cours d'Analyse," t. i, chap. v.); a fairly simple example is given by the origin on the curve $x = t^6$, $y = t^{12} + t^{15} + t^{16}$.

Zeuthen's method enables us to determine the Plücker-equivalents of the singularity, and Jordan shows how to find quadratic transformations which reduce the singularity to a simpler character. But I do not see that Mr. Basset's limiting process (as briefly indicated in his letter) would enable us to handle any singularity of this type (called a *cycle* by Jordan), nor have I found any reference to the existence of such types in Mr. Basset's book.

T. J. I'A. B.

Scottish Natural History.

I SEE that NATURE of December 29, 1910, refers to two statements made before a natural history society by Mr. Symington Grieve, viz.:—

(1) That half a century ago white-tailed eagles were more abundant than golden eagles, or words to that effect.

(2) That Mr. Grieve is of the opinion that wild cats are on the increase in Scotland owing to the instructions issued by proprietors and factors for their protection.

With regard to the first, naturalists would like to have further data. It is certainly true white-tailed eagles *were* then vastly more abundant than now, and that they are now verging on extinction as an existing species. But that they were "far more numerous half a century ago than the golden eagle" requires more exact statistics. Forty years ago there were quite eighty eyries of golden eagles occupied over all Scotland, but I cannot find any *evidence to prove* that white-tailed eagles at any time anywhere in Scotland even approached that figure, and during at least forty years I have paid considerable attention to all statements made as to their distribution and their subsequent decrease. Locally in some few districts white-tailed eagles were more numerous than golden eagles, but not generally, and I believe all occupied eyries could at any time have been easily counted.

As regards the increase of wild cats, that is also quite undoubted, but the true reason is not the direct instructions given by proprietors or factors generally, though that may have some local value also, but to the protection afforded by the increased area of lands devoted to deer afforestation.

T. A. HARVIE BROWN.

Dunipace, Larbert, Stirlingshire, N.B.,
December 29, 1910.

The Origin of Man.

THE following extract from a review in "Dodsley's Annual Register for 1767" of Dr. Adam Ferguson's essay on the "History of Civil Society" may be of interest:—

"Many of the authors who have written on man, and those too, some of the most ingenious, have set out by considering him as an animal. . . . Nay, one in particular has thrown out doubts of his having been originally a monkey or baboon." (The reviewer goes on to speak of this theory as "too ridiculous for serious animadversion.")

Could any of your readers say who was the "one in particular"?

CHARLES E. BENHAM.

Colchester, January 7.

COLLIERY WARNINGS.

WHEN an appalling colliery disaster, like that at Hulton Colliery, happens to coincide with a "colliery warning," public attention is naturally attracted to the fact, and the warning at once becomes invested with an appearance of importance that is out of all proportion to its true value. There appears to be an impression that these colliery warnings are issued by some central responsible authority, such as the Meteorological Office might be, and that they are based upon sound scientific principles, but as a matter of fact they are issued by the Press Association, and are

apparently issued in defiance of all the dicta of science and all the teachings of practical experience. All these warnings are based on the assumption that a high barometric pressure indicates a condition of danger for the coal miner; for example, the warning published on December 19 last states :—"While the glass remains at about its highest level, miners are advised to beware of escapes of firedamp from the strata." The entire falsity of this assumption has been repeatedly pointed out in the technical press, but as the warnings are still being issued on the same lines, it may be worth while to place the main data on the subject before those interested in the matter.

Firedamp occurs occluded in coal, and also contained under pressure in cavities and fissures in the coal seam itself and in the strata adjacent to it. Furthermore, in every colliery there are larger or smaller areas from which the coal has been removed, and which are more or less loosely filled with débris, either deliberately thrown or packed in to fill up partly the empty spaces, or due to the breaking down of the roof of the coal seam. Such a partially filled space is known technically as the "goaf"; the ventilating current in a colliery traverses the various roadways and workings, passes along the working faces of the coal, and may sweep along the edge of the goaf, but the goaf itself is never ventilated. Hence in a fiery colliery the goaf gradually fills with a mixture of firedamp and air. The object of the ventilating air current is to dilute the firedamp given off gradually from the coal faces, or coming off more rapidly from cavities (firedamp escaping in this way being known as a "blower"), to such an extent as to produce a non-explosive atmosphere in all accessible parts of the mine.

A gas explosion can only occur in a properly worked colliery when an evolution of firedamp takes place in excess of the normal, and the question directly before us is how this rate of evolution of firedamp can be affected by changes of atmospheric pressure. It is an obvious truism that increase of pressure must tend to prevent the escape of firedamp from the coal or the strata of rock. In the case of gas contained in cavities, this is often under very great pressure, as high as 30 atmospheres having been recorded by actual measurement, and in such circumstances, even a considerable change in the height of the barometer, say 3 inches, amounting to only one-tenth of an atmosphere, would have but little influence. On the other hand, blowers sometimes give off gas at pressures not greatly above that of the atmosphere, and then fluctuations of atmospheric pressure may have a decided effect. Thus in the *Colliery Guardian* of December 13, 1907, Mr. D. S. Thomas gives a record of his observations on a blower extending over a twelvemonth, in which he found that the flow of gas from the blower increased quite regularly whenever the barometer fell, so much so that "the slightest change in barometric pressure was shown more delicately than the barometer itself could record it."

As regards occluded gas, it is quite certain that this comes off more readily when the coal is placed under diminished pressure. Numerous investigations have been made on this point, and it has been found that whilst a small reduction of pressure causes the occluded gas to commence to come off, yet even after many hours' exposure in a vacuum at ordinary temperatures, a considerable proportion of the gas is still retained. As regards therefore the gas contained in the coal and the surrounding rocks, it appears to be beyond controversy that a low barometer must necessarily correspond to a somewhat increased evolution of firedamp.

The gas contained in the goaf is under somewhat different conditions; so long as the air in the airways of the mine is under the same pressure as that in the goaf, there is no tendency for the latter to flow into the former once the condition of equilibrium has been attained, whether this be under a *régime* of high or of low barometric pressure. A rapid fall of the barometer would necessarily affect the airways first, and would therefore cause the foul air from the goaf to flow out into the airways of the mine, and it is quite conceivable that a series of rapid alternations of high and low pressure, bringing about a considerable interchange between the air in the roadways and in the goaf, would promote diffusion, and thus help to increase the proportion of firedamp in the airways; in the main, however, it is the falling of the barometer that will bring about this result. This reasoning, based upon elementary physical laws, appears to be incontrovertible, and points conclusively to a falling barometer as the condition to be dreaded, and that this is the case is well known to all mining engineers, and apparently to everyone except the Press Association. It seems probable that the firedamp of the goaf plays a greater part in fouling the air of a mine than does that evolved from the coal, as a general rule, and that therefore a rapidly falling barometer is more dangerous than a continuously low barometer in most cases.

Numerous observations have abundantly confirmed this reasoning; the Prussian and Austrian Firedamp Commission showed conclusively that the percentage of firedamp in the air of mines was greater when the barometer fell, and the British Commission of 1886 came to the same conclusion, though they attached less importance to the subject; it may be advisable to quote their words :—"While we recognise that variations of atmospheric pressure exert influence on the escape of gases which have accumulated in the cavities, and possibly to a slight extent on that of gases emitted directly from the coal, we entertain great doubt as to the wisdom of placing reliance on the issue of meteorological warnings."

In addition to the work of the various commissions, there are in existence numerous reports of investigations carried on in this country and on the Continent, notably in Westphalia and the north of France, and all agree in showing that an increase of firedamp in the air of mines attends a fall of barometric pressure. It is thus inexplicable why the Press Association should still continue to look upon a high barometric pressure as a source of danger, unless on the reasoning that a high barometer must fall before very long, and it may be charitably assumed that the warnings are issued on this hypothesis. Nevertheless, the statement of the recent Royal Commission on Mines respecting these warnings (second report of the Royal Commission on Mines, 1909, p. 175) :—"They are misleading, and, as far as we can see, their publication serves no useful purpose," deserves most emphatic endorsement.

Seeing that a barometric change cannot, of course, *per se*, bring about a colliery explosion, but can only produce conditions under which an explosion is liable to occur, the explosion itself being determined by the coincidence of several more or less accidental circumstances, it is hardly to be expected that statistics of explosions would be of any great value. In order, however, to get as much light as possible upon the facts of the case, I tabulated some time ago all the explosions that occurred in the year 1905, and compared them with the state of the barometer at Kew; parenthetically, I may remark that I took the Kew readings because the news agency bases its warnings upon it, although it is, of course, the state of the local barometer and not of the Kew barometer that really affects the question. The results were as follows :—

Out of 138 explosions there were :—

21	explosions when the barometer stood between		29·0 and	29·49 in.
56	,,	,,	29·5 ,,	29·99 ,,
54	,,	,,	30·0 ,,	30·49 ,,
7	,,	,,	30·5 ,,	30·8 ,,

Furthermore, there were :—

48	explosions when the barometer was	rising	
70	,, ,,	falling	
20	,, ,,	steady or slightly fluctuating.	

I also compared the colliery warnings issued in the first half of 1905 with the explosions that took place. There were in those six months 62 days on which explosions took place out of about 155 working days, so that if a date should be selected at random, the probability that an explosion would occur on that day or the day following would be about 4 to 1; during those six months there were fifteen warnings issued, only six of which were followed within forty-eight hours by an explosion, so that the Press Association only hit upon a dangerous date once in less than ten times. Obviously it could do better if it trusted to chance alone, and if the matter were not such a serious one, I should be tempted to advise the newspapers concerned to turn over the subject of colliery warnings to their sporting tipsters. Over a series of years the average number of explosions was about 150 per annum, and the average number of warnings about 25, so that even if every warning were followed by an explosion, only one explosion in six would have been foretold.

Of course, it is every explosion that must be taken into account, and not only serious explosions or those attended by loss of life. Whether a small gas explosion occurs doing no damage at all, or whether the explosion extends throughout the whole of a colliery, killing its hundreds, is obviously determined by the circumstances of the case, and is independent of barometric fluctuations; indeed, modern researches are forcing us very near to the conclusion that in present-day colliery practice every serious extensive explosion is a coal-dust explosion rather than a gas explosion, though the latter may, and very often does, originate it. In fairness to the news agency, I may point out that when the barometer is high there is a likelihood that the coal-dust in a mine may be drier than when it is low, and it is possible, though not proved, that in these circumstances the risk of a coal-dust explosion may be somewhat greater. This consideration, however, does not affect the general conclusion that the colliery warnings as issued by the Press Association, which pointedly refer to firedamp, are misleading, and would be harmful but for the fact that most colliery managers know too much about the subject to pay any attention to them.

I hold that it would be a real service to the mining community if the Meteorological Office would send out notice whenever an area of considerable barometric depression is approaching our shores as long in advance as possible, so as to warn colliery managers to be on the look out for a fall in the barometer.

I understand that similar predictions are furnished to farmers at harvest time for a small fee, and surely if this can be done where material interests alone are involved, it is not too much to ask for the like assistance where men's lives are at stake. It is not at all certain that the influence of barometric changes upon the possibility of colliery explosions is of any great importance, but in matters of such supreme gravity, no precaution, however trifling, should be neglected.

HENRY LOUIS.

SOURED MILK AND ITS PREPARATION. LACTIC CHEESES.

IN a former article[1] the nature, preparation, and uses of soured milk were dealt with. It was pointed out that the consumption of sour milk is widespread in the East, that in all the sour milks a peculiar micro-organism is present, with artificial cultures of which it is possible to prepare soured milk in imitation of the natural product, and that soured milk tends to lessen intestinal putrefaction and seems to be beneficial in many complaints. The micro-organism (*Bacillus bulgaricus*) present in all the natural sour milks is one possessing distinct and special characteristics, though exhibiting marked variation or "pleomorphism," and Makrinoff,[2] who has critically studied the question, believes that all the varieties which have been described are referable to one species. Two more or less distinct *races* seem to exist, namely, one that produces a somewhat viscous product, another that does not, and for the preparation of soured milk the latter is to be preferred as yielding a more palatable product. The morphological and staining characters of the *Bacillus bulgaricus* are so distinctive that

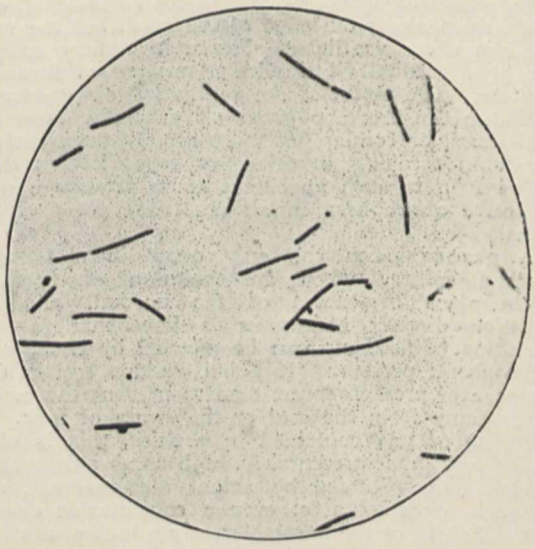


FIG. 1.—Film of properly soured milk, showing presence of the *B. bulgaricus* only (Gram, ×1200).

a microscopical examination, combined with the Gram staining process, of the soured milk, enables us to judge to what extent the *B. bulgaricus* has developed, and whether there is contamination with other organisms (Figs. 1 and 2).

For the preparation of soured milk it was pointed out that the milk must be properly sterilised by adequate boiling, inoculated with a proper "starter," that is a culture of the *B. bulgaricus*, and incubated for from 12 to 24 hours at a temperature of 105° to 110° F. Starters may be obtained in the liquid and solid (tablet) forms, but unquestionably the liquid are far superior to the solid ones. Thus Quant[3] examined certain tablet preparations, and compared them with a liquid culture as regards flavour of, and production of lactic acid in, the soured milk produced. The liquid culture produced 2·34 per cent. of lactic acid *B.P.*,[4] the tablets yielded only 0·07 to 0·42 per cent. of lactic acid *B.P.*; moreover, the curd and flavour were unsatisfactory with the latter. Quant also

1 NATURE, April 7, 1910, p. 159.
2 *Centr. f. Bakt.*, Abt. ii., Bd. xxvi., 1910, p. 374.
3 *Brit. Med. Journ.*, 1909, ii., p. 1738.
4 *B.P.* = British Pharmacopœia.

directs attention to the importance of a proper incubation temperature. He found, using the liquid culture, that the yield of lactic acid at 105° F. was more than one and a half times that at 85° F., and more than one and one-third times that at blood heat, 98·4° F. Samples of five preparations were also examined for the *British Medical Journal*[1] with the following results :—

Percentage of Lactic Acid Produced.

Sample	After 10 hour's incubation
(1) Fluid culture (Oppenheimer)	0·96
(2) Fermenlactyl tablets	0·00
(3) Lactobacilline ,, ...	0·02
(4) Sauerin ,, ...	0·07
(5) Trilactine ,, ...	0·27

From this table it will be seen that the liquid culture is far superior to the tablets. The writer also examined[2] liquid sauerin, and sauerin, trilactine, and fermenlactyl tablets, and of these the liquid sauerin alone could be considered satisfactory.

In response to a request by the editor, several firms have been good enough to furnish preparations which

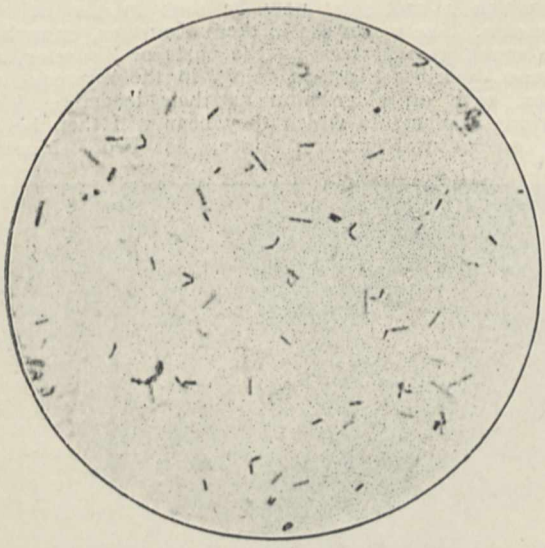


FIG. 2.—Film of soured milk prepared with tablet starter. Numbers of small Gram-negative bacilli present (Gram and eosin, × 1200).

have been examined by the writer with the following results :—

I. Content of *B. bulgaricus* :—

(1) *Tablets.*

(*a*) *B. bulgaricus* present in 1/100 and 1/1000 of a tablet, not in less. Streptococci also present.

(*b*), (*c*), (*d*) Very few *B. bulgaricus* present, even in 1/100 of a tablet; milk not curdled.

(2) *Fluid Culture.*

(*a*), (*b*), and (*c*) *B. bulgaricus* present even in 1/100,000,000 c.c. No streptococci.

(3) *Tablets.*

(*a*), (*b*), and (*c*) Very few *B. bulgaricus* present even in 1/100 of a tablet; milk not curdled.

(4) *Lactic Cheese.*

B. bulgaricus present in 1/100,000 gram, not in less. Streptococci present.

(5) *Sour Milk Cream Cheese.*

B. bulgaricus present even in 1/100,000,000 gram. Streptococci present.

From this it will be apparent that the fluid preparation (No. 2) has a content of *B. bulgaricus* enormously greater than the tablet preparations (Nos. 1 and 3). The lactic cheeses, if fairly fresh, contain a high content of *B. bulgaricus,* and are a pleasant and wholesome addition to the diet.

II. Characters of soured milk made with the preparations :—

(1) *Tablet.*—Milk markedly curdled. Acid, but somewhat cheesy odour. *B. bulgaricus* present in moderate number, also streptococci. Gram-negative bacilli present.

(2) *Fluid Culture.*—Milk well curdled. Acid, pleasant odour. Abundance of *B. bulgaricus*; no other micro-organism.

(3) *Tablet.*—Milk curdled, but *B. bulgaricus* scanty. Gram-negative bacilli present.

The result of these tests is to show that the tablet preparations do not produce a satisfactory soured milk, and the product is contaminated with bacilli other than the *B. bulgaricus* (see Fig. 2). The fluid culture, on the other hand, yielded an excellent soured milk, the flavour of which, however, would probably be improved if lactic streptococci were present in addition.

Special lactic acid-producing streptococci (*e.g. S. lebenis*) are always present in the natural sour milks, they aid the rapid growth of the *B. bulgaricus* by producing an acid environment, they tend to lessen the separation of the curd, and, in the writer's opinion, render the soured milk more palatable.

The small content of *B. bulgaricus* present in dry tablet preparations renders these comparatively inefficient for internal administration, and not to be compared with the ingestion of even a few cubic centimetres of properly soured milk.

I am indebted for the photomicrographs to Mr. J. E. Barnard.

R. T. HEWLETT.

[1] *Brit. Med. Journ.*, 1909, i., p. 104.
[2] *Brit. Med. Journ.*, 1910, ii., p. 1584.

THE BRITISH SCHOOL AT ATHENS.[1]

THE fifteenth volume of the "Annual of the British School at Athens" is somewhat less in bulk than its immediate predecessor. Probably its present length is about the extreme of what is convenient for a book of this format. The most important articles, as before, are those which describe the continuation of the work of the school at Sparta, which has been so successful, and has conferred such great distinction upon British archæology in Greece. Mr. Dawkins, the director, describes the work generally, and the conclusion of the excavation of the sanctuary of Artemis Orthia, and Mr. Droop the pottery, with regard to which he has made important discoveries which have given us quite a new idea of the history of ceramic art in the Peloponnese. The long list of inscriptions recovered in the sanctuary of Artemis Orthia is finally disposed of by Mr. A. M. Woodward, who appends to his admirable and painstaking work a series of corrections of re-discovered inscriptions which had previously been copied by Fourmont.

The main part of this section of the "Annual" is devoted to the description of the Menelaïon, the *heroön* of Menelaos and Helen, of whom the latter, at any rate, seems to have been originally a minor deity, a nature-goddess, akin to Artemis Orthia herself. The shrine is placed on a hill a little to the south of Sparta, and was solidly built on a strong revetment-wall of great stone blocks, to which the top of the hill serves as a core. This imposing work is probably of the fifth century B.C., but the explorers found many traces of far older occupation, going back to the Mycenæan period.

A large number of smaller antiquities were dis-

[1] "The Annual of the British School at Athens." No. xv. Session 1908–9. Pp. viii+412+20 plates. (London: Macmillan and Co., Ltd., n.d.) Price 25s. net.

covered, mainly small votive offerings, consisting chiefly of figurines of terra-cotta and lead. These leaden figures are extremely interesting, and are well published in a series of plates. Those of warriors are

FIG. 1.—A Laconian Vase of the Seventh Century. From "The Annual of the British School at Athens."

of remarkable interest, as showing Spartan military dress from the seventh century onward. Small ornaments of lead, such as little spiked wreaths, were found in enormous numbers; Egyptian scarabs were found; of these one, pl. viii., Fig. 4, is published upside down. These are of the seventh century, as also is a ring (Fig. 12, p. 142).

The work at the Menelaïon is described by Messrs. Wace, Thompson, and Droop. Sandwiched between this and the preceding descriptions is a curious note on a Scottish parallel to the Spartan custom of electing the dead Lycurgus as eponymous *Patronomus*; in 1547 St. Giles himself was elected patron provost of Elgin for "ane zeyr nyxt to cum." This note, which is by Mr. P. Giles, seems a little incongruous in the prominent position which it occupies, and would have been better as a footnote somewhere else.

Messrs. Wace and Hasluck continue their interesting notes on the topography of Lakonia, and Mr. Traquair describes the notable churches of western Mani. The revival of church building by the always independent Maniotes at the end of the eighteenth century is interesting; it seems probable that this was largely due to the Greek cruise of the Russian squadron of Orlov, which revived the hopes of Orthodox Christendom for freedom from the domination of Islam. Mr. Hasluck continues his researches into the byways of Greek history during the Frankish period with his articles on "Monuments of the Gattelusi" (the Genoese lords of Aenos on the Maritza) in the Ægean, and on "Frankish Remains at Adalia," and also deals with "Albanian Settlements in the Ægean Islands." We return to the classical period with Mr. Woodward's article on a new fragment of an Athenian "Quota-List of the year 417–6 B.C.," giving the amounts paid by the subject-allies to the treasury of the Confederation of Delos in that year, and with Dr. Duncan Mackenzie's interesting reconstruction of figures in the East Pediment of the Temple of Ægina, in opposition to the views of the late Prof. Furtwängler. Dr. Mackenzie has, we are sorry to say, held over the next instalment of his long article on "Cretan Palaces," which has been a feature of recent volumes of the "Annual." Messrs. Wace and Thompson also contribute a short article on their discovery of "A Cave of the Nymphs on Mount Ossa," previously unknown. A large number of fragmentary votive *stelae* were found.

The third portion of this year's "Annual," and not the least important, also deals with Greek religion. This is the publication by Profs. Bosanquet and Gilbert Murray of the Hymn to the Kouretes, the warrior guardians of the infant Zeus, who, like the Salii of Rome, with whom they were compared long ago, leapt in their dance with clashing of sword and spear. In the hymn, which was discovered during the excavations of the school at Palaikastro, in Crete, the worshippers of Zeus pray the god to leap as did the Kouretes around him when a babe, as a ritual act to bring prosperity and good fortune to Crete: "To us also leap for full jars, and leap for fleecy flocks, and leap for fields of fruit, and for hives to bring increase. Leap for our cities, and leap for our seaborne ships, and leap for young citizens and for goodly law." So Prof. Murray admirably translates the Greek of the hymn. The march and dance of the Kouretes and the Salii remind one greatly of the leaping March of the Minoan "Harvesters," as they are called, on the steatite vase found by the Italian excavators at Agia Triada, in Crete, some years ago, of which a cast may now be seen in the British Museum. Are we to see in them Kouretes, or rather the young men performing the parts of Kouretes, as Strabo describes them as doing, in the mysteries of Zeus, with an older man as their leader? The curious implements which they bear will then be of an agricultural nature, since, as Prof. Murray

FIG. 2.—The re-discovered inscriptions in the Shrine of Orthia. From "The Annual of the British School at Athens."

observes, the Kouretes "were certainly connected with spring and fertility" (p. 360), but developed later into weapons, which Prof. Savignoni and the Italian archæologists first took them to be. I am, at the

moment of writing, uncertain whether or not this comparison has been made before.

The restoration of the text of the hymn and the translation by Prof. Murray is very interesting. I speak under correction, but is *παγκρατὲς γάνους* really to be rendered by "Lord of all that is wet and gleaming"? Why should Zeus Kouros be lord of all that is "wet and gleaming"? Why not "bright and Gleaming"? Though no doubt *γάνος* gives, strictly, the idea of "wet and gleaming," yet surely the reference is to the gleaming ripple of the cornfields, not to the sea?

Of the admirable character of the translation a specimen has been given above.

The myth of the Kouretes in its anthropological aspect is dealt with by Miss Jane Harrison, who treats it with her usual learning and wealth of illustration. Her conclusions are important, as bringing the dance of the Kouretes into connection with the initiatory rites at adolescence which are common among savage tribes; she aptly compares them with the initiation ceremonies in use among the Wiradthuri tribes of New South Wales. The scent on the Agia Triada vase derives a new significance from this comparison.

The director contributes a scheme for the transliteratia of modern Greek, which is to be used in future by contributors to the "Annual," with the exception that *η* is to be transliterated by *e* and not by *i*. This seems rather too great a concession to the weaker brethren; it gives an entirely wrong impression of the pronunciation to those who are accustomed to the values of *e* and *i* in foreign words.

The volume is one of the most interesting that the school has produced, although for the first time we miss in it any description of Minoan or Mycenæan discoveries. But the resumed excavations at Phylakopi, in Melos, which are now to be taken in hand, will no doubt enable the School to contribute again very shortly important material for the study of prehistoric Greece.

H. R. HALL.

KOREAN METEOROLOGY—OLD AND NEW.[1]

FOR the last six years a meteorological observatory, equipped with modern instruments, has existed at Chemulpo, and has been working energetically to establish a network of stations, from which the climatic elements of the country might be derived. Many difficulties have been encountered, but that these have been successfully overcome is shown by the issue of the first volume of scientific memoirs from the observatory, in which the director, Dr. Y. Wada, describes the progress that has been made and sketches the programme it is proposed to follow. He is to be congratulated upon the success of his vigorous direction, for a map shows that forty-five stations have been furnished with instruments, from which reports are received regularly. Most of these stations are scattered round the coast, at lighthouses, but there is also a chain of observatories running through the interior, and these no doubt will be increased as the country progresses.

A paper by Dr. T. Hirata shows that discussion proceeds simultaneously with the collection of observations. He investigates the amount of evaporation in Korea and South Manchuria, and its relation to precipitation. Although the data at present are slender, and the conclusions somewhat precarious, the inquiry is one of great economical importance, because the quantity of rain is barely sufficient to ensure the safety of the rice harvest on which the welfare of the country largely depends, and all information connected with moisture is of deep significance.

But as such inquiries have only a local interest and would fail to attract attention, Dr. Wada has done well to quicken curiosity by reference to the science that flourished in the Korea of the past. He shows that the raingauge, supposed to have been invented by Castelli, about 1639, was in use in the East long before its value was appreciated in Europe. Dr. Wada, quoting from the second volume of the historical annals, explains that in the sixth year of the reign of King Sejo (corresponding to 1442 in the Gregorian Calendar), the King had a bronze instrument constructed to measure the rainfall. It was a vase of a depth of 30 cm. and a diameter of 14 cm. Every time rain fell, 'observatory officials measured the height and informed the King. But the important point in this account is, that this was not a toy set up from curiosity, but that similar instruments were distributed throughout the provinces, and the results of all observations were reported to the court. Naturally

FIG. 1.—Old Raingauge in Taiko.

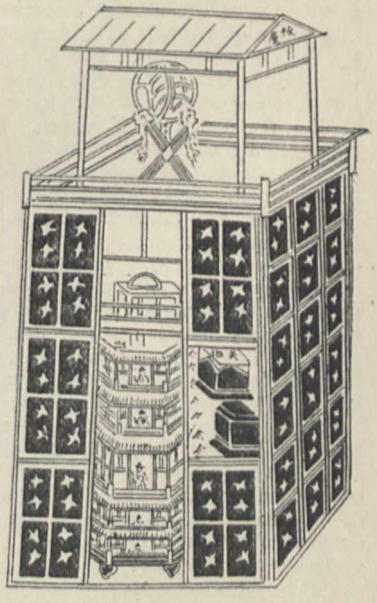


FIG. 2.—A Chinese Clepsydra of about 820 years ago.

[1] "Scientific Memoirs of the Korean Meteorological Observatory." Vol. i. Chemulpo, Korea, 1910.)

the director has endeavoured to recover specimens of these instruments and also the register of observations. Unfortunately, he has found no records and none of the original vases. But he has unearthed three copies of the pluviometer. The illustration reproduced here (Fig. 1) shows the instrument with the pedestal on which it stood. This instrument dates back to 1770. The three large Chinese characters declare that it is an instrument to measure rain, and the seven smaller give the date of its construction, in Chinese reckoning. Several pillars have been found without pluviometers attached, and one is particularly interesting, as a long Chinese inscription is engraved upon it, and though some of the characters have been obliterated by time, enough remains to connect it with the original order of King Sejo.

This same king erected astronomical observatories and fitted them with excellent instruments for the time. He seems to have prided himself on the possession of an automatic clepsydra, in which the hours and quarters were sounded by manikins. The general form of clepsydra seems to have consisted of four vessels at different levels, "and water poured in the highest vessel flows, passing through the intermediate ones, into the lowest, where an arrow with graduations to indicate the time in its upper part, was floated." Fig. 2 gives the general form of the instrument, but the mechanism is not well shown. Dr. Wada also reproduces a photograph of an ancient observatory, demonstrating the forward state of science of the age, about 647 A.D. It is supposed to have been used for the making of observations to correct the calendar, but there is nothing in the picture to suggest that it ever formed part of an observatory. It is simply a tower-like structure.

THE ADMISSION OF WOMEN TO THE FRENCH ACADEMIES.

WE learn from the *Times* of January 5 that at the recent quarterly plenary meeting of the five academies of the French Institute, the question of the eligibility of women candidates for the institute came up for consideration. It arose from the circumstance that Mme. Curie, the discoverer of radium, has been put forward as a candidate for one of the vacant seats in the Academy of Sciences. How her claims are regarded by that body may be inferred from the fact that in the list as finally submitted her name stands at the head. It is stated that at the general meeting more than 150 academicians were present, and that the proceedings, as might have been expected, "were extremely animated." Eventually the motion in favour of the admission of women was rejected by 90 votes to 52. The institute further adopted a motion to the effect that whilst it did not presume to dictate to the separate academies, there was, in its opinion, "an immutable tradition against the election of women, which it seemed eminently wise to respect."

It remains to be seen what the Academy of Sciences will do in face of such an expression of opinion. Mme. Curie is deservedly popular in French scientific circles. It is everywhere recognised that her work is of transcendent merit, and that it has contributed enormously to the prestige of France as a home of experimental inquiry. Indeed, it is not too much to say that the discovery and isolation of the radio-active elements are among the most striking and most fruitful results of a field of investigation pre-eminently French. If any prophet is to have honour in his own country—even if the country be only the land of his adoption—surely that honour ought to belong to Mme. Curie. At the moment, Mme. Curie is without a doubt, in the eyes of the world, the dominant figure in French chemistry. There is no question that any man who had contributed to the sum of human knowledge what she has made known, would, years ago, have gained that recognition at the hands of his colleagues which Mme. Curie's friends are now desirous of securing for her. It is incomprehensible therefore, on any ethical principles of right and justice, that because she happens to be a woman she should be denied the laurels which her pre-eminent scientific achievement has earned for her.

There may be room for difference of opinion as to the wisdom or expediency of permitting women to embark on the troubled seas of politics, or of allowing them a determinate voice in the settlement of questions which may affect the existence or the destiny of a nation; but surely there ought to be no question that in the peaceful walks of art, literature, and science, there should be the freest possible scope extended to them, and that, as human beings, every avenue to distinction and success should unreservedly be open to them.

All academies tend to be conservative and to move slowly; they are the homes of privilege and of vested interest. Some of them even incline to be reactionary. They were created by men for men, and for the most part at a time when women played little or no part in those occupations which such societies were intended to foster and develop. But the times have changed. Women have gradually won for themselves their rightful position as human beings. We have now to recognise that academies as seats of learning were made for humanity, and that, as members of the human race, women have the right to look upon them as their heritage and property no less than men. This consummation may not at once be reached, but as it is based upon reason and justice it is certain to be attained eventually.

NOTES.

AN earthquake of unusual violence occurred in Russian Turkestan at 1.25 a.m. on January 4, or shortly after 11 p.m. on January 3 (Greenwich mean time). At Vyernyi, the chief town of the district, with more than 11,000 inhabitants, the shock lasted for nearly five minutes, and has been succeeded by a large number of after-shocks. Nearly every building in the town is damaged, and all the mud-houses in the neighbourhood have collapsed. The total loss of life is unknown, but forty bodies have so far been recovered from the ruins. It is reported that the whole of the town of Prjevalsk, which is situated on the shores of lake Issik Kul, has been destroyed by the waters of the lake. The extraordinary violence of the earthquake is attested by its effects on the seismographs of distant observatories. At Pulkova, more than 2200 miles from the epicentre, practically all the instruments were thrown out of order. This was the case even in this country. At West Bromwich, the first tremors were recorded at 11.35 p.m., and soon attained a range of 15 mm. By 11.54 the range was far beyond the capacity of the instrument, and at midnight the east-west needle collapsed. The great movement continued until 12.12 a.m., and the disturbance did not end until 3.56 a.m., giving a total duration of 4¼ hours. At Cardiff the maximum movement was registered at 12.14 a.m., and was so great that the instrument was deranged. At Limerick all the instruments were dismounted. The earthquake, which is one of the greatest of the last quarter of a century, is evidently a successor of that which occurred on June 9, 1887, when Vyernyi suffered even greater injury than on the recent occasion, owing to the prevalence of stone buildings, which have since been largely replaced by wooden ones.

WE regret to see the announcement of the death, on January 10, of Mr. J. W. Tutt, whose work in entomology and other departments of natural history are known to many men of science. Mr. Tutt was trained as an elementary-school teacher at St. Mark's College, Chelsea, and was at the time of his death headmaster of the Portman Place Higher Grade School. He became a Fellow of the Entomological Society of London in 1885, and was a member of its council. He was also prominently associated with other entomological and natural history societies in the City and South London, and was honorary member of La Société Entomologique de Namur and La Société Entomologique de Genève. He was editor of the *Entomologist's Record* as well as of the *South-Eastern Naturalist*, and the author of numerous papers and other publications of substantial scientific value, including "A Natural History of British Lepidoptera," "A Natural History of British Butterflies," "A Natural History of British Alucitides," "Migration and Dispersion of Insects," "Melanism and Melanochroism in British Lepidoptera," "British Noctuæ and their Varieties," "Monograph of the British Pterophorina." Mr. Tutt also wrote a number of works on the more popular aspects of natural history, and in many ways contributed to the advancement and extension of scientific knowledge.

WE record with regret the death, on January 6, of Sir John Aird, at the age of seventy-seven years. Sir John Aird's name will be associated by most people with the erection of the Assuan dam and the Assiut barrage. With his partners he was the builder of the Manchester Ship Canal. He was also actively engaged in many other great engineering undertakings, which include, among others, waterworks at Amsterdam, Calcutta, Copenhagen, London, and Birmingham; the docks at Tilbury, Southampton, Avonmouth, and Singapore; the West Highland Railway and the Hull and Barnsley Railway; and gas plants on a large scale in many parts of the world. Sir John Aird was elected an associate of the Institution of Civil Engineers in 1859, and a member of the Iron and Steel Institute in 1887. He was created a baronet in 1901.

THE French Prehistoric Congress is to be held at Nîmes on August 13–20 of this year.

THE French Society of Therapeutics has awarded its gold medal to M. Ch. Moureu, for his work on the rare gases and the radio-activity of French mineral waters.

MR. F. M. BAILEY, Colonial Botanist, Queensland, and Mr. G. H. Knibbs, Commonwealth Statistician, Commonwealth of Australia, were included among the new C.M.G.'s in the list of New Year Honours. We regret their names were omitted from our note last week.

BY the generosity of Dr. Charcot, the *Pourquoi Pas?* has become the property of the French Department of Public Instruction. The vessel is anchored off Rouen, and is attached to the Paris National Museum of Natural History. An annual grant of 10,000 francs, we learn from the *Revue scientifique*, has been made towards the upkeep of the ship, which will be utilised by the museum for oceanographical cruises.

THE Christiania correspondent of the *Morning Post* states that more than a hundred distinguished Norwegians, including the Prime Minister, the Ministers for Foreign Affairs, Public Works, and Commerce, and the Rector of the University, gave a banquet on January 7 in honour of Dr. S. Eyde, the well-known engineer, who has done so much towards the development in Norway of the industry based upon the fixation of atmospheric nitrogen.

WE learn from the *Chemist and Druggist* that the late Dr. Ernest Durand, known as the donor to the Paris Museum of Natural History of the herbarium originally belonging to the botanist Cosson, has left the sum of 6000*l.* to be devoted to the classification and study of the botanical collections in the museum. At the time these collections were given to the authorities, in 1906, Dr. Durand gave 2000*l.* to defray the expense of classification, &c.

A MEETING of the International Association of Seismology will be held in Manchester under the presidency of Prof. Arthur Schuster, F.R.S., beginning on Tuesday, July 18 next. The meeting will consist of delegates of the twenty-three countries belonging to the association, and other men of science who may be invited by the president. The president asks us to state that he will be glad to hear from anyone interested in the subject.

AT a meeting on January 4, the Development Commissioners considered their policy in connection with agricultural instruction in England and Wales and in regard to the financial needs of the Scottish agricultural colleges, and decided upon the terms of a letter to the Scottish authorities. The Commissioners also decided to obtain, temporarily, scientific assistance for the investigation of the possibilities of the cultivation of tobacco and flax.

THE arrival of several boxes of skins of mammals and other animals from Sze-chuen at the natural history branch of the British Museum affords the *Times*, in its issue of January 3, an opportunity of referring to the generosity of the Duke of Bedford in providing funds for collecting expeditions in northern China and other districts in the heart of Asia, these museum expeditions having been carried on for several years. Reference is also made to similar work which has been carried on for some time in Africa at the expense of Mr. C. D. Rudd. The latest of these expeditions is now at work in British East Africa.

ON Tuesday next, January 17, Prof. F. W. Mott, F.R.S., will begin a course of six lectures at the Royal Institution on "Heredity," and on Thursday, January 19, the Astronomer Royal, Mr. F. W. Dyson, F.R.S., will deliver the first of three lectures on "Recent Progress in Astronomy." The Friday evening discourse on January 20 will be delivered by Sir James Dewar, F.R.S., on "Chemical and Physical Change at Low Temperatures"; On January 27 by Prof. W. H. Bragg, F.R.S., on "Radio-activity as a Kinetic Theory of a Fourth State of Matter"; and on February 3 by Dr. A. E. Shipley, F.R.S., on "Grouse Disease."

THE council of the Rhodesia Scientific Association adopted the following resolution at a meeting held recently:—"That a gold medal be offered for an original paper advancing our knowledge of the transmission of any insect- or arachnid-borne disease affecting Rhodesia, such paper to be read at a meeting of the Rhodesia Scientific Association for publication in its Proceedings. The medal will only be awarded for a paper which, in the opinion of the council, is of sufficient scientific merit." Non-residents as well as residents in Rhodesia are invited to send in papers not later than July 31 addressed to D. Niven, Secretary Rhodesia Scientific Association, P.O. Box 586, Bulawayo.

THE council of the Institute of Metals reports that a large increase has recently taken place in the membership of the institute, which now reaches more than 550. Addi-

tional honorary members have been appointed in the persons of Dr. R. T. Glazebrook, F.R.S., and Sir Andrew Noble, Bart., K.C.B., whilst Sir William H. White, K.C.B., F.R.S., has been elected the first fellow of the institute. The annual general meeting of the institute will be held on January 17–18. On the latter day, papers will be read at the Institution of Mechanical Engineers, Westminster, S.W., commencing at 10.30 a.m. Among the papers are the following:—A new critical point in copper-zinc alloys: its interpretation and influence on their properties, Prof. H. C. H. Carpenter; some practical experience with corrosion of metals, Engineer Rear-Admiral J. T. Corner, C.B.; the adhesion of electro-deposited silver in relation to the nature of the German silver basis metal, Prof. A. McWilliam and Mr. W. R. Barclay. There will also be presented the preliminary report to the Corrosion Committee, by Mr. G. D. Bengough. This report will be of an important character, dealing with the present state of our knowledge of the corrosion of non-ferrous metals and alloys, with suggestions for a research into the causes of the corrosion of brass condenser tubes by sea water. Full particulars regarding the institute can be obtained from Mr. G. Shaw Scott, secretary of the Institute of Metals, Caxton House, Westminster, S.W.

THE first annual meeting of the Astronomical Society of Barcelona was held on December 8, 1910, when the new president and executive council were elected. Addresses were delivered by the retiring president on the progress of astronomical science during the year 1910, and by the secretary on the development of the society since its foundation. The inaugural meeting of the society was held on January 30, 1910, at the University of Barcelona, as a result of the labours of Don Salvador Raurich, who had been carrying out valuable educational work in the city by means of popular articles on astronomical and allied subjects contributed to the columns of *Las Noticias*, a well-known Barcelona journal. At the inaugural meeting Dr. Esteban Terradas, professor of physics in the University of Barcelona, was elected first president, and a strong executive council was formed. In April King Alphonso became a life member, and was elected honorary president. At the present time the membership numbers 230, and as a result of the first year's work the society finds itself with a bank balance of 80*l.* after paying all expenses. In the future it is intended to devote the accumulated funds of the society to the erection and equipment of an observatory, where members may meet regularly in a social way for practical observation and the informal discussion of questions of astronomical interest. During the year lectures on astronomical subjects were delivered in the Grand Saloon of the University of Barcelona, and numerous addresses on a smaller scale were given on practical spectroscopy and general astronomy in the private observatories of certain members. The following is a list of the officers of the society for the year 1911:—*President*, Prof. Eduardo Fontseré, chief of the Time Service of Barcelona; *vice-presidents*, Prof. Luis Canalda and Don Ferdinand Tallada; *secretary*, Don Salvador Raurich; *vice-secretary*, Don A. Pulvé; *treasurer*, Prof. M. Font y Torné; *other members of the council*, Prof. Ignacio Tarazona, professor of astronomy in the University of Valencia; Dr. Enrique Calvet, Don José Subiranas, and Don Juan Mercadal. The address of the secretary is Diagonal, 462, Barcelona, where all communications should be addressed. The society is entering upon its second year of activity with bright prospects, and is very successfully cultivating a taste for astronomical study among all classes in Spain.

THE Research Defence Society has just published a small book called "The Truth about Vivisection." The book is a collection of leaflets dealing with some of the main points in the practice of experiments on animals, and of the results obtained by this means. It also includes a leaflet on the charges made against the Rockefeller Institute, and also the correspondence between the secretary of the Church Anti-vivisection Society and the Bishop of North Queensland. All the points dealt with are clearly explained, and technical details are avoided so far as possible. The book is therefore suitable for anyone to read, even if not conversant with the correct phraseology. This is a great advantage, because the details of the whole matter are naturally of a highly technical character. Much of the misapprehension which exists in the minds of many people, including those who are definitely anti-vivisectionists, arises from want of knowledge. In the great majority of cases this is not wilful, but simply because the details have hitherto been almost impossible for the uninitiated to follow. There are, however, a few persons to whom the words of Mr. Rudyard Kipling are applicable. He says that there will always be persons "who consider their own undisciplined emotions more important than the world's most bitter agonies—the people who would limit and cripple and hamper research because they fear that research may be accompanied by a little pain and suffering." It is very desirable that all thinking people should endeavour to acquaint themselves with the essential facts of the case, and the recent publications of the Research Defence Society have now made this possible by providing the necessary information in a simple form. The leaflets show that 95 per cent. of the experiments performed are of inoculations, which are not really in any way an operation, being merely needle-pricks. A great number of these are routine investigations carried out on behalf of various Government departments for the preservation and improvement of the public health. The history of the successful fight against Malta fever and other tropical diseases forms a chapter of intense interest in the history of the British Empire, and is one which well repays study; this side of the question might with advantage be somewhat further developed in the collection of pamphlets in question. The little book is highly to be recommended, and should supply a great want.

IN a report contributed to the December (1910) issue of *Man* on the Ceylonese drum known as *udakiya*, Dr. A. Willey connects this hour-glass pattern of instrument with certain drums made from human skulls found in Tibet. In the latter type the drum consists of two human *calvaria* inverted and superposed, the ends being covered with pieces of skin. The use of such drums for magical purposes is not uncommon in Tibet, and thence the shape may have passed to India, where it is still used by ascetics and spirit mediums, and thence to Ceylon. The custom which still prevails in Tibet of drinking from the skull of a holy man or an enemy is remotely connected with this form of drum.

IN the December (1910) issue of *Man* Messrs. E. T. Nicholle and J. Sinel describe the exploration of a Palæolithic cave-dwelling, known as La Cotte, at St. Brelade, Jersey. The existence of this habitation has been known since 1881, and it has now been investigated under great difficulties, due to its position. Bones of *Rhinoceros tichorhinus*, horse, reindeer, and deer, with human teeth and some fragmentary bones, have been unearthed. The flint implements, found in considerable numbers, belong to the well-known tongue-shaped Mousterien class, the

"pointe à main" of Mortillet. Falls of rubble have now rendered it impossible to make further examination of this site at present.

IN the Johns Hopkins Hospital Bulletin for December, 1910, there is an instructive article by Dr. Lewellys F. Barker on electrocardiography and phonocardiography, and containing many illustrations of the apparatus employed and of the cardiograms obtained. It is chiefly remarkable for the description of the electrocardiographic installation in the medical clinic of the Johns Hopkins Hospital, which shows that the apparatus may be fitted up at a smaller cost than is generally supposed, and that it may be applied to the diagnosis of a good many cardiac and nervous diseases. The remarkable progress in this department of clinical inquiry is well shown in this paper, and especially in the analysis of the many curious cardiograms obtained at Baltimore and elsewhere.

IN the Proceedings of the Royal Society, ser. B, vol. lxxxiii., p. 124, Dr. R. Kirkpatrick describes, under the name of *Murrayona phanolepis*, a new type of sponge from Christmas Island, Indian Ocean, referable to the family commonly known as the Pharetronidæ, equivalent to the Pharetrones of Zittel. When this group was first established, it was believed to be extinct, with its latest representative in the Mæstricht Chalk, but, inclusive of the new Christmas Island form, which constitutes a subfamily by itself, six living genera, each with a single species, are now known. Murrayona differs from all the other genera in that the skeleton consists of a firm basal network devoid of spicules, overlain by a dermal layer of scales, the axial core of spicules found in the other living genera having been discarded. The absence of spicules in some of the fossil Pharetrones may be due to the same cause, although in other instances (as has hitherto been considered to be the case with all) it may be the result of fossilisation. Apparently there is no such genus as Phareton, and if this be the case the family requires a new name.

THE two articles in the *Journal of Economic Biology* for December, 1910, are devoted to "warbles." In the first of these Prof. G. H. Carpenter furnishes notes on the life-history of the reindeer warble-fly (*Œdemagena tarandi*), his specimens being derived from a young reindeer in the Dublin Zoological Gardens. He finds that the egg of Œdemagena has a thin flap at the free end, along the edge of which the egg-case readily splits. The position and appearance of this recall the "lid" of the egg of the horse bot (*Gastrophilus equi*), and suggest that the maggots of Œdemagena are licked off and swallowed by the reindeer immediately after hatching. In *Hypoderma bovis*, the ox warble, the egg has no such lid, which lends support to the suggestion that the host swallows the eggs instead of the maggots. In the second article Messrs. Cooper and Nuttall, who accept the idea that cattle lick off the eggs of Hypoderma from their legs as a definite fact, discuss means of preventing the destruction of hides by warbles. A hide was cut into four quarters, of which three were severally treated with different chemicals, including picric acid, and it was found that in none of the cases was tanning interfered with. It is recommended that the experiment of treating the legs of oxen with picric acid should be tried.

THE current number of the *Quarterly Journal of Microscopical Science* (December, 1910) contains an elaborate and very interesting memoir, by Prof. J. P. Hill, on the early development of the Marsupialia, with special reference to the native cat (*Dasyurus viverrinus*). This forms the fourth of the author's well-known contributions to the embryology of the marsupials, and in it he describes in detail the process of cleavage, the formation of the blastocyst, and the differentiation of the embryonal ectoderm and endoderm. The uterine ovum possesses a shell-membrane and a layer of albumen outside the zona, analogous with the corresponding structures in the egg of monotremes, but is much smaller than the latter, and contains much less yolk, its condition in these respects being intermediate between that of the monotreme and that of the eutherian egg. The character of its early development is also intermediate between that of the two latter groups. Cleavage is complete, and at first meridional, resulting in the formation of a ring of eight blastomeres placed equatorially within the egg-shell, followed by an equatorial cleavage which divides each blastomere into two, an upper, smaller, and clearer, and a lower, larger, and more opaque. Two rings, each of eight cells, are thus formed, the upper one giving rise to the embryonal region of the blastocyst wall, and the lower to the extra-embryonal region, which the author regards as homologous with the trophoblast of the eutherian ovum. Prior to the completion of the first cleavage, the egg eliminates from itself a spherical mass of yolk which takes no direct part in development, though it becomes enclosed in the blastocyst cavity. The paper includes a valuable discussion of the early ontogeny of the Mammalia, in which the author defends the generally accepted view that the mammals are descended from ancestors which had large, heavily yolked eggs, and vigorously opposes the recently promulgated theory of Hubrecht, in accordance with which the alecithal character of the eggs of higher mammals represents the primitive condition. He also entirely disagrees with Hubrecht's interpretation of the trophoblast as an embryonic membrane comparable with that of the nemertines and other invertebrates. The "entypic" condition of the eutherian embryo is explained as a secondary modification due to the loss of the egg-shell.

A NOTE by Miss A. G. Stokey on the sporangium of *Lycopodium pithyoides*, published in the *Botanical Gazette* (September, 1910), indicates that the sporangium arises from the leaf, but during development grows away from it, and appears to be cauline. In size and shape, as well as in the proportion of wall cells, the sporangium resembles that of *L. dichotomum*.

THE annual report, for 1910, of the Department of Agriculture, Trinidad, by Prof. P. Carmody, covers the reports of the botanical departments in Trinidad and Tobago, of various estates, and the Government laboratories. The cacao exports for the year were the highest on record; crops of sugar-cane were good, but the sucrose content of the juice proved to be small. Analyses of Castilloa rubber trees of different ages showed that the latex in young trees contained more than 50 per cent. of resin, and this decreases to about 8 per cent. after eight or ten years.

A CYTOLOGICAL investigation of corn rust, *Puccinia graminis*, described by Dr. F. Zach in the *Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften*, Vienna (April, 1910), deals with the crucial stage when the fungus invades the palisade cells of the leaf and enters upon a contest with the protoplasm and nucleus. Sometimes the fungus is worsted and its hyphæ are dissolved; in other cases the fungus is victorious, when the protoplasm and nucleus are disintegrated and certain portions are excreted. It is suggested that the power of the host to withstand the attack of the parasite is partly innate, but to a great

extent determined by climatic and soil conditions. The author criticises the mycoplasm theory of Eriksson, which refers mainly to the phenomena here described.

A CATALOGUE of hybrid plants raised at Kew during past years is published in the *Kew Bulletin* (No. 9). The three hybrid species of Cytisus are interesting, two being ascribed to chance pollination by insects, while the third, *Cytisus Dallimorei*, producing pale purple flowers, was the result of an artificial cross between a variety of *C. scoparius* and *C. albus*; it received an award at the Temple Show last year. Success has been attained with several Rhododendron hybrids, notably a cross from *Rhododendron Fortunei*, and two monophyllous Streptocarpus hybrids are recorded. A Strelitzia that flowered for the first time during the winter 1909–10 was raised from a cross made in 1893.

THE Agricultural and Forestry Department of the Nyasaland Protectorate has issued its second annual report, from which we learn that the past year has been one of the most successful on record. A few years ago the only industry of any importance was coffee; when this failed, the plantations were closed down. With the introduction of cotton, tobacco, and rubber, the area of land under cultivation has steadily increased, and at no time in the history of the protectorate have such large areas of virgin land been opened up for planting as at present. The experimental work of the department consists in the improvement of existing crops and testing of new crops likely to be of value. Afforestation is also being undertaken, the railway and tobacco industries having been responsible for a large consumption of the native timber.

THE *Agricultural Journal of India*, vol. v., part iii., contains articles on the cultivation of millet, jute, Caravonica cotton, and bananas. The millet, *Andropogon Sorghum*, is grown in the dry zone of Upper Burma, where the yearly rainfall is from 20 to 25 inches, and rice will not grow. The grain furnishes food for the natives, and the leaves and stalks for cattle. Jute is grown on land suitable for rice; in some districts it is possible to take winter rice after jute, and thus to get two crops in one year; but this is not always possible, and in general it may be said that the area under jute represents the loss of so much land to rice. Caravonica cotton is a hybrid tree cotton recently introduced, for which many excellent properties were claimed. It is stated, however, that the variety has not been a success, and, further, that no tree cotton is known that will answer as a field crop.

THE need for phosphatic manures in all parts of the world, and the rate at which their already high consumption is increasing, makes it important that all known phosphate deposits should be mapped as thoroughly as possible. Should a phosphate famine ever occur, it would be more serious than a coal or any other famine, as no substitute of any kind is known. The United States Department of Agriculture Bureau of Soils has recently investigated the phosphate fields of Idaho, Utah, and Wyoming, and published the results as Bulletin 69 of their series. The deposits are considerable, and though they are not yet extensively worked because of their distance from markets, there is no doubt that they will become important in future. It is recommended that steps should be taken now to control the mining rights and to prevent waste of the lower-grade deposits that will not at first be profitable to work.

PROF. EMILE CHAIX, Avenue du Mail, 23, Geneva, has issued a circular letter, accompanied by a pamphlet, directing the attention of geographers and geologists to the "Atlas photographique des formes du Relief terrestre." This work was organised by the ninth International Congress of Geography in 1908, in accordance with a proposal by Profs. Brunhes and Chaix, and subscriptions are now asked for, so that a series of views may be prepared and published. Prof. Chaix's pamphlet furnishes the details, and it will be possible to subscribe for 100 plates at half a franc apiece, or single plates at one franc each. It is estimated that the whole series required would be about 500 to 600 plates, their issue being spread over ten years. The samples furnished give a picture about 13 cm. by 9 cm., and are of a geological rather than a geographical character. The scheme, however, is a wide one, and we may hope to see such subjects as typical cirques, alluvial plains, and escarpments, illustrated from all parts of the world. It is at present, for example, difficult to obtain views of our own Cotteswold Hills, or the meanders of the Severn, or the Hercynian ridges of southern Ireland. The cooperation of scientific photographers is invited, and it is to be hoped that geographical considerations will prevail in the selection.

IN the meteorological chart of the North Atlantic Ocean for January (first issue), published by the Meteorological Committee, attention is directed to the displacement of the high-pressure system to the region of Madeira and North Africa as one of the marked features in the daily weather maps of December 8–14, 1910, embracing the North Atlantic and adjacent shores. An enormous region of low pressure, extending from Nova Scotia to the western half of Europe, is shown by the charts; on the morning of December 12 the barometer reading on board the *Mauretania*, in lat. 51° N., long. 21° W., was as low as 28·04 inches. A remarkable circumstance connected with several well-developed secondary disturbances which advanced in rapid succession towards Ireland was that none of their centres passed eastward of the Irish Sea. Under their influence, the weather conditions were of an exceedingly unsettled type all through the week.

THE flexure of a rectangular plate under uniform hydrostatic pressure is a problem which mathematicians have from time to time attacked by different methods. A new investigation, based on the methods of Mr. Walter Ritz, is now published by Mr. D. Pistriakoff, of the Kieff Polytechnic. It is published in Russian, with a short abstract in French.

THOSE mathematicians and physicists who experience difficulty in forming a clear mental picture of the concepts of non-Euclidian geometry will find a useful and suggestive paper on the Bolyai-Lobatschewsky system, by Prof. H. S. Carslaw, in the Proceedings of the Edinburgh Mathematical Society, xxviii. (1910). The author starts by showing how the properties of planes and straight lines in ordinary space can be extended by inversion to spheres and circles through a fixed point. He then proceeds to consider the properties of spheres and circles that are orthogonal to a given fixed sphere, and shows that if these be called "ideal planes" and ideal lines, they will be found to possess properties exactly analogous to those of hyperbolic geometry. In the plane geometry thus established "ideal parallels" are represented by circles which touch on the fixed orthogonal circle, and thus it follows that through a given ideal point two parallels can be drawn to a given line. In short, Prof. Carslaw shows that a geometry identical with that of Bolyai and Lobatschewsky can be built up in ordinary Euclidian space, and, so far as plane geometry is concerned, in an ordinary

Euclidian plane. Unless some unforeseen fallacy in this investigation should be discovered which has escaped Prof. Carslaw's notice, we have here a convincing proof that Euclid's parallel postulate is incapable of demonstration. In fact, it is argued that if any inconsistency existed in the Bolyai-Lobatschewsky postulate this inconsistency would be extended by Prof. Carslaw's "ideal" system to Euclidian geometry. Do not these arguments point to the view that Euclid's postulate should be regarded as a property of matter rather than of space?

In the *American Architect* for November 23 Mr. Wm. H. Goodyear describes measurements of 1910, undertaken on behalf of the Brooklyn Museum, of the spiral stairway of the Leaning Tower of Pisa. The main result of these measurements is to confirm the author's view that the inclination of the tower was intentional, and was not due to subsidence after or even during construction. The main evidence on this point is derived from an examination of the steps between the thirteenth and sixty-ninth. Not only does the mean height of the ceiling increase by 1 foot 10½ inches between the thirty-fifth and forty-ninth steps, but there is an increase in the downward dip of the ceiling to the inner wall of about 8½ inches in the whole interval. As the stairs in question represent the extremities of the line of greatest slope, the effect of these changes is to throw the weight of the structure off the overhanging side. On the higher floors these variations appear to have been abandoned, presumably on the ground that the safety of the structure was sufficiently secured without them, whereas if the inclination were accidental it is obvious that the tendency would be to increase the precautions as the subsidence increased. The author further points out the advantages from an æsthetic point of view of the standing of the Leaning Tower in a depression or "well," and also of the change of inclination of the upper storeys, both of which support the theory of intentional inclination of the structure.

The measurements of the magnetic properties of iron, steel, nickel, and cobalt at the temperature of liquid air, which have been made by Dr. R. Beattie and Mr. H. Gerrard, and were described in the *Electrician* for December 23, 1910, confirm the view generally held on the strength of results obtained at higher temperatures, viz. that decrease of temperature increases hysteresis. The curves given for the hysteresis losses as functions of the magnetic induction in alternating and in rotating fields are of the same general form at the temperature of liquid air as at ordinary temperatures. The loss in cobalt in a rotating field is about twenty times that in nickel. The authors make no reference to the Langevin-Weiss theories, but, so far as one can judge from the curves, their results do not furnish any material support for those theories.

Vol. iii. of the Journal of the Municipal School of Technology, Manchester, consists of nearly four hundred pages of reprints of papers communicated by the staff and students to scientific societies and to the technical Press during the year 1909. The principal papers deal with mechanical and electrical engineering and with chemistry, and show that in these subjects, at least, the Manchester School stands in a position which no other technical school or polytechnic in the country has approached. Of the thirty papers, two may be selected as typical of the work the school is doing. The first, by Prof. Nicholson, deals with experiments directed to the removal of the obscurity which enveloped the subject of the transmission of heat from the furnace gases to the water in a steam boiler, and some of the results obtained have already been incorporated in boiler design. The second, by Prof. Knecht and Mr. J. P. Batey, contains the results of examinations of a number of dye-stuffs in solution in order to settle the question whether these substances exist in solution as colloids or not. The authors conclude that the dyes tested do not. These examples serve to show how successfully the Manchester School of Technology is bringing the power of science to bear on the industries of which Manchester is the centre.

An interesting article on photo-elasticity, by Prof. E. G. Coker, appears in *Engineering* for January 6. Account is given of apparatus and experimental results obtained at Finsbury Technical College, the experiments having for their object the determination of the condition of stress in transparent bodies by the effect which these latter, when subjected to such stresses, produce on polarised light passed through them. A special optical bench designed by Mr. F. Cheshire is used, in which a lantern, fitted with an arc lamp, projects a beam of parallel light. The beam is polarised by a Nicol's prism, then passed through the specimen, which latter is stressed by some convenient apparatus. A lens focuses the beam on a second Nicol's prism, which serves as an analyser, and the image of the specimen so formed is thrown on a screen or sensitive plate. A feature of the article is the reproduction in colours, by the three-colour process, of a large number of photographs taken on Lumière plates direct from the specimens under stress. These are of special interest to engineers, and include examples of beams, tension members, a furnace flue, circular hooks and chain links, a locomotive plate spring, a square threaded screw and nut, and a pillar. Examples are included showing the disturbance in the stress distribution caused by notching the specimens in various ways, and also the effect of a non-axial load on a tension member. Probably glass is the material possessing properties most closely resembling materials in general use by engineers, but, owing to the difficulty of preparing glass specimens, xylonite has been used.

Mrs. H. Periam Hawkins sends us a copy of a new (the fourth) edition of "The Stars from Year to Year," in which the account of Halley's comet, to which reference was made in the notice of the book in last week's Nature (p. 304), is brought up to date. We do not quite understand why the earlier edition should have been sent to us for notice when a new edition was to be issued a few weeks later.

The current quarterly issue of Mr. C. Baker's catalogue of second-hand instruments for sale or hire has reached us. Particulars are given of more than 1500 pieces of scientific apparatus which can be bought or hired at the second-hand department at 244 High Holborn, London. From the same house comes a very complete list of additions since 1909 to the stock of lantern-slides of scientific interest.

Mr. Edward Stanford announces for publication on January 16 the third edition, rewritten and enlarged, of "The Building of the British Isles," by Mr. A. J. Jukes-Browne. It is eighteen years since the last edition of this work was issued, and much fresh matter has consequently been embodied in the new book.

In the paragraph relating to the "Live Stock Journal Almanack" in Nature of December 29, 1910, the name Lord William Cecil should have been Lord Arthur Cecil.

OUR ASTRONOMICAL COLUMN.

THE JANUARY METEORS.—Mr. W. F. Denning writes:—"The night when the shower of Quadrantids or Boötids was expected proved very clear at Bristol and many other places. The display of meteors was not a very abundant one, but what the event lacked in numbers was amply compensated for by the brilliancy of the objects observed.

"Not only were the meteors generally very conspicuous, but they traversed long tracks of the heavens, and their flights were readily traced back to the visual radiant. This year I made the centre at 227°+54° from about eight paths, and there seemed another well-defined shower of similar meteors from 250°+47° in Draco.

"The meteors were of moderate speed and accompanied by trains. They were also well observed by Miss Helen M. Metcalfe, of Kildare, Mr. W. H. Steavenson, of Cheltenham, and others. No doubt some of the larger members of the shower were recorded at several stations, and it is hoped that observers will send in their notes so that the heights and velocities may be computed. January is a good month for large meteoric fireballs, and it remains to be seen whether the last half of the present month will provide the usual number seen in preceding years."

NOVA LACERTÆ.—The weather conditions, in London at any rate, have not been favourable for observations of the new star discovered by the Rev. T. E. Espin on December 30, 1910.

According to observations recorded in the *Times*, Mr. Hinks examined the nova on January 1 and 2, and found it fainter on the second night; a bright line in the red, the C line of hydrogen, was apparently the strongest in the spectrum, and three other bright lines were observed.

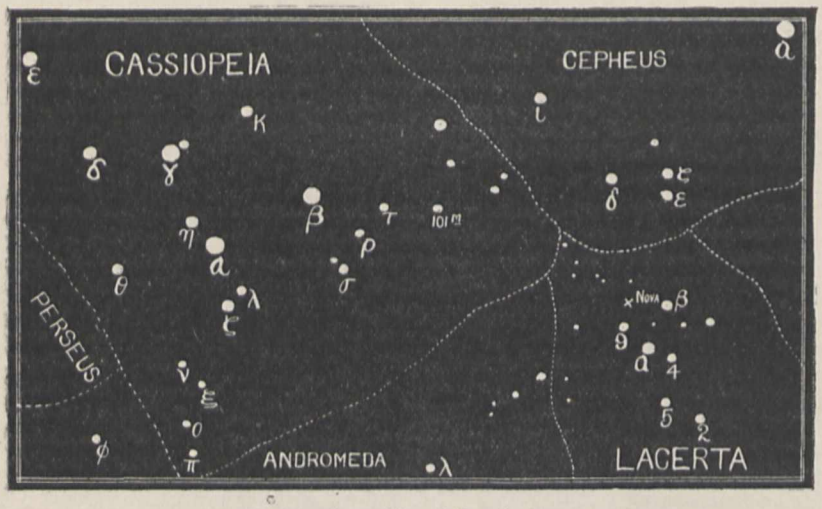


Chart showing position of Nova Lacertæ.

Mr. Espin, writing to the *Observatory* (January, No. 431), states that a further examination, on January 1, confirmed his previous observation of the spectrum; it is neither type iii. nor iv. Two bright lines are conspicuous, the stronger one probably F, and a yellow line, which he suggests is D_3. Three bands appear between F and D, and on the more refrangible side of F there is a band so strong as to make the spectrum appear discontinuous; beyond that there is a bright band. The spectrum reminds Mr. Espin of that of R Cygni, with the details more pronounced. He suggests that the star may turn out to be a variable, although, if so, it is curious that it has not been discovered, as have several others in the neighbourhood, at the Harvard Observatory.

A *Daily Mail* report states that no spectrum observations have been possible at Greenwich, owing to the bad weather, but photographs, which show the nova to be decreasing in brightness, have been secured. The Astronomer Royal expresses the opinion that the object is really a nova, not merely a previously undiscovered variable star.

The nova is conspicuous among the stars near by by reason of its distinctly red colour. We append a chart showing its position relative to the bright stars of Cassiopeia, Cepheus, and Lacerta.

COMETS DUE TO RETURN IN 1911.—Mr. Lynn's annual note of the periodical comets due to return this year appears in No. 431 of the *Observatory*. He includes Brooks's 1889 comet, as it was due at perihelion on January 8, but suggests that no further observations of it at this return are likely; it was nearest the earth on August 9, 1910.

Faye's comet, in accordance with Prof. Stromgren's conclusion as to the acceleration of its perihelion passage, returned in 1910, and observations have been recorded in these columns.

Encke's comet is due in the coming summer, but Mr. Lynn, considering its faintness in 1908, fears that we are losing this well-known object, first observed in 1786.

Wolf's comet, of 1884, is not due until early in 1912, but observations may be secured about the end of the present year.

PRELIMINARY RESULTS DERIVED FROM RADIAL-VELOCITY DETERMINATIONS.—At the Boston meeting of the Astronomical and Astrophysical Society of America Prof. Campbell read a paper in which he gave the preliminary results derived from the study of 1073 radial-velocity values.

The position of the solar apex comes out as A=272·0°±2·5°, D=+27·5°±3·0°, and the corresponding velocity of the solar motion was found to be 17·8 km. This latter value is lower than those previously found, but the available data will yield no higher value. Apparently there is a difference depending upon the spectral type of the stars considered, for, taking 330 stars of types O–F_4, V was found to be 17·7 km., whilst 704 stars of types F_5–G, K and M yielded 18·0 km.

Further, the radial velocities of stars freed from the solar motion component do not appear to be a function of the visual magnitudes. Stars of the later spectral types—as divided above—appear to have radial velocities nearly 50 per cent. greater than those of the earlier types; the increase is progressive. The mean velocity for thirteen nebulæ considered is 23·4 km. The results also confirm Kapteyn's theory of a systematic drift.

In making the observed radial velocities and the proper motions to correspond, it was indicated (1) that the stars of different magnitudes are less differentiated in distance than has hitherto been supposed; (2) all the brighter stars down to the fifth magnitude are further away than indicated by the formulæ for mean parallaxes; (3) the parallax stars which have been used as sample stars are not representative of the stars in general. Some of these results may be modified by the proposed solution, using Boss's proper motions now available.

Other results accruing from the systematic study of radial velocities indicate that, in general, the periods of revolution are shorter for the early than for the later types; the orbits also show less eccentricity. Seventy orbits, now known with reasonable certainty, are in accord with the theoretical conclusions of Darwin, Poincaré, and See regarding the origin and development of binary stellar systems (Journal R.A.S. Canada, vol. iv., No. 5).

STELLAR MAGNITUDES.—A popular and very interesting paper on stellar magnitudes is published by Mr. J. E. Maybee in No. 5, vol. iv., of the Journal of the Royal Astronomical Society (Canada). Mr. Maybee explains the system of magnitudes, tells how they are determined, and discusses some of the interesting facts which have accrued from photometrical studies of the stars.

Astronomical students and amateurs will probably find a great deal of useful information in the paper.

PRIZE SUBJECTS PROPOSED BY THE PARIS ACADEMY OF SCIENCES FOR 1912.

GEOMETRY.—Grand prize of the mathematical sciences (3000 francs). The subject proposed for 1912 is the improvement of the theory of algebraic differential equations of the second or third order the general integral of which is uniform. No memoirs having been received on the question proposed for 1910, this will also be awarded in 1912. Francœur prize (1000 francs), for work useful to the progress of pure or applied mathematics; Poncelet prize (2000 francs), for a work on pure mathematics.

Mechanics.—Montyon prize (700 francs), for inventions or improvement of instruments useful to the progress of agriculture, or the mechanical arts or sciences; Fourneyron prize (1000 francs), for a memoir on the theory and experiment of air resistance, applicable to aviation. The question set for 1910 is also postponed to 1912. Boileau prize (1300 francs), for researches on the motion of fluids contributing to the progress of hydraulics. As an alternative, the funds may be applied to the assistance of a scientific man without means.

Navigation.—The extraordinary prize of 6000 francs, for work tending to increase the efficiency of the French naval forces; Plumey prize (4000 francs), for an improvement in steam engines or any other invention contributing to the progress of steam navigation.

Astronomy.—Lalande prize (540 francs), for a memoir or work useful to the progress of astronomy; Valz prize (460 francs), for the author of the most interesting observation made during the current year; Janssen prize, a gold medal awarded for a discovery or work representing an important progress in physical astronomy.

Geography.—Tchihatchef prize (3000 francs), for the encouragement of exploration in the lesser known portions of Asia; Binoux prize (2000 francs), for original geographical work; Delalande-Guérineau prize (1000 francs); Gay prize (1500 francs). The question proposed for 1912 is the study of the tides of the earth's crust.

Physics.—Hébert prize (1000 francs), for a treatise or discovery concerning the practical employment of electricity; Hughes prize, for a discovery or work contributing to the progress of physics; L. La Caze prize (10,000 francs), for works or memoirs contributing to the progress of physics.

Chemistry.—Jecker prize (10,000 francs), for works contributing to the progress of organic chemistry; Cahours prize (3000 francs), for the encouragement of young chemists; Montyon prize (unhealthy trades) (prize of 2500 francs and a mention of 1500 francs), for a means of rendering a trade or calling less unhealthy; L. La Caze prize (10,000 francs), for the best work on chemistry.

Mineralogy and Geology.—Victor Raulin prize (1500 francs), for facilitating the publication of works relating to mineralogy and petrography.

Botany.—Desmazières prize (1600 francs), for the best work published during the year on cryptogams; Montagne prize (1500 francs), for memoirs on the anatomy, physiology, development, or description of the lower cryptogams; de Coincy prize (900 francs), for a work on phanerogams.

Anatomy and Zoology.—Savigny prize (1500 francs), for the assistance of young travelling zoologists, not receiving Government support, concerning themselves specially with the invertebrates of Egypt and Syria; Da Gama Machado prize (1200 francs), for memoirs on the coloured parts of the tegumentary system of animals; Thore prize (200 francs), for the best work on the habits and anatomy of one species of European insects.

Medicine and Surgery.—Montyon prize (2500 francs, and mentions of 1500 francs), for works or discoveries useful in the art of healing; Barbier prize (2000 francs), for a discovery useful in surgical, medical, or pharmaceutical science, or in botany in relation to medicine; Breant prize (100,000 francs), for the discovery of a specific cure for cholera, or, as an alternative, for the discovery of the causes of this disease, leading to its eradication; Godard prize (1000 francs), for the best memoir on the anatomy, physiology, and pathology of the genito-urinary organs; Baron Larrey prize (750 francs), for a work dealing with the subject of military medicine, surgery, or hygiene; Bellion prize (1400 francs), for works or discoveries useful in medicine; Mège prize (10,000 francs); Argut prize (1200 francs), for the discovery of a remedy for a disease at present incurable.

Physiology.—Montyon prize (750 francs), for experimental physiology; Philipeaux prize (900 francs), for experimental physiology; Lallemand prize (1800 francs), for researches relating to the nervous system; L. La Caze prize (10,000 francs), for the best work on physiology; Martin-Damourette prize (1400 francs), for a work on therapeutical physiology; Pourat prize (1000 francs), for new data on the utilisation and assimilation of albumenoids in food.

Statistics.—Montyon prize (1000 francs, and two mentions of 500 francs), for the best memoir on questions relating to statistics.

History of Sciences.—Binoux prize (2000 francs).

General Prizes.—Arago medal, Lavoisier medal, Berthelot medal, Henri Becquerel prize (3000 francs), Gegner prize (3800 francs), Lannelongue prize (2000 francs), Tremont prize (1100 francs), Wilde prize (one of 4000 francs and two of 2000 francs), for work in the fields of astronomy, physics, chemistry, mineralogy, geology, or experimental mechanics; Longchampt prize (4000 francs), Saintour prize (3000 francs), for work in the physical sciences; Victor Raulin prize (1500 francs), for work in mineralogy and petrography; Bordin prize (3000 francs), for researches on determining sex in living beings; Houllevigue prize (5000 francs); Caméré prize (4000 francs); Jérome Ponti prize (3500 francs); prize founded by Mme. la Marquise de Laplace; Felix Rivot prize (2500 francs).

HALLEY'S COMET.

ALTHOUGH our British skies were so unfavourable for observations of Halley's comet, the almost constant flow of published results shows that those astronomers more fortunately situated in clearer atmospheres and lower latitudes reaped a rich harvest; some of the most striking results are briefly referred to below.

Among the favourably situated observatories, that at Johannesburg, the Transvaal Government Observatory, was one of the most favoured, and appears to have used its opportunities to the fullest possible extent. Brief notes have appeared in NATURE from time to time, but in Circular No. 4 the results to the end of June are described in full, and illustrated by some forty reproductions of photographs and numerous drawings of the nucleus and head on various dates.

The photographs are described by Mr. H. E. Wood, who, at the request of Mr. Innes, the director, employed the 10-inch Cooke lens, of 44·6 inches focal length, to photograph the comet on every possible occasion. This instrument is the one presented to the observatory by Mr. Franklin-Adams, and has two finders, one of which is mounted on swivels, allowing it to be moved in two directions; this device proved exceedingly useful for getting the whole of the comet on the plate when the length of the tail exceeded 8°.

On the original photographs the scale is 1°=20 mm., but in reproducing them this has been slightly reduced, and varies, on the nine plates, between 19·2 and 14·2 mm. per degree.

Between April 11 and June 3 the weather conditions were very favourable, except for the occasional intrusion of the moon, and photographs were secured on forty-four dates. Their general excellence is emphasised by two unmounted, direct prints which accompany the circular, thus affording a comparison between original and reproduction. Seven of the photographs were taken by Mr. Mitchell, the others by Mr. and Mrs. Wood, and Mr. Wood describes each in detail.

The maximum lengths of the tail shown on the photographs are 17° on May 6 (60 minutes' exposure), 17° 15′ on May 14 (38 minutes), and 18° on May 30 (120 minutes), but in each case the image of the tail evidently extended beyond the edge of the plate. On June 3, however, 120 minutes' exposure failed to record more than 4° 30′ of tail.

The majority of the photographs show a composite tail

in which a number of rays appear to emanate from a point immediately behind the nucleus, while the envelopes around the nucleus appear to form a cap over the tail. Extraordinary irregularities and contortions are shown on the photograph of May 21, which is an exceptional one. The first photograph of the series, taken on April 11, showed a fan-shaped tail 9′ long after 4 minutes' exposure. This gradually increased, and on April 19 (37 minutes) a tail of 7° 45′ long was depicted, which was straight for 4° and then appeared to be blown to the south quite suddenly, the remaining part being very faint. A very confused, intricate, and contorted tail was photographed on April 21, one bright streamer, forming the northern boundary, bending twice at right angles at about 45′ from the head.

On May 4 the photograph which we here reproduce, from one of the direct prints, was taken with 30 minutes' exposure, and shows a tail 15° long to the edge of the plate. At 5° from the head the breadth was 1°, and the tail appears to be composed of a large number of overlying shafts with a central bright streak. The southern edge is slightly convex, and shows a number of delicate branches emerging from it with striking regularity; the northern edge is quite simple.

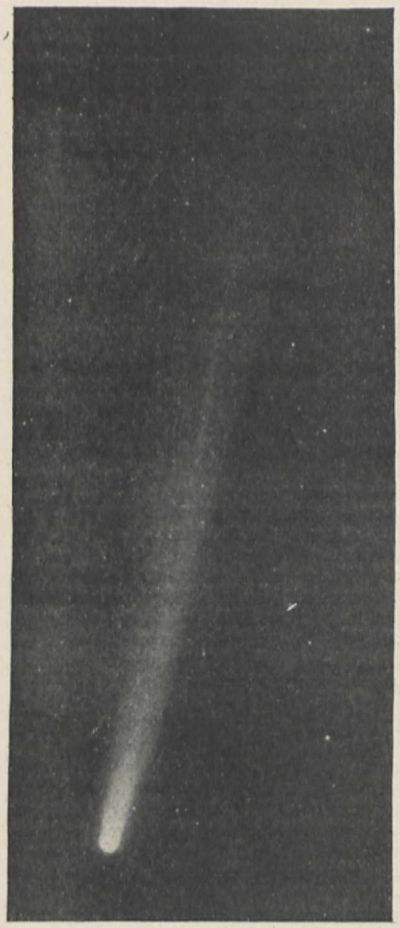


FIG. 1.—Halley's Comet, May 4, 1910. Photographed at the Transvaal Observatory. Exposure 30 minutes.

Later photographs show a great number of streamers, ten rays being visible near the head on May 8; but the tail was straight, no branching of the streamers being shown. Three days later the tail was bifurcated by a dark central space, along the north edge of which there was a bright ray; this division was accentuated on a later photograph taken on May 11. An elongation of the head appeared on May 12, when the envelopes about the nucleus extended to a distance of 1° behind it. The last photograph before transit was taken on May 16 with 12 minutes' exposure, and shows 9° of tail, which was 2° 5′ wide at a distance of 5° from the nucleus. The greater brightness of the envelopes on the southern edge is noticeable to a distance of 1° from the nucleus, and the tail appears quite simple, without rifts or rays.

After the transit, on May 21, a condensed stellar nucleus was shown on the photographs, and the envelopes on the northern edge were stronger than those on the southern. But on May 25 the envelopes were apparently symmetrical, and two days later the nucleus was very bright, and there was no visible condensation. On June 25 the head was much broader than the tail, and appeared to be granular, suggesting a very close cluster of small stars; this, Mr. Wood suggests, may be a photographic effect. Although on several photographs taken in June the head is described as being large, no mention is made here of the division of the nucleus as recorded by other observers.

The circular also contains a most interesting *résumé* of the measured lengths of the tail recorded visually by Messrs. Innes and Worssell. The greatest apparent length was on May 19, when the tail extended 150° from the assumed position of the head; the greatest length actually seen and measured, with the whole comet visible, was 107°, on May 17. As mentioned in an earlier circular, the eastern, or morning, tails were seen at Johannesburg three days after the transit of the comet, but Mr. Innes believes that a rupture took place before May 18, and that the eastern tails seen on May 21 were not then connected with the main body of the comet. Mr. Innes's testimony as to the magnificence of the comet is worth quoting here. He says:—"It may be said that it would require much imagination to desire a more impressive and brilliant spectacle than that presented by Halley's comet on the mornings of May 15, 16, and 17. It was indeed a 'Great Comet,' such as the writer had never seen before and can hardly expect to see again."

No less interesting are the notes regarding the general visual appearances between January 25 and July 6, but space will not permit mention of more than a few of them. A secondary nucleus was measured on April 16, and was then 12″, in position angle 48·3°, from the primary; this appearance of a second nucleus was not persistent, but was recorded, on and off, many times. The drawings from the visual observations are reproduced on Plates x. and xi., and form a valuable record of the innumerable changes in the various phenomena attending the comet during the apparition. On May 6 the head was decidedly yellowish, an appearance not noted before, and the tail apparently intercepted about half the light of the star B.D. +8·5°, reducing its relative magnitude by 0·8. The nucleus and bright coma were also recorded as decidedly yellow on May 12, when the jets from the nucleus had a most extraordinarily complicated appearance, which was accentuated on the succeeding day (see Nos. 31–34, Fig. 2).

After the transit the visual observations showed a stellar nucleus without jets or rays, which, however, developed later. The nucleus, too, changed and became multiple, and three nuclei were recorded on June 2. Later, the separate nuclei appear to have become diffuse, and on June 4 had the appearance of a large, out-of-focus double star, distance about 4″, almost resolved; the colour was still yellow. By July 6 the head, although much brighter in the centre, showed no stellar nucleus.

Father Goetz, of the Buluwayo Observatory, also contributes some notes of visual observations, and gives a sketch of the comet's head as seen on May 13; a peculiar feature is a much brighter segment of the inner envelopes immediately in front of the nucleus. Two faint stars were seen through the coma on May 21, and were not appreciably dimmed.

A number of meteorological phenomena were recorded by the observatory staff and by numerous correspondents. Especially interesting are the lunar-halo phenomena depicted on Plate xii., and the note that unusually high temperatures were recorded at the observatory during the time of the comet's passage.

Mr. Innes offers to lend, under suitable conditions, the original drawings reproduced on Plates x. and xi. to any recognised investigator who may require them.

The Utrecht observations of the comet are recorded by Profs. Nijland and van der Bilt in No. 4453 of the *Astronomische Nachrichten*. They give positions from December 3, 1909, to May 27, and a number of notes describing the various peculiar phenomena observed. They also record the yellow and orange-yellow colour observed early in May, and direct attention to the various shapes and position angles assumed by the head. The sketches made between April 29 and May 6 so nearly resemble, in their peculiar forms, those made by Bessell and others in 1835, that the present observers suggest that the great periodic comet has its own special physiognomy.

The same journal contains a record of the observations

made by M. F. Sy at the Algiers Observatory. Positions are given for the period April 10 to July 10, and the various phenomena of the head and the tail are briefly described. Observations of Venus and the comet, as suggested by Prof. Birkeland, were made, under adverse conditions, on May 2, but no special phenomena were remarked. Similar duplications of the nucleus to those recorded at Johannesburg were observed on May 3, 8, and later dates, but only a single nucleus was seen on May 5. A notable recrudescence of brightness apparently took place on July 9, as compared with July 5 when a nebulosity, 1′ in diameter, and no nucleus were seen. References to these alternating duplications of the nucleus are made in the December (1910) number of the *Bulletin de la Société astronomique de France*, where MM. Millochau, Borrelly and others describe their observations. M. Jamain finds that the successive appearances are best explained by the supposition that the nucleus of the comet had a rotatory motion, with a period of about 21·5 hours.

In No. 4461 of the *Astronomische Nachrichten* Dr. J. Mascart reproduces three excellent photographs, and three drawings of the head, taken at his special observing station at Teneriffe during May and April respectively; the complicated structure of the head on April 16 and 18 is especially remarkable. But Dr. Mascart deals chiefly with the conditions of observation on a mountain site, and strongly emphasises the advantages which accrue from the establishment of an astronomical observatory in a clear atmosphere and at a high altitude, yet more or less readily accessible. Finally, he suggests the necessity for establishing an important and permanent international observatory on Mount Guajara, where he was stationed. Dr. Mascart gives more details, and discusses such matters as the zodiacal light, &c., in an article which appears in the December (1910) issue of the *Rivista di Astronomia*, Turin (vol. iv., No. 12, p. 585).

A note in the December (1910) number of the *Observatory* (No. 429) suggests that, as the comet has now sufficiently emerged from the sun's rays, a few more observations may be secured, even in European latitudes, before it finally disappears until August, 1985. An ephemeris for Greenwich midnight, and extending to the end of March, is given; as the declination is about 18° south, those observatories situated in the southern hemisphere will enjoy better conditions. At present the comet is apparently situated in the constellation Corvus, and is travelling slowly in a south-westerly direction; its position for December 31, 1910, is R.A. = 11h. 53·4m., dec. = 18° 12·7′ south, but after January 11 it will again commence to travel northwards.

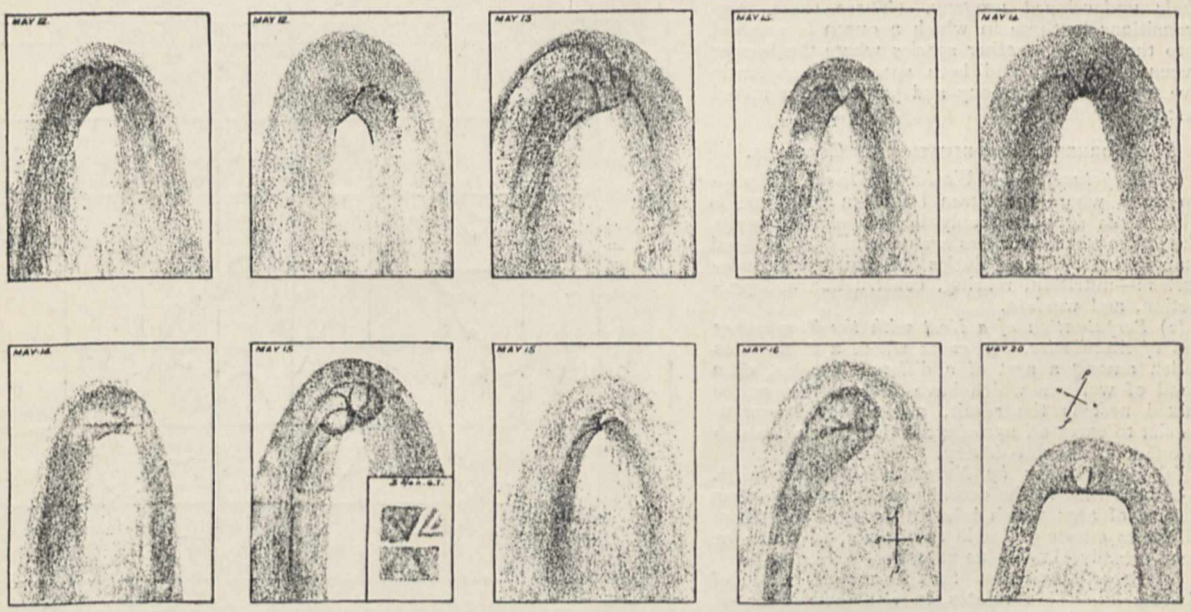


FIG. 2.—Changes in the Head of Halley's Comet, as observed at the Transvaal Observatory.

ON THE ORIGIN OF SLAVERY AND PARASITISM IN ANTS.

TWO interesting papers on the origin of slavery and parasitism in ants, by Henri Piéron, Maître de Conférences à l'Ecole pratique des Hautes-Etudes, have appeared recently in the *Revue générale des Sciences* (September 15 and 30, 1910), and the main points are summarised below. The papers are conveniently divided into sections, and are rendered more valuable by full references being given for all the statements referred to.

I. FEMALES: FOUNDATION OF COLONIES.

(1) *Foundation of a New Nest by a Fertilised Female.*—After the marriage-flight of ants, the males and females fall to the ground, when the males die, and those of the females which escape the numerous dangers to which they are exposed taken refuge in crevices in the ground, where they lay their eggs. For a month or more the female appears to subsist largely by the absorption of the alary muscles, now no longer required; but in some cases, as in *Atta sexdens*, the female carries with her a supply of the mycelium of an edible fungus, on which she and her progeny afterwards subsist. The earliest hatched workers in nests founded by a single female share her privations, being much smaller than those hatched later. In some cases a portion of the eggs are sacrificed for the nourishment of the female and the newly hatched larvæ, and are also used by *A. sexdens* as a hot-bed for the fungus. Some of the species of ants in which nests are founded by a single female are among the oldest in existence, going back, almost unchanged, to Tertiary times.

(2) *Foundation of a New Colony in a Pre-existent Nest.*—Female ants will sometimes take up their abode, and rear a fresh colony in the deserted nests of other species, or even, on more or less friendly terms, establish a colony of their own in inhabited nests of other species. On the other hand, ants of the genus Solenopsis, &c., usually form nests in small galleries round and communicating with the nests of larger species, which they plunder at will, without the larger ants being able to pursue them into their narrow fastnesses.

(3) *Foundation of a New Nest with the Aid of Workers of the same Species.*—The females of some ants are unable to form a new colony without the aid of workers, and if they fall to the ground near their own nest, or one of the same species, they may return to the nest, or may be joined by a colony of workers, and thus assisted to establish a new one.

(4) *Foundation of a New Colony with the Aid of Workers of another Species.*—Although ants usually

destroy those of other species which enter their nests, they will sometimes receive females, especially if fertilised, into their communities, whether females of their own species are living in the nest or not, and hence mixed nests of two or more species may originate. Many instances are quoted, both among European and American ants, and the author sums up the various alternatives as follows:—(i) isolated workers may dig a nest for the queen and make their dwelling with her; (ii) she may be received into a nest which has lost its own queen; (iii) she may be received into a nest possessing a queen, whom she kills and supersedes; (iv) she may be received into a nest where a queen lives, whom she does not injure, but who disappears, either making her escape or being killed by the workers; (v) she may be received into a nest where the former queen remains, and continues to perpetuate her brood.

Illustrations of these alternatives are then given, with comments, and the author concludes that the formation of new colonies depends rather on the behaviour of the workers than on that of the queen.

(5) *Foundation of a New Colony by Conquests of Nymphs.*—This section relates to cases in which a war-like queen enters the nest of another species and drives away the adult ants, establishing herself as the queen of their undeveloped progeny. These cases form transitions to those in which a queen is received into the nest of another species where the former queen still lives, and both species subsequently live together in harmony and perpetuate a mixed nest.

II. Workers: Perpetuation of Colonies.

(1) *Perpetuation by Workers without Allies.*—In cases where the queen founds a nest, and is afterwards supported only by her own progeny, the duties of the workers are generally less defined than in bees. These duties fall under four categories:—nutrition, rearing, construction and protection, and warfare.

(2) *Perpetuation of a Nest with the Temporary Aid of Auxiliaries.*—In cases where a female has fallen among a nest of a different species, or a band of workers which have adopted her, and a mixed nest is the result, a tendency seems to persist to carry off nymphs of other species, which is one cause of ant-slavery.

(3) *Perpetuation by Nutrition* (*Myrmecophily*).—This relates to the actual parasitism of various species of ants which inhabit the nests of others either as guests or (as in Solenopsis, to which we have already alluded) as parasites.

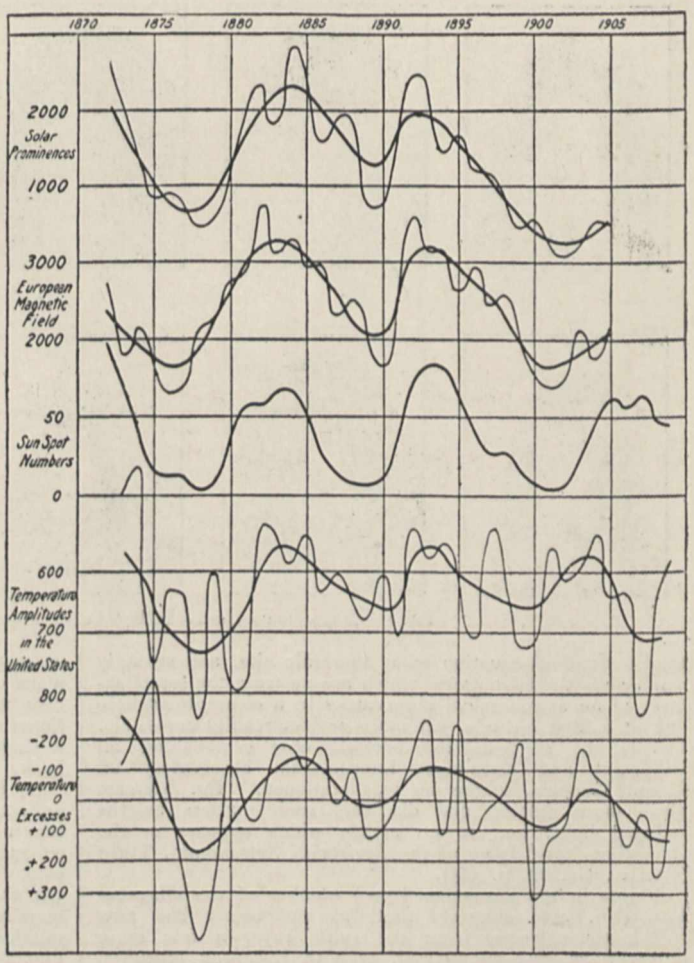
(4) *Perpetuation by the Permanent Aid of Auxiliaries.*—This relates to ant-slavery proper, where the mistresses are more or less completely dependent on their slaves for their very existence.

(5) *Perpetuation in the Complete Absence of the Workers of a Species.*—The strangest cases of all are perhaps those of certain species of ants which are only male and female, and which live parasitically in the nests of others. Sometimes when such a workerless queen introduces herself into a strange nest the workers kill their own queen instead of the intruder, in which case the colony is inevitably devoted to destruction by the impossibility of any further production of workers.

In his second paper M. Piéron reviews and comments on the views of Darwin, Wasmann, Wheeler, Emery, and Santschi on the various problems connected with ant-life. He regards *Formica fusca* as an ancestral form of the genus Formica, it being undistinguishable from *F. flori* found in Baltic amber, and having thrown off a series of closely related forms in most parts of the world. This ant shows the primitive stage in which the new nest is formed by the female only. Thence we pass on to *F. rufa*, of which the female can only found her nest with the aid of workers of her own or another species, and from thence to the stages of slavery and parasitism. Then M. Piéron discusses the general problem of the origin of slavery and parasitism among ants, the theory of progressive stages leading to these curious habits, the explanation of the different conduct of the females, the problem of the rise of slavery and parasitism among neuters, and the origin of aid and tolerance towards intruders of other species. His final conclusion seems to be that in proportion as evolution leads further and further from a primitive state, insects, like men, become more and more dependent on each other. Among ants, those with the simplest and most primitive habits are the most abundant, while as they become slave-holders, and later on parasites, their colonies and individuals become rarer and rarer. It is evident that when ultra-civilisation degenerates into slavery and parasitism it is neither good for man nor ant.

TEMPERATURE CHANGES AND SOLAR ACTIVITY.

PROF. F. H. BIGELOW (*American Journal of Science*, vol. xxx., August, 1910, p. 115) has been discussing the variations of the mean annual temperature of the United States of America and their relation to the changes of solar activity as shown by the frequency of sun-spots and prominences.



Prominences, magnetic field, sun-spots and the temperature amplitudes and excesses of the United States.

To arrive at a correct estimate of the mean temperature of the States and the departure from the mean for thirty-three years, monthly maps showing the departures of about 100 stations were prepared, and lines of equal departures drawn. The product of the area under one sign and the departure gives a "temperature volume." The difference between the negative and positive "temperature

volumes" gives the measure of the departure of the whole area from the thirty-three-year mean. The sum of the two volumes (regardless of sign) is given as the amplitude of the departures during the month. Annual mean departure numbers and annual mean amplitude numbers were obtained and plotted as curves, and compared with curves of solar prominences and sun-spots and the mean horizontal magnetic force (see figure). (The two temperature curves are inverted.)

Prof. Bigelow says:—"The synchronism in the long period between the two solar curves and the three terrestrial curves cannot be questioned, that for the magnetic field being direct and those for the temperature system of the United States being inverse." . . . "The synchronism between the curves of short period is not so well pronounced as for the long period . . .;" and Prof. Bigelow points out that this may well be due to inherent imperfections in the solar and magnetic observations.

Arguing that an increase of solar action produces an increase of temperature in the tropics but a relative decrease in the temperate zones because of the increased flow of cold air from the poles to the equatorial regions, Prof. Bigelow produces this set of curves as evidence, and points out that the succession of minor crests is about three years, this being the three-year period which he first described in 1894.

It is unfortunate that this investigation has been kept to the limits of the United States. It does not absolutely follow that the case is proved for the whole temperate zone. Prof. Bigelow remarks that "there is a tendency for temperature to oscillate about a sort of nodal line on the Eastern Edge of the Rocky Mountain Plateau," and one wonders what would have been the effect on the curves had the plateau occupied the greater instead of the less part of the States. M.

LONDON COUNTY COUNCIL CONFERENCE OF TEACHERS.

THE meetings held at Birkbeck College on January 5, 6, and 7, were no less important than those of the twelve preceding years. Indeed, the general standard of papers read was higher. The audiences ranged from 500 to 800, and they showed a better appreciation of improved principles and methods than was evident, say, seven years ago. In the case of the earlier conferences there was undoubtedly a tendency for the listeners to say, "This method of teaching is all very well—ideal perhaps—but impossible under the conditions in *my* school." By his organisation of these conferences, Dr. Kimmins has brought home to those who have attended them the fact that work of the finest quality is actually done under conditions which appear, or even are, the most adverse. Not once, but fifty times, have these meetings demonstrated that the possibility of working on improved lines depends on the inspiration of the teacher.

Recognition of the dominant influence of the teacher in the practice, as distinct from the administration, of education, was made by the chairman of the London County Council Education Committee, Mr. E. A. H. Jay, who presided at the opening session, and Mrs. Bryant's plea for specialisation derives much of its weight from this recognition.

The most largely attended meeting was that opened by Mr. George Alexander, who urged the value of dramatisation and of good elocution by the children. It was clear that he was preaching to the converted. The discussion on "Memory" was of interest, as it brought out in a remarkable way the utility to the teacher of recent work in experimental psychology, notwithstanding the fact that the professional psychologists regard such application of their work as premature. The application of scientific method to education means that teaching will be brought more and more into harmony with an increasingly trustworthy psychology. Further, it means that the teaching of history will be more scientific (as exemplified in the masterly paper read by Mr. B. Lewis) and the teaching of science more historical and humanistic. It will mean a new educational era.

Specialisation in Teaching.

Mrs. Bryant, headmistress of the North London Collegiate School, opened the discussion on this subject with a paper advocating a certain degree of specialisation on the part of every teacher of a staff. She assumed that it was more normal for teachers to specialise than not, and that there was something artificial in a school where every teacher taught everything. In a condition of free growth, schools developed from a minimum of specialisation in the subjects taken by each teacher towards a state in which nearly all progressive teachers specialised more or less. Specialisation did not mean limitation entirely to one subject; still less did it mean one teacher, one subject, all the teacher's life. There were persons who taught mathematics only, or classics only, or science only, for all their life's career. These were specialists in a special sense; but these subjects were not only large in extent, but multiple in the nature of the subject-matter they comprised. There was, however, a specialisation open to the humblest holder of a pass degree or a teacher's certificate. For all sorts of reasons, teachers have the ability and an impulse to specialise—and to vary their speciality. To learn a new thing and then have an audience to talk to and make talk about it—this is the joy of the teacher who *is* (not merely *was*) a student also. Moreover, the learners share the joy, and are stimulated thereby. Again, the move may come from a sense that there is a need for a certain kind of knowledge in the school curriculum. We see this just now in the case of teachers who believe that Scripture should be taught with more intelligence and scholarship. The practical motive sets going the movement towards patient study, and presently we have enthusiastic learners who are also effective teachers. The modern head of a school could organise the work so that each teacher took a larger share in the work she was best fitted to teach, so that without one dismissal or resignation the advantages of limited specialisation could be secured. These advantages were great:—(1) the scholarship of the teaching staff was raised, and therewith that of the learners, ideas were more accurate, inquiry more thorough, interest more real, curiosity more lively and fresh; (2) the teacher became a student, and to little children the reality of this made all the difference. The good teacher is always finding some new problem and solving it, just as the bad administrator is always trying beforehand to settle how everything is to be done. It was well that variety of personal influence should be brought to bear upon the child; moreover, the sense of belonging, not to the class merely, but to the larger whole of the school, is quickened when the child has real acquaintance with many members of the staff.

Mr. Frank Bulley gave a clear account of the simple arrangements made in the John Ruskin School, whereby the main advantages of specialisation are being secured in an elementary school. Dr. Borland urged that assistant teachers should be encouraged to specialise in music, and that one or more of such "specialists" should be included in every staff.

Memory.

Prof. J. Adams presided over the second session, which was devoted to the psychology of memory and the influence which our knowledge of this subject should have upon teaching. The chairman introduced the subject with an indication of its difficulty and importance. Dr. C. Spearman spoke on "The Relation of the Memory to the Will." The paper pointed out the remarkable contrast between the present cultivation of the study of memory by psychology and its neglect by education. This was attributed to an unfortunate want of touch between education and psychology, arising largely from the defective character of most psychological text-books. As a result, educationists have generally failed to recognise that memory, taken in its largest significance, embraces more or less exhaustively all the mental processes whatever, of intellect, and even of will. There are, indeed, most important differences between its higher and its lower manifestations, seeing that some persons excelled in the one and some in the latter. Our present exaggerated examination system is, in fact, chiefly disastrous owing

to its predominant cultivation of the lower kinds and to its showering its rewards and honours upon the pupils endowed with these. But, on the other hand, there are also most important resemblances between the two kinds; the fundamental laws of mind have the same form in both cases, and the study of the simpler and more accessible kind seems an indispensable preliminary to obtaining any really scientific and effective grasp of the higher ones. Various instances were given to illustrate the light shed in this manner on many of the most difficult problems in the education of the will, such as the encouragement of good impulses and the repression of bad ones; the fallacies were exposed which underlie the present harmful emphasis laid on game contests between schools, and the pernicious exaggeration of examinations.

The Teaching of Geography.

Mr. B. C. Wallis gave an account of the five years' course adopted in the County Secondary School, Holloway. The first stage dealt with the globe as a model of the earth, and was mainly observational and descriptive. The second stage occupied three years, and was largely heuristic in character, involving quantitative work relating to the world, the North Atlantic shore lands, and the British Isles. In the third stage an attempt was made to apply methods of investigation used in the previous stage to the original authorities, chiefly Government publications.

Mr. C. J. Rose dealt with "Open-air Teaching of Geography," and the financial difficulties in the poorer districts received attention. Mr. C. J. Fairgrieve discussed the problem of the ideal room for indoor teaching of the subject, a problem which certainly needs more attention than it has received hitherto. Mr. Alford Smith opened a useful discussion, and it appears that the revolution in the treatment of geography which has already been accomplished in most secondary schools is making headway in elementary schools, in spite of defective maps and atlases. A great amount of energy, ingenuity, and knowledge is being shown by the most progressive teachers of all classes of schools in the construction of home-made apparatus of a teaching power far surpassing the products of the trade.

Educational Experiments in Schools.

Mr. B. Lewis described the combined scheme of history and geography adopted at the Old Castle Street School. Compared with the sciences, history was apparently amorphous, and clear ideas were best obtained by focussing many converging lines of association on events of world-wide import. He adopted the chronological method; the concentric method failed to emphasise growth and development. He contrasted present with past, and thus tried to cultivate historical feeling. The physical geography of Britain was studied with special reference to the Saxon invasion, that of each European country was associated with that period of its history when it most closely influenced England. For similar reasons the geography of America and India was treated in connection with the events of the eighteenth century, that of the China Seas studied when the Russo-Japanese war was the historical topic, viz. at the end of the course. At the same time the geography of Britain and Europe was distributed over all the standards, as appeared from the details given of one section of the course. The manner in which the scheme was worked out led the chairman, Sir Alfred Keogh, to declare that it was the finest piece of short historical description ever delivered. The Rector of the Imperial College also warmly endorsed the plea, put forward in a paper by Mr. A. G. Gawler, for individual work even in large classes. Mr. Gawler's opinion is that in teaching the path of individuality is the path of least resistance, and the boy who journeyed along it lifted himself to a higher plane. In the concluding meeting papers were read on "Number Teaching," "Stencilling," and "Animals in Infant Schools." Prof. M. J. M. Hill presided, and dwelt upon the association of the University of London with the County Council in promoting educational efficiency.

G. F. D.

THE MAKING OF A DARWIN.[1]

I MAY take my text from a recent remark of Henry Fairfield Osborn, to the effect that a Darwin could not be produced in the American university of to-day. This raises a number of questions, some of them unanswerable, but all of them worthy of the attention of scientific men interested in the continuance of a race of investigators.

As a starting point we may quote Prof. Osborn's words in full:—

"If 'the poet is born, not made,' the man of science is surely both born and made. Rare as was Darwin's genius, it was not more rare than the wonderful succession of outward events which shaped his life. It was true in 1817, as to-day, that few teachers teach and few educators educate. It is true that those were the dull days of classical and mathematical drill. Yet look at the roster of Cambridge and see the men it produced. From Darwin's regular college work he may have gained but little, yet he was all the while enjoying an exceptional training. Step by step he was made a strong man by a mental guidance which is without parallel, by the precepts and example of his father, for whom he held the greatest reverence, by his reading the poetry of Shakspere, Wordsworth, Coleridge and Milton, and the scientific prose of Paley, Herschel and Humboldt, by the subtle scholarly influences of old Cambridge, by the scientific inspirations and advice of Henslow, by the masterful inductive influence of the geologist Lyell, and by the great nature panorama of the voyage of the *Beagle*.

"The college mates of Darwin saw more truly than he himself what the old University was doing for him. Prof. Poulton, of Oxford, believes that the kind of life which so favoured Darwin's mind has largely disappeared in English universities, especially under the sharp system of competitive examinations. Yet this is still more truly the atmosphere of old Cambridge to-day than of any of our American institutions. It would be an interesting subject to debate whether we could nurture such a man; whether Darwin, were he entered at a Columbia, a Harvard, or a Princeton, could develop mentally, as Charles Darwin did at Cambridge in 1817. I believe that conditions for the favourable nurture of such a mind are not with us. They are repose, time for continuous thought, respect for the man of brains and of individuality, and of such peculiar tastes as Darwin displayed in his avidity for collecting beetles, freedom from mental convention, general sympathy for nature, and, above all, order in the world of ideas. If the genial mind cannot find the kindred mind, it cannot develop. Many American school and college men are laughed out of the finest promptings of their natures. In short, I believe our intellectual environment would be distinctly against a young Darwin of to-day."

These words of Osborn hint at certain weaknesses in our American educational system to which I shall refer later on. Meanwhile, I do not think that it is the whole truth or wholly the truth. If a Darwin were to be "laughed out" of his career, the event would have occurred in the English secondary school, where he was, in fact, nicknamed "Gas" on account of his interest in chemistry; and it is certainly not true that in the old Cambridge or the new Cambridge there is as high a valuation of unexpected originality as the supposititious young Darwin would find to-day in America.

I think that the elements which make up a Darwin can be reduced to three, whereof the first far overtops the others, the heredity of great genius being far more rare than one would infer from Osborn's words, and far more difficult to mar or discourage.

What, then, are the elements that we unite to make a great investigator, not of Darwin's class, let us say, for that comes only with many centuries, but a naturalist not unworthy to come in as a footnote to a page on Darwinism? The fundamental elements, as I take it, are these three: first, the original material, to which we may look to heredity alone; second, meeting nature at first

[1] Presidential address delivered before the American Association for the Advancement of Science, Minneapolis, Decemb r 27, 1910, by Dr. David Starr Jordan.

hand, and meeting her early and persistently; third, the personal inspiration and enthusiasm derived from some great teacher. In Darwin's case the raw material was of the highest order, the best which amphimixis ever put together. This material no university could spoil, though Cambridge and Edinburgh confessedly tried their best. Beetles, racehorses, flowers and trees, contact with nature—these kept up an enthusiasm promoted rather than checked by the hopeless dreariness of his university exercises. These gave the second element, and the third came from the privilege of the young Darwin to be "the man who walked with Henslow," and later with Sedgwick also.

In the American universities, heredity plays her part; her limitations, whatever they may be, are racial, and our stock is good. Nature is close at hand, closer than in the Old World, and whosoever is really filled with zeal to know her has not far to go. Agassiz remained in America because in America he was nearer to his studies than he could be in Europe. Here "nature was rich, while tools and workmen were few and traditions none." All this our American universities offer in abundance. The final question is, then, that of personality, and the question I would raise is whether, in accumulating tools and traditions even as in Europe, we are not failing in this regard. Are we not losing sight of the *man*, of the thing, above all others, which goes to the shaping of a great naturalist or a great scholar in any field? We may say that the machinery of our universities is developed, not for the shaping of a Darwin, but for the moulding of very commonplace models. But so it is everywhere. Paulsen could never conceive that any of the great scholars of England should be professors in an English university. The work of the university, with its gowns and hoods, its convocations and degrees, its taking seriously the State-governed Church and the hereditary aristocracy, seem so alien to the life of the great scholar that one cannot conceive his taking part in them. Yet great scholars have done just this. They have developed in just this atmosphere, drinking from the real fountains of learning hidden within the university, and not from the drippings of the gargoyles with which mediævalism has adorned its exterior.

In like fashion we could not conceive of the young Darwin, in a claw-hammer coat, in the afternoon defending his one major and two minors with a thesis which no one will ever read, on a topic leading up a blind alley, as a doctor in any German university. But even this, or much worse or more incongruous, might happen to a Darwin or a Huxley, or a Lyell or a Gray, or a Helmholtz, an Agassiz or a Gegenbaur, were such to grow up into the universities of to-day. Externals count for little, and all these things are external. The man, the teacher, and the contact with nature—these are the only realities. The beginning is in the man, his ability, his "fanaticism for veracity," and his persistence in the work. The university cannot make the man. It cannot wholly shut him away from objective truth, even if it tries desperately to do so, and its principal influence is found in the degree to which its grants the inspiration of personality.

The reading of good books cannot be regarded as an element peculiar to any sort of university training. A good mind seeks good books and finds them. Shakespeare, Coleridge, and Lyell were just as accessible to me or to you as they were to Darwin. They are just as accessible to anybody anywhere. Time to read them is not even essential. One secret of greatness is to find time for everything in proportion to its worth to us. A further advantage is ours in this generation. We have the "Origin of Species" and the whole array of fructifying literature arising from this virile stem.

The only possible element in which the American university could fail is that of the influence of personality. Can it be that this influence is waning? Do our men no longer "walk with Henslow," as once they walked with Gray and Silliman and Agassiz?

Do our men go to the university for the school's sake and not for the men who are in it? Is it true that as our universities grow in numbers and wealth, their force as personal centres or builders of schools of thought are declining? To some extent this is certainly true. Once, when a young naturalist went in search of training and inspiration, he went to Agassiz. He did not go to Harvard. He scarcely thought of Harvard in this connection. Agassiz was the university, not Harvard. The botanist went to Gray. He did not go to Harvard. Later the chemist went to Remsen, the physiologist to Martin, the anatomist to Mall, the morphologist to Brooks. That these four men happened to be together at Johns Hopkins was only an incident. The student went out to find the man, and he would have followed this man around the world if he had changed from one to another institution.

I saw the other day a paper of an irate German morphologist who, in attacking a certain idea as to the origin of fishes' arms and ours, denounced "die ganze Gegenbaurische Schule" who followed Gegenbaur in his interpretation of this problem. Never mind the contention. The point is that there is a Gegenbaur school of morphology. This school was not the university, but Gegenbaur himself. We ought to have more such schools in America, schools of advanced thinkers gathered around a man they love, and from whose methods and enthusiasm the young men go away to be centres of like enthusiasm for others. I believe that our system of university fellowships is a powerful agency in breaking up this condition. If, by chance, it were possible for us to produce a Darwin, the raw material furnished, it would be a difficult task if a fellowship of 500 dollars has drawn him to the laboratory of some lesser plodder, preventing him for ever from being "the man that walked with Henslow."

The fellowship system keeps our graduate courses running regardless of whether these courses have anything to give. So long as our fellows are hired to take degrees, then sent out to starve as instructors, so long shall we find our output unworthy of our apparent advantages; and in our sober moments we shall say with Osborn, we do not see how an American university could produce a Darwin. At the same time, professors in universities in other lands will admit that the machinery for mediocrity offers little promise to the great. Jacques Loeb tells the story of a young man who applied through him for a fellowship in physiology at Chicago. His admiration for Loeb's wonderful genius as an experimenter and as an original worker on the borderland of life and matter led him to wish to work with Loeb above all other things. Loeb wrote back that he had resigned his chair in the University of Chicago to go to the University of California. Then, said the candidate, "will you kindly turn over my application for a fellowship to your successor at the University of Chicago?" This single case is typical of the attitude into which our fellowship system, as it is now administered, throws the young digs who arise in our various colleges. The embryo professor asks for his training, not for the man of genius who will make him over after his kind, but for the university which will pay his expenses while he goes on to qualify for an instructor's position. By this and other means we are filling the ranks of our teaching force, not with enthusiasts either for teaching or for research, but with docile, mechanical men, who do their work fairly, but with few touches of the individuality without which no Darwins nor Darwinoids can ever be produced. It is a proverb at Harvard, I am told, that "the worm will turn, and he turns into a graduate student."

Thirty-seven years ago it was my fortune as a beginner in science to attend the meeting of this association at Dubuque. The very contact with men of science which this meeting gave was a wealth of inspiration. To hear these men speak, to touch their hands, to meet them on the street, to ride with them to the fossil-bearing rocks or the flower-carpeted prairie, for the moment, at least, to be counted of their number, all these meant wonderful things.

Of these men, let me speak primarily of the students of natural history, for then, and even yet, I know little of anything else. They were naturalists "of the Old School," these workers of the early 'seventies. Louis Agassiz, dean of them all, was not at Dubuque, but I came to know him very soon after. There was Asa Gray. I heard at Dubuque some Harvard man say, "There goes Asa Gray. If he should say black was white, I should see it looking whitish." There was Shaler, the many-

sided, every side altogether charming; and Spencer F. Baird, the father of cooperative science, the science at the Capitol at Washington. There was Fred Putnam, the ever-present veteran, a veteran even in his youth. There was Joe Le Conte, ever clear-headed and ever lovable. There was Newberry and Leslie and Gill and Allen and Swallow and Leidy and Calvin and Marsh and Coues, Wilder with his shark brains, and Scudder with his butterflies, and I know not what others, the great names of thirty years ago, names which we honour to-day.

These men of the Old School were lovers of nature. They knew nature as a whole rather than as a fragment or a succession of fragments. They were not made in Germany or anywhere else, and their work was done because they loved it, because the impulse within would not let them do otherwise than work, and their training, partly their own, partly responsible to their source of inspiration, was made to fit their own purposes. If these men went to Germany, as many of them did, it was for inspiration, not for direction; not to sit through lectures, not to dig in some far-off corner of knowledge, not to stand through a doctor's examination in a dress coat with a major and two minors, not to be encouraged *magna cum laude* to undertake a scientific career. The career was fixed by heredity and early environment. Nothing could head them off, and they took orders from no one as to what they should do or what they should reach as conclusions. They did not work for a career—many of them found none—but for the love of work. They were filled with a rampant, exuberant individuality which took them wherever they pleased to go. They followed no set fashions in biology. Such methods as they had were their own, wrought out by their own strength. They were dependent neither on libraries nor equipment, though they struggled for both. Not facilities for work, but endeavour to work, if need be without facilities, gave them strength, and their strength was as the strength of ten.

For this reason each typical man of this sort had Darwin walking with him. He became the centre of a school of natural history, a rallying point for younger men who sought from him, not his methods or his conclusions, but his zeal, his enthusiasm, his "fanaticism for veracity," his love for nature, using that hackneyed phrase in the sense in which men spoke it when the phrase was new.

Students of Agassiz, notably Scudder, Lyman, Shaler, and Wilder have told us what all this meant, where "the best friend that ever student had" was their living and moving teacher. The friendship implied in this, his worthiest epitaph, rested, not on material air, but on recognition of "the hunger and thirst that only the destitute student knows," the craving to know what really is, which outranks all other human cravings.

Marcou tells us the story of the wonderful work done in the little college of Neuchâtel, without money, materials or prestige, investigating, writing, printing, engraving, publishing, all in one busy hive at a thousand dollars a year, when the greatest of teachers had youth, enthusiasm, love of nature, and love of man as his chief or only equipment. This story was repeated, with variations, at Cambridge, and with other variations by Agassiz's disciples throughout the length and breadth of America.

I heard Agassiz say once, "I lived for four years in Munich under Dr. Döllinger's roof, and my scientific training goes back to him and to him alone." Later, in America, he dedicated his contribution to the "memory of Ignatius Döllinger, who first taught me to trace the development of animals."

This suggests the thought of the heredity in science so ancient or characteristic of the Old School. From Döllinger, Agassiz was descended. From Agassiz, all of the naturalists of the Old School of to-day, all the teachers and investigators who have reached the sixty-year mark, or are soon to reach it. These men, from Joseph Le Conte and David A. Wells, of his first class, through Shaler, Wilder, Putnam, Alexander Agassiz, Hartt, Baird, Walcott, Whitman, Brooks, Snow, Lyman, Clark, William James, Faxon, Fewkes, Garman, down to Minot and myself, the two youngest of the lot, as I remember—Minot venerable already, according to the Boston Press.

It is characteristic of the men of the Old School that they formed schools, that they were centres of attraction to the like-minded wherever these might be. There were no fellowships in those days whereby men are hired to work under men they do not care for and along lines which lead, not to the truth they love, but to a degree and a career. We speak sometimes of the Agassiz school of naturalists, the Gray school of botanists, as in Germany "die ganze Gegenbaurische Schule" of anatomy, "die Haeckelsche Schule" of biology. These may be terms of praise or of opprobium, according to the degree of one's sympathy with that school and its purposes.

To belong to a school in this sense is to share the inspiration of its leader. The Gray school of botanists no longer place the buttercup or the virgin's bower at the head of the list of plants as a typical flower. Gray did this; but this is not an essential in honouring Gray. They begin at the bottom, Darwin fashion, and the honour of the end of the list is given to the specialised asters and mints, or the still wider wandering orchids, the most eccentric, the most remotely modified, no longer to the typical, the conventionally simple. In this there is a tacit assumption that Gray would have done the same had he possessed the knowledge which is now the common property of his students. Probably he would; but that matters nothing, for each one follows his own individuality.

The characteristic of the Agassiz school was the early and utter discarding of the elaborate zoological philosophy which the master had built up. The school went over bodily to the side of Darwin, not because Darwin had convinced them by his arguments, but because their own work, in whatever field, led them to the same conclusions. No one who studied species in detail could look an animal in the face and believe in the theory of special creation. The same lesson came up from every hand, and we should not have been true to the doctrines of the master if we had refused faith to our own experience. When the Museum of Comparative Zoology was finished, Haeckel is reported to have said, perhaps in envy, perhaps in jest, that "the output of any scientific establishment is in inverse ratio to the completeness of its equipment." In other words, the more men have to do with the less they would do.

Statistics show that in this paradox there is at least a grain of truth, and this grain of truth stands at the base of my own misgivings. With the scantiest of equipment much of our greatest work has been done. It is said that Joseph Leidy's array of microscopes and knives cost not less than a hundred dollars. The "Poissons Fossiles" was written when its author lived from hand to mouth in the Latin Quarter of Paris, copying "on the backs of old letters and on odd scraps of paper the books he needed, but which he could not buy." Since Haeckel said the words I have quoted, if he ever said them, facilities for biological work have multiplied a thousand-fold. Every German university, Jena with the rest, and most American universities as well, have a far greater equipment than the Museum of Comparative Anatomy had forty years ago. Victor Meyer is reported to have said that the equipment of every chemical laboratory should be burned once in ten years. This is necessary that the chemical investigator should be a free man, not hampered by his outgrown environment. In like vein, Eigenmann has said that when an investigator dies all his material should be burned with him. These should be his creation, and he should create nothing which he cannot use. These could be useful to none other except as material for the history of science. Therefore, too much may be worse than too little. The struggle for the necessary is often the making of the investigator. If he gets what he wants without a struggle, he may not know what to do with it.

But facilities do not create. The men who have honoured their universities owe very little to the facilities their universities have offered them. Men are born, not made. They are strengthened by endeavour, not by facilities. *Facilis descensus.* It is easy to slide in the direction of least resistance. That direction is not upward. It is easy to be swamped by material for work, or by the multiplicity of cares, or by the multiplication of opportunities. I may be pardoned for another personal allusion. I have spent the best portion of my life in the service of science, but for the most part not in direct

service. I have tried to help others to opportunities I could not use myself. I have been glad to do this, because that which I might have done has been far more than balanced by the help I have been able to give to others.

But it is not clear that this greater help has led to greater achievement. I cannot find that the output bears any direct relation to the means for producing it. The man who is born to zeal for experiment or observation cannot be put down. He is always at it. Somewhere or somehow he will come to his own. No man ever adds much to the sum of human knowledge because the road is made easy for him. Leisure, salary, libraries, apparatus, problems, appreciation, none of these will make an investigator out of a man who is willing to be anything else. There is human nature among scientific men, and human nature is prone to follow the lines of least resistance. It takes originality, enthusiasm, abounding life, to turn any man from what is easily known to that which is knowable only through the sweat of the intellect. Of all the men I have tried to train in biology, those five I regard as ablest because their contributions to science have been greatest, were brought up out of doors or within bare walls in which books, specimens, and equipment were furnished from the scant salary. A struggling teacher, a very young teacher at that, at 1800 dollars per year, and 10 per cent. of this for a biological library, is not a condition to attract advanced students to-day, but, so far as my own experience has gone, I have never known stronger students than those who came to me to be trained under these pinching conditions.

To-day the conditions are adjusted to the promotion of the docile student rather than the man of original force. He goes, not to the man, but to the university. He finds work in biology no longer a bit of green sod under the blue sky shut off by conventional and ugly hedges, and therefore to be acquired at any cost. It is a park, open on every side to anybody. Or, dropping the poor metaphor, he finds his favourite work not a single hard-won opportunity in a mass of required language and mathematics. He finds the university like a great hotel with a menu so varied that he is lost in the abundance. His favourite zoology or botany is not taught by a man. It is divided into a dozen branches, each taught by an instructor who is a cogwheel in the machine. The master under whom he would seek inspiration is busy with the planning of additional cogwheels or the oiling of the machinery. Or, more often, there is no master teacher at all. The machinery is there and at his hand. He has but to touch the button and he has alcohol, formal, xylol, or Canada balsam—whatever he needs for his present work. Every usable drug and every usable instrument is on tap; all we need, degrees and all, are made for us in Germany. Another button will bring him all the books of all the ages, all the records of past experience, carrying knowledge far ahead of his present requirements, usually beyond his possible acquirements. The touch of personality, the dash of heredity, is lost.

Worse than all this, for the student who is worth while will orient himself even among the most elaborate appliances and the most varied concourse of elective, is the fact that he is set to acquire training without enthusiasm. Sooner or later he receives a fellowship in some institution which is not the one to which he wishes to go. Virtually, he finds himself hired to work in some particular place not under the man, of all men, he has chosen to know. He is given some petty problem; it seems petty to him and to others. He takes this as his major, with two convenient minors, and at last he is turned out with his degree to find his own life, if he can, with his degree. His next experience is to starve, and he is not so well fitted for this as he would have been had he begun it sooner. If he finds himself among facilities for work, he will starve physically only. If he marries, he starves in good company, but more rapidly and under greater stress. If chance throws him into a college without facilities, he will starve mentally also. In any case, he will lament the fact that the university has given him so much material help, so little personal inspiration, and at the end values its product so low, that with all the demands of scholarship and scholarly living his pay is less than that of the bricklayer or the hack driver; for he has attained a degree of scholarship without a corresponding degree of compelling force. His education has not given him mastery of men, because its direction has not been adequately his own.

It is always the struggle which gives strength. Learning or polish may be gained in other ways, but without self-directed effort there is not much intellectual virility. Good pay, like some other good things, comes to the man who compels it. To make oneself indispensable, real, forceful, with a many-sided interest in men as well as in specialised learning, is the remedy for low salaries. As college men, we get all that we are worth on the average. Our fault is that we are in the average. We need more individuality.

In so far as the universities can remedy this, it would lie in the encouragement of men to take their advanced work in actual centres of inspiration. No one university has many such. Let the fellowships lead men to the few. Or let them be travelling fellowships, available at the best centres of inspiration in this or any other country. Or, if the choice among departments be too delicate a matter for university officials to undertake, let the distribution of fellowships be confined to the men who already are on the ground. These men, in one way or another, have shown their confidence, have chosen their master. If the university wishes now to smooth their path to success, it could give pecuniary assistance without hiring them to go where they do not wish to go. There is no nobler ambition for a great investigator than to hope from a school of science to continue his own kind, by his own method, his own inspiration, the contagion of his own love of knowledge. In no way can this be done save by letting like come to like, by opening the way from his own kind to find the way to their master. In this our present fellowship system is failing, and this failure is showing itself in the cheapening of virility and the cheapening of originality among our doctors of philosophy as compared with our young workers of a generation ago.

An eminent teacher of physics said lately:—

"The numbers of doctors' degrees in physics bear no relation to the eminence of the professors who grant them. They depend solely on the number of fellowships offered, on the number of assistantships available. In the institution which has conferred the greatest number in recent years, almost every one of these is drawn by the stipend offered; scarcely one by the unquestioned greatness of the leading professor."

The primary fault seems to be in our conception of research, which tends to point in the direction of pedantry rather than that of scholarship. Not all professors have this tendency, only those who are neither great scholars nor great teachers. It is, or ought to be, a maxim of education that advanced work in any subject has greater value to the student, as discipline or as information, than elementary work. Thoroughness and breadth of knowledge give strength of mind and better perspective. They give, above all, courage and enthusiasm. With each year, up to a certain point, our universities carry their studies further toward these ends, and the student responds to each demand made on his intelligence and his enthusiasm.

Then research begins, and here the teacher, as a matter of duty, transforms himself into the pedant. Instead of a closer contact with nature and her problems, the student is side-tracked into some corner in which numerical exactness is possible, even though no possible truth can be drawn from the multiplicity of facts which may be gathered.

This sort of research, recently satirised by Prof. Grant Showerman in the *Atlantic Monthly*, is not advanced work at all. It may be most elementary. The student of the grammar school can count the pebbles in a gravel bank to see what percentage of them lie with the longest axis horizontal as easily as the master can do it. That is not research in geology, however great the pains which may be taken to ensure accuracy. The student may learn something. All contact with gravel teaches something of the nature of rocks, as all reading of Plautus teaches something of poetry; all contact with realities gives some reality as a result. Yet there is no result involved in the case above indicated in the investigation itself. We know

that if flat stones are free to fall, the longest axis will approach horizontally, and that is the end of the matter.

Mr. Showerman's suggested comparison of the "prefixes in P to be found in Plautus," "the terminations in T of Terence," and "the sundry suffixes in S," is scarcely an exaggeration of the kind of work assigned to many of our research students. Such work is in itself absolutely elementary. It teaches patience and perhaps exactness, although, where the student finds that error is just as good as truth in the final round-up, he is likely to lose some of "the fanaticism for veracity" which is the central element in the zealous comradery of the extension of human knowledge. So long as the "new work" on which our doctors of philosophy address themselves is found in material rejected by scholars because a study of it cannot possibly lead anywhere, so long will these doctors be neither teachers nor enthusiasts. They will justify the clever sneer as to the turning worm and the graduate student. Elementary facts about raw material is not the advancement of knowledge. They are killing to those who have a capacity for something better. The listing of "Terence's terminations in T" is a type of work which, at the best, bears the same relation to research that forge-work bears to engineering. It is worth while to the engineer to know what it is like and to be able to handle a hammer if need be. Moreover, a hammered-out horse-shoe is an actual reality. But to make a horse-shoe, even one of a form never seen before, is not the final thesis for which the engineer enters the university.

Much of the graduate work in non-mathematical subjects receives an appearance of accuracy from the use of statistics or other forms of mathematics. This seems to make the results "scientific." Mathematics is a science only when its subject-matter is science—when it deals with results of human experience. At other times it is simply a method—a form of logic. A mathematical enumeration, or even a formula, does not give exactness where it did not exist before.

The statistical enumeration of the "prefixes in P" or the pebbles in the bank is held to give the method of research. It teaches patience and accuracy, two fundamental virtues in the progress of science. Patience, perhaps, if the student persists to the bitter end. Accuracy, certainly not. Sooner or later the student will discover that to multiply by ten one of his columns of figures, or to divide another by five, will have no effect on his final conclusion, for there is not going to be any conclusion. He will then learn to supplement his tables by the quicker and more satisfactory method of guesswork. He turns from the methods of pedantry to the method of journalism. At the best, he will find that the less laborious methods known as qualitative have the advantage over quantitative methods, where matters of quantity have no real significance.

No one should begrudge any amount of time or strength or patience spent on a real problem. In that regard, Darwin's attitude towards the greatest of biological problems is a model for all time. But we should believe that there is a problem, and that our facts point towards the truth in regard to it. A fact alone is not a truth, and ten thousand facts may be of no more importance. A horse-shoe is not an achievement. Still less are ten thousand horse-shoes. "Facts are stupid things," Agassiz used to say, "unless brought into connection by some general law." In other words, facts signify nothing, except as the raw material of truth.

A graduate student of an honoured philologist in a great university lately explained her graduate work to me. A chapter in Luther's Bible was assigned to her, another to each of her fellows. This was copied in longhand, and after it all the variant German versions of the same chapter. Her work was to indicate all the differences involved. There may have been something behind it all. The professor may have had in mind a great law of variance, a Laut-verschiebung or Entwickelung of pious phraseology. But no glimpse of this law ever came to the student. More likely, the professor was at his wits end to find some task in German which had never been accomplished before, and which had never before occurred to any German taskmaster. No wonder the doctor's degree is no guarantee of skill as a teacher! Among the first essentials of a teacher are clearness of vision and enthusiasm for the work. This is not cultivated by these methods. It is not even "made in Germany." The "law of time relations of iron and sulphuric acid" may be developed in a year's work by dropping a thousand weighed shingle nails into a thousand test tubes of sulphuric acid, each having the amount requisite to turn the whole into an iron sulphate. The length of the period before each shingle nail disappears and that before the resultant liquid becomes clear can be measured. It may even be proved that the cleaner the nail the more quickly it dissolves. But all this is not chemical research. It gives no wider grasp on the marvellous processes of chemical reaction, and no greater enthusiasm for chemical work or grasp on chemical teaching.

If the counting in Plautus of the prefixes in P is a type of the only sort of research that the classical knowledges permit, then let them go without research. Let them fall back on the charms of Latin verse, the surprises of Latin wit, the matchless power of description of which the Greek language is capable, and the monumental splendour of the oldest of the story-tellers, who brought even the gods into his service. Let literature be literature, and science science, and enthusiasm will precede and follow any real advance in knowledge. Let the student be free to learn, and not to grind. Let him go with the masters of his own free will, not as he is hired by the pedants. As a final result we shall have again schools of thought and action in America, and the doctor's degree will not be a hindrance in the profession of university teaching.

When our graduate work is really advanced work, undermen who know the universe in the large as well as in the small, its great movements as well as its forgotten dust heaps, we shall have our American schools of science, and the Darwins will again "walk with Henslow" over fields as green as were ever those of Cambridgeshire.

With the failure of the enthusiasm of the teacher we have a lowering of ideals on the part of students. They come too often to look on science as a career rather than as an opportunity, to do that which in all the world they would rather do, that which they would die rather than leave undone. Too often, in the words of John Cassin, "they look upon science as a milk cow rather than as a transcendent goddess."

The advent of the elective system, thirty years ago, bore a wonderful fruitage. Men, soul-weary of drill, turned to inspiration. Teachers who loved their work were met by students who loved it. The students of science thirty years ago came to it by escape from Latin and calculus with the eagerness of colts brought from the barn to a spring pasture. In regions of eternal spring these colts do not show this vernal eagerness. Now that science is as much a matter of course as anything else, there is not this feeling of release; and the feeling that one to whom the secrets of the woods and hills, the story of the sea and the rocks, have been made known, belongs to a chosen class, disappears when these matters are made open to everyone. Scientific knowledge, as the result of continued endeavour and of persistent longing, is more appreciated than when it comes as an open elective to all who have completed English 3 and Mathematics 5.

In one of the poems of James Whitcomb Riley this sentence is expressed:—

> "Let's go a visiting back to Grisby's Station,
> Back where we used to live, so happy and so poor."

"So happy and so poor" the American college once was that the student, the teacher, and nature were all together, all hand in hand. It was this which made at Munich the "Little Academy," concerning which Agassiz once spoke so eloquently. It was the contrast with greatness in the most simple surroundings that gave the school at Penikese its unique position. As to this school, I once used these words:—

"With all appreciation of the rich streams which in late years have come to us from many sources, and especially from the deep insight and resolute truthfulness of Germany, it is still true that 'the school of all schools

which has had most influence on scientific teaching in America' was held in an old barn on an uninhabited island, some eighteen miles from the shore. It lasted for three months, and in effect it had but one teacher. The school at Penikese existed in the personal presence of Agassiz; when he died, it vanished!"

Contact with great minds is not so common to-day as it was when the men of the Old School were the leaders of the new. The enthusiasm of struggle, the flash of originality, grows more rare as our educational machinery becomes more perfect. If our present system fails, it is in the lack of personal contact and personal inspiration. If we cannot create new Darwins, the raw material being found, it is because they cannot walk with Henslow. Henslow is somewhere else, perchance in some Government bureau of science, or, if he is present, he has too much on his mind to be a good walker. We do not value him enough to make him free.

We have too much university in America, and too much of what we have in boys' schools. The university as such is a minor affair, an exotic attachment. Should a great teacher, a real man of God, of the God of things as they are, arise in the faculty, he becomes a department executive. More than half his students are of gymnasium grade, and nine-tenths of his teaching is done by young men, men who have not made their mark or who have made it only as cogwheels in the machine. Too often these are caught in the grind, and are never able to show what they might have been if their struggles had been towards higher ends. Smith teaching Zoology 10; Brown, Botany 7; and Robinson, Geology 3, cannot lead their students or themselves to look on nature in the large or to see the wonderful vistas beheld by a Lyell or a Rumboldt. The university in America is smothered by the college. The college has lost its refinement of purpose through coalition with the university. The two are telescoped together, to the disadvantage of both. The boy has the freedom and the facility of the university when he can make no use of it. The university man is entangled in the meshes of the college. University facilities we have enough for ten times—twenty times—the number of students. We go into the market to hire young men to avail themselves of them. There is no corresponding emphasis laid upon men, and men of the first rank are no more numerous to-day than they were in the days of Agassiz, Lowell, Longfellow, Gray, Holmes, Dana, Silliman, Gibbs, Leidy, Goodwin, Angell, White, and Goldwin Smith.

It is the man who makes the school, and completes the chain of heredity from the masters of the last century in Europe to the masters of the twentieth century in America. Excellent as our facilities are, complete as are our libraries, our laboratories and our apparatus, easy as is our access to all this, we have only made a beginning. Another ten years will see it all doubled. What we have is far from complete. But the pity of it is, our students will not guess its incompleteness. Half as much or ten times as much, it is the same to them as the doubling of the bill of fare at the Waldorf-Astoria would be unnoticed by the guests. A still greater pity is this, even the teachers will not know the difference. They can use only what they have time and strength for. The output is no greater for the helps we give. The greatest teacher is one who is ruler even over his books, and who is not smothered by them.

Enthusiasm is cultivated by singleness of purpose, and in our system we make provisions to distract rather than to intensify. There is a learned society, to which many of us belong, Sigma XI. Its value depends on its ability to make good its motto, Spoudon Xynones, "Comrades in Zeal." We whistle to keep up our courage in the multitude, not of dangers, but of distractions, and if we whistle in unison we may keep step together. This society in a cooperative way, the same spirit in different places, stands for enthusiasm in science. Now enthusiasm comes from struggle, from the continuous effort to do what you want to do, and for the most part in the way you want to do it. Hence comradery in zeal should make for individuality, for originality.

The most serious indictment of the "new school" in science is its lack of originality. Even its novelties are not original. They are old fabrications worked over, with a touch of oddity in the working. The requirements for the doctor's degree tend to curb originality. But these do not go far. A man may be original and even in a dress coat in the daytime may be rated as *summa cum lauda*. The greatest foe of originality is timeliness. Rather, timeliness is evidence of lack of originality, of lack of individual enthusiasm.

When a discovery is made in botany the young botanists are drawn to it as herrings to a searchlight, as moths to a lantern. In Dr. Coulter's words, "they all dabble in the same pool." Not long since the pool was located in morphology; then it was in embryology; then in the fields of mutative variations; now it is filled with unit characters and pedigreed cultures.

I would not underrate any of these lines of work or any other, but I respect a man the less when I see him leaving his own field to plunge into one which is merely timely, into one in which discovery seems to be easy, and the outlook to a career to be facilitated.

All honour to the man who holds to his first love in science, whatever that may be, and who records his gains unflinchingly, though not another man on earth may notice what he is doing. Sooner or later the world of science returns to every piece of honest work. The revival of the forgotten experiments of the priest Mendel will illustrate this in passing. Hundreds of men are Mendelians now who would never have thought of planting a pea or breeding a guinea-pig had not Mendel given the clue to problems connected with these things.

The man of to-day, busied with many cares, looms up smaller than the man of the Old School who walked with Henslow and then walked with nature. In this thought it is easy to depreciate our educational present.

Homer, referring to the Greeks of earlier times, assures us "There are no such men in our degenerate days." I have never verified this quotation—the men of our days are too busy to verify anything—but we may take the sentiment as characteristic. From the days of Homer until our own time, the man of the Old School has always found the times out of joint. Perhaps in getting so elaborately ready we are preparing for a still more brilliant future. It may be that books, apparatus, material, administration, and training are all worth their weight in men, and that modern educational opportunities are as much better than old ones as on the surface they seem to be. I know that all these misgivings of mine represent no final failure. Each generation has such doubts, and doubts which extend in every direction. The new strength of the new generation solves its own problems. The new men of the new schools of science will master the problems of abundance and of distraction even as ours solved the problem of hostility and of neglect. The man is superior to the environment, and the man of science will do the work he loves for the love of it. In this love he will develop the abundance of life in others as in himself, and this is the highest end of all our striving.

The atmosphere of a great teacher raises lesser men to his standard. It perpetuates the breed. It was not books or apparatus that made Döllinger or Agassiz or Brooks successively centres, each of a school of research. It was the contagion of devotion, the joy of getting at the heart of things, the love of nature, the love of truth. Sometimes, in our wealth of educational opportunity, we long for the time when, as of old, the student had the master all to himself, the master unperplexed by duties of administration, not called hither and thither by the duties of his station, but giving himself, his enthusiasm, his zeal, and his individuality to the student, not teaching books, but how to make books our servants, all this time master and student struggling together to make both ends meet, and sometimes succeeding, "so happy and so poor." So it was in the old time, and so it shall be again when the new demands and the new wealth find their adjustment. And to find this we shall not go back to Grigsby's Station, nor yet to Penikese; for the scholars that are to be shall rebuild the American universities in their own way, as the scholars of to-day are restoring the University of Cambridge, and in a greater or less degree all other universities in all other lands where men know and love the truth.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—A large number of university courses of advanced lectures in science subjects are in progress or announced. In botany, a course of ten lectures on the history of British botany will begin on January 20 at University College. The first lecture of the course will be by Mr. Francis Darwin, on "Stephen Hales," and the work of other famous botanists will be described in later lectures, the lecturers being Profs. Vines, Bower, Farmer, Lang, Oliver, Scott, Dr. Arber, Mr. Praeger, and Mr. Henslow. Dr. W. N. Shaw, reader in meteorology, will begin a course of eight lectures on climatology, with special reference to British possessions, on the same day at the London School of Economics. Several courses of advanced lectures in physiology are announced. Prof. E. A. Minchin will begin a course of twenty-one lectures on the protozoa at the University on January 16 at 5 p.m. A course of three lectures on the comparative anatomy of the vertebrate ear, by Mr. R. H. Burne, will begin on January 19 at the Royal College of Surgeons. The times of the lectures in each case will be 5 p.m., and admission will be free, without tickets.

DURING the temporary absence of Prof. Starling, F.R.S., owing to ill-health, Dr. W. M. Bayliss, F.R.S., has been appointed acting professor of physiology in University College, London.

IT is announced in *Science* that Harvard University is to receive 12,000*l.* from the will of the late Mrs. William O. Moseley, and that a gift of 100,000*l.* has been made to Dartmouth College by Mr. Edward Tuck.

The degree of D.Sc. as an external student has been granted to Arthur Slator, of University College, Nottingham, and Birmingham and Leipzig Universities, for a thesis on "Studies in Fermentation," and other papers.

WE learn from *Science* that, as a memorial to her husband, Mrs. Edward H. Harriman, of New York City, has endowed with 20,000*l.* the chair in forest management in the Yale Forest School. Mr. Andrew Carnegie has agreed to give to the Maria Mitchell Memorial Association a sum of 2000*l.* toward the establishment of a research fellowship in astronomy, on condition that the sum of 1000*l.* required to complete the fund of 5000*l.* be subscribed. The progress made in ascertaining the approximate value of the Wyman bequest for the Graduate College of Princeton University confirms the original estimate of between 400,000*l.* and 600,000*l.*

A COURSE of six free public lectures is to be given at University College, Gower Street, W.C., by Lieut.-Colonel Ernest Roberts, introductory to the study of Indian sociology, on Tuesdays at 4.30 p.m., beginning on February 21 next. A course of eight lectures, free to all internal students of the University of London, is to be given by Dr. H. H. Dale in the Physiological Institute, University College, on Fridays at 4.30 p.m., commencing on January 20. The London County Council has arranged two courses of ten lectures for teachers, which are free to London teachers, to be given on Wednesdays at 6 p.m., beginning on January 18, at University College. One course is on scientific reasoning and its cultivation, the lectures being given by Dr. A. Wolf, and the other on models to illustrate the geometry of space, the lectures being given by Dr. L. N. G. Filon, F.R.S.

THE Philosophic Faculty of the University of Marburg has conferred the degree of Doctor Honories Causa upon Mr. Ernst Leitz, of Wetzlar, the principal of the well-known firm of manufacturers of microscopes, microtomes, and other optical and scientific instruments.

SOCIETIES AND ACADEMIES.

LONDON.

Faraday Society, December 13, 1910.—Mr. F. W. Harbord in the chair.—J. **Swinburne**: Separation of oxygen by cold. The problem of separating oxygen from the air is not the same as making liquid air. To separate oxygen from nitrogen involves doing mechanical work, which is converted into heat. A rectifying plant may be considered as an apparatus, which takes in heat substantially at the boiling point of the liquid with highest boiling point, and gives it out at a lower temperature near the boiling point of the most volatile liquid. An air separator thus takes in heat at 90° A, gives out heat at about 82° A, and at the temperature of the works, say, 273° A. The Linde process may be regarded as a rectifying plant of this sort, and a thermodynamic engine, in which a gas is compressed so as to liquefy at 90° A under pressure, and to evaporate at 82°, thus supplying the heat at the boiling point of oxygen and absorbing it at the boiling point of the air. Such a process is generally considered irreversible, but is, in fact, nearly reversible, and therefore economical. Assuming an efficiency of 40 per cent., the cost of oxygen comes out approximately 1*s.* a ton on a large scale. This ought to lead to its use in blast furnaces and other cases where an extra high temperature may be important.—Dr. H. J. S. **Sand** and W. M. **Smalley**: A new apparatus for the rapid electro-analytical determination of metals. A glass-frame anode for use with silver and nickel kathodes. In order to reduce the amount of platinum employed, a pair of electrodes has been designed which, while retaining as much as possible the essential features of those previously described, contains as little platinum as possible. The anode has been made largely of glass, so that the total weight of platinum has been reduced to about 5 grams. Special care has been taken in the design to render it as little fragile as possible. For copper determinations a kathode of silver is employed, which has been designed so that it can be made without much difficulty with the facilities usually available in a chemical laboratory. For zinc determinations a kathode of nickel was employed. The results of copper and zinc depositions are substantially as good as those obtained with platinum electrodes. The time required for determining 0·3 gram of copper is about seven minutes. A stand for holding the auxiliary apparatus required in electro-analysis is also described.

Geological Society, December 21, 1910.—Prof. W. W. Watts, F.R.S., president, in the chair.—T. O. **Bosworth**: The Keuper marls around Charnwood Forest. The area under consideration includes the towns of Leicester, Loughborough, Coalville, and Hinckley. The Charnian rocks project through a mantle of Triassic deposits, which once completely covered them. The quarries have been opened in the summits of the buried hills. A quarry is so worked that its outline follows the contour of the buried hill; consequently, the section presents but a dwarfed impression of the irregularity of the rock-surface. On the buried slopes and in the gullies are screes and breccias, and bands of stones and grit are present in the adjacent beds of marl. All these stones are derived only from the rock immediately at hand. Where exposed, the Charnian igneous rocks are deeply weathered and disintegrated, but the same rocks beneath the Keuper are fresh right up to the top. The Keuper marls lie in a catenary manner across the gullies. There has been almost no post-Triassic movement in Charnwood. All the points of contact of any one bed with the Charnian rocks lie on one horizontal plane. The inclination of the strata must, therefore, be due to subsequent sagging. The Upper Keuper deposits accumulated in a desert basin, of which parts were dry and parts were occupied by ever-shifting salt-lakes and pools. In these waters the red marls were laid down. The abundant heavy minerals are garnet, zircon, tourmaline, staurolite, rutile, magnetite. The grains are intensely worn. The quartz-grains are sometimes wind-worn. The false bedding is mainly from the south-west. The ripples indicate prevalent south-westerly winds.—R. L. **Sherlock**: The relationship of the Permian to the Trias in Nottinghamshire. The conformability or unconformability of the Bunter to the Permian has been much discussed, but it is generally considered that there is a small unconformity between them. In this paper, a section on the Great Central Railway near Annesley is described. It shows a gradual passage from the Middle Marl into the Lower Mottled Sandstone. Detailed mapping has confirmed this conclusion. From Nottingham to Mansfield the Middle Marl retains a

uniform character and thickness, but at Mansfield it is apparently absent. At the same place the limestone becomes sandy, forming the Mansfield Sandstone. These two phenomena can be best explained by supposing that a river deposited a sandbar at Mansfield during Permian times. North of Mansfield the Middle Marl becomes normal again. Near Cuckney, the Upper Magnesian Limestone first appears as a very thin bed, and the limestone arises as thin lenticular bands in the passage-bed. It is believed that the Upper Magnesian Limestone and Upper Marl of the northern part of the outcrop are the time equivalents of the Bunter of South Nottinghamshire.

Royal Microscopical Society, December 21, 1910.—Mr. E. J. Spitta, vice-president, in the chair.—W. R. **Traviss**: A small microscope lamp, particularly suited for opaque objects and dark-ground illumination with high powers. The light used was a small inverted incandescent burner carried at the extremity of a short arm, that could be easily moved up and down on a standard. The light could be brought very close to the table or raised to illuminate opaque objects on the stage.—M. J. **Allan**: An easy method of treating printing-out paper (P.O.P.) for all kinds of photography. The author recommends that the prints be washed in a strong solution of salt, then placed in a saturated solution of hypo, after which they are to be washed in running water.—C. H. **Higgins**: A new system of filing slides.—A. A. C. E. **Merlin**: The measurement of Grayson's new ten-band plate. The plate, comprising ten bands running from 1/100oth to 1/10,000th of an inch, had been ruled by an improved machine, and was found to be much better even than Grayson's earlier productions. The author in measuring the bands used a selected objective of 1·32 N.A., having an initial magnification of 143 on a 10-inch tube. A Nelson-Powell screw setting micrometer, which is alone suitable for the purpose, was used. The result obtained was that the variation from the mean in the spacing of the lines did not exceed 1/230,000 inch. The mean diameter of the lines was 0·00002488 inch. The author also made a series of measurements with 1-inch, ½-inch, and ¼-inch objectives, and came to the important conclusion that low powers were unsuited for micrometry.—Jas. **Murray**: Some African rotifers—Bdelloida of tropical Africa. Thirty-three species of bdelloids were obtained from dried moss sent by Mr. A. Allan and Sir Philip Brocklehurst from British East Africa. Nine of the species are new to science. Several of them have very distinct characters not previously noted for any bdelloids. *Harbrotrocha caudata* has a tail-like process, the function of which is unknown. The animal secretes a protective shell, and the "tail" is enclosed in a slender tube open at the end, so that the shell has two openings. *H. acornis* has no trace of spurs, otherwise universal in the order. Several other species approach it in this respect, having the spurs reduced to minute papillæ. *H. auriculata*, when feeding, has at each side of the head a peculiar ring-like auricle, giving it the appearance of a two-handled vase. The nature and function of the auricles remain unknown. Their form, even, is difficult to interpret, as they present apparently contradictory appearances from different points of view. The bdelloids take a very important place in moss-faunas. In every country they are abundant, and in most regions there is a fair proportion of peculiar species. When more fully known the bdelloids seem likely to prove a group of hitherto unsuspected importance, both in point of numbers and diversity of forms. All these moss-dwellers can revive after desiccation. The adult animals become dormant when deprived of moisture, and revive when remoistened. It is not, as Zacharias concluded from his experiments in 1886, that the survival of the species is effected by means of eggs.

MANCHESTER.

Literary and Philosophical Society, December 13, 1910.—Mr. Francis Jones, president, in the chair.—Miss Margaret C. **March**: Preliminary note on *Unio pictorum*, *U. tumidus*, and *D. cygnea*. The form of the British unionids can be shown to be dependent on current and soil, and is therefore useless for systematic purposes when taken alone. The umbonal markings of these animals merge into one another, and are therefore useless specifically. Phylogenetically, they show that *U. pictorum* is most archaic, *anodon* least, *tumidus* being intermediate. The edentulousness of American anodons illustrates heterogeneric homæomophy. The ornament and dentition of unionids show relationship to trigonids, and a descent from a pre-trigonid ancestor.—D. M. S. **Watson**: Notes on some British Mesozoic crocodiles. The author discussed some systematic and nomenclatural difficulties, recording the occurrence of a new variety of *Metriorhynchus hastifer* in the Corallian of Headington, of *M. hastifer* itself in the Kimmeridge Clay of Britain, and discussed *Petrosuchus laevidens* and *Steneosaurus stephani*.—Prof. F. E. **Weiss**: Sigillaria and Stigmariopsis. The author exhibited some specimens of axes of Sigillaria associated with stigmarian bark. From the repeated occurrence of these specimens it was suggested that they represented the base of the aërial or the subterranean axes of Sigillaria, probably of the Eusigillaria type. The secondary wood was more copiously developed than is general in the aërial axes. The primary wood was of sigillarian type, so that these stigmarian axes have centripetal primary wood, and their pithcasts would be striated like those described for Stigmariopsis. It was noticed that in some instances small axes were found in contiguity, and apparently in continuity, with the main axes. These smaller axes resemble the ordinary stigmarian axes very nearly, and do not show the centripetal primary wood of the main axis, but only a few fine tracheids in the pith region.

PARIS.

Academy of Sciences, January 3.—M. Armand Gautier in the chair.—The Fanny Emden prize (3000 francs). This prize will be awarded for the current year for the best work dealing with hypnotism, suggestion, and generally physiological actions capable of being exerted at a distance from the animal organism. In the special circumstances, memoirs on this subject will be received up to June 1.—M. **Bertin**: The general laws of accelerated or retarded motion of a ship following on a change in the power of the engine. The formulæ developed from theoretical considerations are compared with experimental results obtained by the vessel *Patrie*; the agreement is satisfactory.—Pierre **Termier**: Remarks on the geological map of the Alps.—M. **de Forcrand**: The thermochemical study of some binary compounds of the metals of the alkalies and alkaline earths. A table is given, summarising recent determinations by various authors, giving the heats of solution and formation of the chloride, bromides, iodides, and fluorides of lithium, calcium, strontium, barium, sodium, potassium, rubidium, and cæsium, and some general conclusions are drawn based on these data.—Ernest **Esclangon**: A rotating governor for fixed or variable velocity. The method of regulation, described and illustrated, has been designed for the control of meridian and equatorial telescopes. It permits of easy regulation when in actual motion.—G. **Tzitzéica**: The W congruences.—Michel **de Domeczky**: The theory of symmetrical functions.—C. **Popovici**: Stable permanent movements.—Leinekugel **le Cocq**: The general theory of two indeformable suspended solids, from which are derived formulæ applicable to all systems of rigid suspension bridges.—O. **Boudouard**: The testing of metals by the study of the damping of vibratory movements. Details of experiments on specimens of iron and steel containing up to 1·0 per cent. of carbon, and the thermal treatment of which is exactly determined.—C. E. **Guillaume**: The definition of the practical electrical units.—A. **Lebedeff**: The extraction of zymase by simple maceration. A simple method is described of obtaining zymase not requiring the use of costly materials.—L. **Bruntz** and L. **Spillmann**: The physiological significance of the vital coloration of leucocytes. The so-called vital coloration of leucocytes appears to represent, as in phagocytosis, a defensive physiological action, and this general phenomenon is carried out both in vertebrates and invertebrates by identical processes.—Henry **Pénau**: The cytology of *Bacillus megatherium*.—D. **Roudsky**: The possibility of rendering *Trypanosoma lewisi* virulent for other rodents besides the rat.

NEW SOUTH WALES.

Linnean Society, November 30. 1910.—Mr. C. Hedley, president, in the chair.—Dr. R. **Greig-Smith**: The permanency of the characters of the bacteria of the *Bacillus coli* group. Twelve races of bacteria of this group, upon their isolation from rachitic stools, showed diverse cultural characters. They were cultivated for seven months, and again examined. The activities towards dextrose and mannit were found to be the most permanent. The permanency of the other characters was lactose, neutral-red, motility, milk, growth on gelatin, saccharose, the power of fermenting, which is easily acquired and presumably easily lost.—Dr. R. **Greig-Smith**: Contributions to our knowledge of soil fertility. Part i.: The action of wax solvents and the presence of thermolabile bacteriotoxins in soil. Water extracts from soil a substance which is filterable through porcelain and toxic to bacteria. The toxin is destroyed by heat, by sunlight, and by storage. It disappears from air-dried soil, and decays in aqueous solution. It is not destroyed by salts such as sodium chloride or potassium sulphate. Soils vary in the amount of toxin they contain, good soils containing less, poor soils more. The particles of soil are covered or "waterproofed" with soil-wax or "agricere," which consists of a mixture of saponifiable and unsaponifiable bodies. With the removal of the "waterproofing," the soil nutrients are more easily dissolved by soil water and attacked by bacteria.—W. W. **Froggatt**: Notes on fruit-flies (Trypetidæ), with descriptions of new species. Fifteen species, referable to the genera Ceratitis, Dacus, and Rioxa (Trypeta), are treated, including seven new.—T. G. **Sloane**: Carabidæ from Dorrigo, N.S.W. With an appendix: Tenebrionidæ from Dorrigo, by J. H. **Carter**.—W. M. **Carne**: Note on the occurrence of a limestone fauna at Grose Valley, Hawkesbury district.—R. J. **Tillyard**: Some remarkable Australian Libellulinæ. Part iii.: Further notes on *Camacinia othello*, Tillyard. The female, not before known, is described, and a figure of its wings given. The range of the species is extended from Cooktown to Torres Straits and Port Darwin. An intermediate form, from the Aru Islands, connects this species with the Malayan and East Indian *C. gigantea*, Brauer.—T. T. **Flynn**: Contributions to a knowledge of the anatomy and development of the Marsupialia. No. 1. The material investigated was furnished by an adult female Thylacinus with three advanced young in the pouch. The external features of the young are described, together with the genital organs of both the adult and the young.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 12.

ROYAL SOCIETY, at 4.30.—The Absolute Expansion of Mercury: Prof. H. L. Callendar, F.R.S., and H. Moss.—The Density of Niton (Radium Emanations) and the Disintegration Theory: Dr. R. W. Gray and Sir W. Ramsay, K.C.B., F.R.S.—The Charges on Ions in Gases, and some Effects that Influence the Motion of Negative Ions: Prof. J. S. Townsend, F.R.S.—The Distribution of Electric Force in the Crookes Dark Space: F. W. Aston.—The Measurement of End Standards of Length: Dr. E. P. Shaw.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—*Adjourned discussion*: Submarine Cables for Long Distance Telephone Circuits: Major W. A. J. O'Meara, C.M.G.

MATHEMATICAL SOCIETY, at 5.30.—A Property of the Number 7: T. C. Lewis.—A Mode of Representation of an Electromagnetic Field as due to Singularities Distributed over a Surface: Prof. H. M. Macdonald.—On the Fundamental Theorem in the Theory of Functions of a Complex Variable: Dr. W. H. Young.—On the Fundamental Theorem relating to the Fourier Constants for given Functions: Prof. E. W. Hobson.

FRIDAY, JANUARY 13.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Verification of the Centre Yard and Three Centre Feet on the R.A.S. Tubular Scale: H. B. Darling.—(1) Proper Motion of Small Star near 17 Lyræ; (2) Measures of a Faint Proper Motion Star: S. W. Burnham.—Periodic Discordance between the R.A's. of the Fundamental Catalogues and those of the Greenwich Standard Clock Stars: W. G. Thackeray.—Micrometical Measures of Double Stars: Rev. T. E. R. Phillips.—Observations of Halley's Comet: J. Tebbutt.—An Adjustable Compensation for an "Invar" Pendulum: R. Inwards.—A suggested method of Determining the Stellar Brightness of a Faint Comet: H. Knox Shaw.—(1) The Magnitude Equation of the Mean Greenwich Observer, from Comparison of Greenwich Standard R.A's. of Clock Stars for 1900 with Boss's Preliminary General Catalogue; (2) Standard Mean R.A's. of Clock Stars for 1860, based on 12-hour Groups from Greenwich Transit Circle Observations in 1853–67: W. G. Thackeray.—*Probable Papers*: The Bearing of the Principle of Relativity on Gravitational Astronomy: W. de Sitter.—Nova Lacertæ (Espin): F. A. Bellamy.

MONDAY, JANUARY 16.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The *Michael Sars* North Atlantic Deep Sea Expedition: Sir John Murray, K.C.B., and Dr. Hjort.

TUESDAY, JANUARY 17.

ROYAL INSTITUTION, at 3.—Heredity: Prof. F. W. Mott, F.R.S.

ROYAL STATISTICAL SOCIETY, at 5.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Dicussion*: (1) The Strengthening of the Roof of New Street Station, Birmingham; (2) The Reconstruction and Widening of Arpley Bridge, Warrington: W. Dawson.

WEDNESDAY, JANUARY 18.

ROYAL SOCIETY OF ARTS, at 8.—The Dutch Labour Colonies: J. C. Medd.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Ordinary Meeting.—At 7.45 Annual General Meeting.—Presidential Address: The Present Position of British Climatology: H. Mellish.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Presidential Address: Prof. J. Arthur Thomson.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, JANUARY 19.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Action of *B. lactis ærogenes* on Glucose and Mannitol. Part II.: G. S. Walpole.—The Pharmacological Action of South African Boxwood (*Gonioma Kamassi*): Dr. W. E. Dixon.—Autoagglutination of Red Blood Cells in Trypanosomiasis: Dr. W. Yorke.—The Transformation of Proteids into Fats during the Ripening of Cheese (Preliminary Communication): M. Nierenstein.—The Action of X-rays on the Developing Chick: J. F. Gaskell.

ROYAL INSTITUTION, at 3.—Recent Progress in Astronomy: F. W. Dyson, F.R.S., Astronomer Royal.

LINNEAN SOCIETY, at 8.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Research Meeting. Neolithic Villages in Thessaly: Messrs. Wace and Thompson.

FRIDAY, JANUARY 20.

ROYAL INSTITUTION, at 9.—Chemical and Physical Change at Low Temperatures: Sir James Dewar, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Modern Electrical Dock-equipment, with Special Reference to Electrically-operated Coal-hoists: W. Dixon and G. H. Baxter.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Design and Construction of Reinforced-concrete Arches: G. F. Walton.

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