THURSDAY, APRIL 14, 1910.

THE CLAIMS OF LONG DESCENT.

Vorträge über botanische Stammesgeschicte, gehalten an der Reichsuniversität zu Leiden. Ein Lehrbuch der Pflanzensystematik. Zweiter Band, Cormophyta Zoidogamia. By Dr. J. P. Lotsy. Pp. 902. (Jena: Gustav Fischer, 1909.) Price 24 marks.

THE expectations aroused by the first volume of this work, which dealt with the Thallophyta, will not be disappointed by that now issued, in which are included the liverworts, mosses, ferns and fern-allies, and also the seed-producing plants that possess ciliated male cells. In its wide compass are thus at the one extreme types of a very low grade of complexity, while at the other stands Ginkgo, long regarded as a true conifer. The endeavour to trace the ancestry of the types in this range of forms raises many of the most interesting and suggestive problems in systematic botany, towards the answers to some of which much progress has been made in recent years.

The contributions to their solution have been made in a literature so scattered, and in so many languages, that much of what has been published is difficult of access, and is apt to remain unknown to students; hence the gain is great when it is collected, analysed, and presented in clear and systematic form, especially when accompanied, as it is here, with an excellent bibliography and ample references to the original sources of information. Such a work as this must necessarily be very largely a compilation if it gives an adequate statement of the present state of knowledge and of the explanations put forward upon many disputed questions; but the author has added to its value by discussing these questions and stating the reasons for and against the solutions advanced.

While indication of relationships and of lines of descent is, as the title of the book implies, a prominent feature throughout, its scope is much wider than this, so that it is an admirable handbook to the study of the structure and life-cycles of the groups discussed in it.

In a brief review it is not possible to note more than a few of the many questions that arise in the consideration of the plants included in this volume. These plants agree in showing a cycle in which there is a marked contrast between the gametophyte and the sporophyte, or the x- and the 2x-generations, as Dr. Lotsy prefers to express them; and they also have the archegonium recognisable, though obscured among the higher forms. The two great divisions of Haploidales and Diploidales, characterised by the dominance of the x- and the 2x-generations respectively, express the recognition that recent discoveries have shown clearly the intimate relationships between the ferns and the seed-plants. After discussing the hypotheses with regard to the origin of the Haploidales and Diploidales, the author supports the view that they are derived by independent lines from Algæ of the group Isokonta. As to the origin of the antithetic generations in the cycle, he holds that the evidence does not warrant a dogmatic conclusion; but in discussing the homologies of leaf and stem in the Diploidales he inclines to Potonie's hypothesis that both represent specialised parts of a thallus, and may be homologous with one another. Among the Haploidales the evidence points more directly to the same conclusion.

The structure and life-histories of a typical moss and of a typical fern are set in contrast; and then follows a similar account of a very simple (? primitive) type of each, to ascertain in how far the supposed algal ancestry can be traced. Then follows a survey of the genera under each division, including every genus that shows features of importance or interest, morphological or biological; and not a few questions of wider than mere systematic value are discussed clearly and helpfully, as they arise in connection with certain forms, *e.g.* under Hepaticæ are discussed the suggestion that Anthoceros may represent a stage in the development of the sporophyte in Diploidales, the origin of the foliose habit, adaptations for economising water in various types, the influence of light on dorsiventral structure, &c. The wide range of structure and of adaptability among Hepaticæ is emphasised as in marked contrast to the relative fixity of type among the true mosses; but among the latter many features of biological import are duly noticed, such as the methods of vegetative multiplication, and their relation in frequency to the greater or less difficulty in securing the union of the male with the female cells.

The classification of the mosses into Acrocarpi and Pleurocarpi is held to be too artificial, as is also the importance attached to the rupture of the capsule in the normal manner by a lid, those forms in which the lid is not broken away being regarded as not forming a related group, but rather as aberrant from various families. Examples are quoted of very long-continued vitality in the spores of certain mosses, up to fifty years in a species of Œdipodium. The enlargement and flattening of the apophysis in Splachnum, and the growth of root-hairs from the seta in Eriopus, may be regarded as efforts on the part of the sporophyte to provide nourishment for itself; but they only emphasise the dependence of the sporophyte upon the gametophyte among the mosses.

In sharp contrast to them, in this respect, stand the vascular plants or Diploidales, although for a brief period, during early germination, the sporophyte fern is as dependent on the gametophyte for nutrition as is the moss-capsule. The dominance of the sporophyte becomes always more evident as the adaptation to life as land-plants becomes more complete, and as the dependence on surface-water to allow of fertilisation of the ovum is done away with, until in the Angiosperms it becomes difficult to trace the gametophytes with certainty, and the sporophytes appear to be themselves sexual, as was long the interpretation of the structure of flowers.

Dr. Lotsy gives a very helpful explanation of the discoveries that in recent years have thrown so much light on the affinities of the great divisions of the Diploidales, and have broken down the distinction between Phanerogamia and Cryptogamia, discoveries in which the English-speaking races have taken so great a part. It is now evident that the tendency to retain the megaspore within the sporangium, and to continue to nourish the gametophyte and also its offspring, the sporophyte, through the sporangium until the young sporophyte is provided with sufficient food in reserve to enable it to begin life on its own account with a fair prospect of success, resulting in the production of the seed, has originated in widely different types, and therefore on independent lines. Thus the true significance of the seed, as an adaptation to secure the fuller possession of the earth's surface, and to escape the dangers of dependence on water for the fertilisation of the egg-cell, has become realised. A new era in botany opened with the recognition of the common ancestry of ferns and cycads, based on similarities in their structure, by the discovery that supposed ferns of the Carboniferous strata produced true seeds resembling those of cycads in important respects, and on the not less startling discovery, which we owe to Japan, of the ciliated male cells in the pollen of Ginkgo and of the cycads. Of these and other great advances in recent years, such as in the knowledge of the Cycadeoidea, Dr. Lotsy gives a very clear account, which should be most helpful to students.

The vascular plants possessed of ciliated sperms, the Zoidogamia, he divides into two great groups characterised by the sperm-cells, which possess two cilia in the Lycopodineæ and their allies, and many cilia in the Filicineæ and seed-formers. He points out that this agrees with the groups based by Lignier on the structure of the leaves. Heterospory has been attained independently in several lines of descent in both these groups, and is thus no certain proof of close relationship among plants in which it occurs. His arrangement is in several respects a good deal different from that in use in English text-books, both in the relations of the larger divisions and in such minor details as breaking up Hydropterideæ and placing Marsiliaceæ beside Schizæaceæ, and Salviniaceæ beside Hymenophyllaceæ, among the leptosporangiate filices.

On similar grounds Selaginella is brought back to Lycopodiaceæ, while Isoetes is placed between the Equisetaceæ and Filices, because of its polyciliate male cells and of the development of its spores and embryo. The present state of knowledge with regard to the structure and life-histories of the Lycopodiaceæ and their allies is in striking contrast to that of not many years back; and of this advance the author gives a good account. The relations of the alliance to other groups can now be estimated in a truer light than was formerly possible. Though certain types within it had advanced far on the way to the formation of seeds, there is no clear evidence pointing to the descent from them of any existing seed-plants.

The lectures treating of the ferns and their allies are of very special interest, in view of the ever-increasing evidence connecting them with the descent of the seed-plants. While the progress during the past decade has been very great, and has revolutionised former beliefs, it has shown also that the production of seeds had already been attained at a period so far back in geological history as to make it very improbable that direct proof of the lines of evolution will be obtained. But while great problems will probably remain unsolved in detail, the general trend of progress has become evident, and there is reason to anticipate that the rate of advance will not slacken; though it seems scarcely likely that there can be many future discoveries so startling as those already alluded to.

The grouping of the leptosporangiate ferns takes full account of Prof. Bower's researches on the sporangia. The eu-sporangiate types, like the leptosporangiate, are derived from the Primo-filices, by separate lines of descent. The Pteridospermeæ are probably more nearly related to Marattiaceæ than to any other existing ferns, but over a very wide gap. The concluding lectures of this volume treat of the Cordaitales, Bennettitales, Cycadales living and extinct, and Ginkgoaceæ. They present subjects of extreme interest, and of the utmost importance in tracing the development of the higher plants.

Those who read this volume will feel that while it demands close attention, and while some of the lectures are of value for reference on subordinate groups rather than for questions of wider interest, the work well repays the attention necessary, and that the aim, kept steadily in view, has been successfully attained, to supply an unbiassed and worthy representation of what is at present known with regard to the groups of plants discussed. The information brought together within its compass has been gathered from a vast field; and the sources from which it has been taken are scrupulously indicated, as regards both text and the excellent and copious illustrations, which do much to aid the exposition, clear though that is. We cannot but feel that it is more useful in its present form, available to be read and re-read, than it could be as a course of lectures. It must prove a great boon to students desirous to obtain an adequate guide to the researches of recent years, in a form that can permit of use as a work of constant reference, from which they may gain wider views of the science of botany.

The third volume, on siphonogamous seed-plants, will be most welcome, though it can scarcely deal with subjects of such interest, or so full of the charm of advancing knowledge. The standard of the two volumes already published is a guarantee for the expectation that it will be a most valuable addition to every botanical library.

UTILISATION OF PEAT.

Commercial Peat: its Uses and Possibilities. By F. T. Gissing. Pp. x+191. (London: Charles Griffin and Co., Ltd., 1909.) Price 6s. net.

In this volume on peat, which is a companion one to that published in 1907 by Messrs. Björling and Gissing, the author's aim is the description, from a commercial point of view, of the various processes proposed for the utilisation of peat.

In pursuance of this object Mr. Gissing describes fully the preparation from peat of alcohol, moss litter, and paper, the cutting and drying of peat, and the manufacture of press turf and of machine turf, but the greater part of the book deals with the products got by the destructive distillation of peat.

The book is clearly written, contains many interesting illustrations, and, when taken in conjunction with Messrs. Björling and Gissing's work, forms a very complete descriptive account of the peat industries. Occasionally, however, the author, carried away by his enthusiasm for the utilisation of peat, refrains from directing attention to the more obvious defects in some of the schemes put forward, and leaves the capitalist in ignorance of facts which might materially alter the latter's relations to the projected industries.

The many attempts made within the past ten years to utilise our peat supplies have proceeded in three main directions, viz. the conversion of peat into fuel, the manufacture of power gas from peat, and the utilisation of peat fibres for the manufacture of paper, alcohol, moss litter, &c.

The chief difficulties attending the conversion of peat into fuel on a commercial scale are the removal of the large amount of water contained in freshly cut peat and the increase of the low specific calorific power, *i.e.* the calorific power of unit volume, of the fuel. The removal of the water by mechanical methods (hydraulic pressure, centrifuging, &c.), and also its removal by artificial heating, have been shown again and again to be unremunerative, and no process in which any of these methods forms a constituent part can, with normal prices prevailing for rival fuels, be regarded as economically sound. The only method for removing the water which has proved commercially successful is the method of air-drying employed by farmers for the production of their turf.

The specific calorific power of turf can be increased by converting the peat into press turf or into machine turf, but the difficulty of drying the product in a moist climate like that of Ireland, and the high cost of transport, render it unlikely that turf will displace coal as a fuel from any districts other than those in the immediate neighbourhood of peat bogs.

The manufacture of producer gas and its employment in industries such as the fabrication of glass, as well as the production of power gas and the recovery of the ammonia simultaneously formed, may under carefully selected conditions be made remunerative, but peat cannot, under any conditions likely to arise in the near future, become so cheap a source of energy as coal at the pit-mouth in England.

It is unlikely that the conversion of peat fibres into paper or into alcohol will prove successful commercially. From one ton of anhydrous, light, surface peat, by hydrolysis about 0·28 ton of reducing sugars can be obtained, and if the latter were all fermentable they would afford about forty gallons of alcohol. If this were the average yield of alcohol from peat the process would be very remunerative, but, unfortunately, about one-half the amount of sugars in hydrolysed peat consists of pentoses which are not capable of undergoing saccharomycetes fermentation, and consequently the yield of alcohol rarely exceeds twenty gallons per ton of dry peat; if surface peat is not employed in the manufacture, the yield may fall so low as five gallons per ton. If the yield of alcohol from a given specimen of peat falls below sixteen gallons per ton, the manufacture of "peat spirit" will be unable to compete with that of "potato spirit" owing to the greater value of the by-products in the latter industry. The peat moss-litter industry, on the other hand, is from the commercial point of view the most flourishing of all the peat industries, and is likely to prove as remunerative to the capitalist in the future as it has been in the past.

HUGH RYAN.

THE HEALTH OF THE SCHOOL CHILD.

The Hygiene of School Life. By Dr. Ralph H. Crowley. Pp. xiv+403. (London: Methuen and Co., 1910.) Price 3*s*. 6*d*. net.

IN his preface to this work the author states that it was written while he was medical superintendent to the Bradford Education Authority, and that the conclusions arrived at and the measures advocated are based upon his own practical experience gained amongst the schools and school-children of that city. He furthermore states that the views expressed receive no added sanction from the fact that he now holds an official position in the Medical Department of the Board of Education. Although this may be so, it seems as if his present position is responsible (through the official non-committal attitude it has engendered) for the one outstanding deficiency of the book, namely, a lack of definiteness and of detail. For instance, one who consults a manual upon the hygiene of school-life might reasonably expect some definite directions upon the cleansing and disinfection of school premises; the measurements of seats and desks for children in different age groups, with the appropriate slope of desks for reading and writing purposes; the distances recommended between the hanging-pegs of cloak-rooms; but in these respects, as in so many others, he will find but generalities. Indeed, generally speaking, the work is sketchy, and requires the addition of fuller and often more definite information to become a useful addition to the already voluminous literature upon the subject of school hygiene.

It need scarcely be said that the matter given and the views expressed by one with the experience and knowledge of Dr. Crowley are sound, and that certain parts of the work reach a good standard of merit; more especially is this true of the chapters upon special groups of school-children. The chapter upon medical inspection of the child in the school is also very good, and it impresses upon the reader the fact that medical inspection, and all that it involves, has a part to play now and in the future, the importance of which can hardly be over-estimated. As Dr. Crowley states in his introduction, it is a service which stands out clear and well-defined, demanding of the medical men and women who perform it the highest qualifications and attainments. While essentially a part of the public health service, it is nevertheless a department which can never know its own full development until it recognises itself as a part of the whole public health service of the country, and links itself up and has an organic relation with that service. Although it is some sixty years ago since a certain measure of medical inspection of school-children was initiated in Paris, and Great Britain has been so slow to adopt a provision the value of which has been appreciated by many other countries for many years, the work has been started in this country with such zeal and enthusiasm that we promise very shortly to have established throughout these islands a scheme which will compare favourably with that of any other country. But it is essential to the best results that there should be a better knowledge of the demands of school hygiene among medical men who are called upon to work in connection with the schools, and also among the teachers; and suitable manuals upon this subject are therefore of great value and importance. The present work is so suitable in many respects that it is to be hoped that in a future edition more explicit information upon many of the practical details of school hygiene, which are wanting in the present volume, will be included.

MODERN SCHOOL GEOGRAPHY.

(1) *Narrative Geography Readers.* By G. F. Bosworth. Book i., pp. viii+133; book ii., pp. viii+145. (London: Macmillan and Co., Ltd., 1910.) Price 1*s.* each.

(2) *A Systematic Geography of Europe.* By G. W. Webb. Pp. viii+96. (London: Methuen and Co., 1910.) Price 1*s.*

(3) *Narratives Selected from Peaks, Passes and Glaciers.* Edited by G. Wherry. Pp. iii+156. (Cambridge: University Press, 1910.) Price 1*s.*

(4) *Cambridge County Geographies: Cheshire.* By T. A. Coward. Pp. x+207+maps. (Cambridge: University Press, 1910.) Price 1*s.* 6*d.*

(5) *An Elementary Practical Geography for Middle Forms.* By F. Mort. Pp. 91. (London: Blackie and Son, Ltd., 1909.) Price 2*s.*

(6) *A School Economic Atlas.* By Dr. J. G. Bartholomew, with Introduction by Prof. L. W. Lyde. Pp. xii+64. (Oxford: The Clarendon Press, 1910.) Price 2*s.* 6*d.* net.

A SET of new school books in geography suggests the possibility of finding from an examination of their contents the main lines along which instruction in this subject is tending at the present time to crystallise.

With a single exception the books named above differ considerably from those in school use ten to fifteen years ago: they suggest development in three directions, the first being that of the story told to beginners, the others, for older pupils, being the scientific methods of actual investigation by the pupil from the raw material of geographical records, and of considering the results of special study as placed together in a monograph, if such a word may be used in this modest connection, or of considering the actual experiences described by the traveller.

The single exception, Mr. Webb's "Systematic Europe" (2), recalls the old type of text-book, with its tit-bit collection of facts, of which the following is a specimen:—"Elche is famous for its date palms" (p. 32). Less than one-fifth of the book is given to a general survey of the Continent, and the remainder is a fairly systematic treatment of the separate countries. Many of the facts seem to be unimportant; others are such as a good pupil might reasonably be expected to find out for himself from a modern atlas, provided he had had some little training in investigation. The attempts in the large-type matter to trace causal connections are not always happy, as, for example, in regard to the Gulf Stream, which is described as washing the western shores of Scandinavia, and to the Föhn effect, which is called a wind.

The "Narrative Readers" (1) set forth, in the first place, facts concerning the lives of children in other lands, and from the stories of their habits and surroundings the author passes to the stories of such interesting things as the whale fishery, Captain Cook's voyages, or the mutiny of the *Bounty*. The child is frequently referred to an atlas, but it would probably be better if the reference were to a globe which could be presented as a model of the earth.

At a certain stage of development it is more important that the child should be able to do things for himself than that he should memorise facts presented to him by an adult; and it is probable that no school subject provides a means for work of this nature so easily and so universally available as geography, hence the development of practical work in this subject. For this the main requirement is a good atlas, and the Clarendon Press is to be congratulated that the first venture in the provision of an atlas is one so likely to be largely adopted as the one under review (6). The child who works through the ample supply of material in the spirit outlined in Prof. Lyde's introduction will be well equipped as a thinker in terms of geography. From the point of view of scientific accuracy it would perhaps be helpful if some numerical values were added to the statistical diagrams relating to the main products of economic importance, and also that the values given should be either triennial or quinquennial averages; possibly future editions will be improved in these directions. Many additional facts are given in the introduction in a concentrated and technical language, presumably for the benefit of the teacher.

Before such an atlas can be used the pupil should have had some preliminary training in the making of similar maps, and for this purpose are provided for schools those books of practical geography of which Mr. Mort's is one example. Although it deals with contouring, with climate, and with vegetation, this book illustrates markedly the indefiniteness of the boundaries of school geography, for some of the earlier work suggested should probably be called observational nature-study, while much of the plane-tabling is surveying work which would, to many teachers, appear to be beyond the scope of a school course. Mr. Mort's book is not entirely "heuristic," as he tells many facts which the pupil might be expected to find out for himself.

It is not possible in practical exercises of this nature to cover the entire ground of geographical studies, and therefore the pupil is provided with two other kinds of text for reference or special study. The first contains narratives by actual travellers, such as those edited by Mr. Wherry (3); these can be used as school readers, or can be set for home reading; this particular set deals with early climbs in the Alps. The second kind takes the form of a special study of a limited area, and the volume on "Cheshire" (4) illustrates the way in which the pupil may be brought into touch with the work of a specialist; such books should be in the geographical reference library. These works appear to typify the best efforts of modern teachers of geography.

B. C. W.

ELECTRICAL ENGINEERING.

(1) *Electrotechnics.* By Dr. John Henderson. Pp. xiv+165. (London: Longmans, Green and Co., 1909.) Price 3*s.* 6*d.*

(2) *Practical Testing of Electrical Machines.* By L. Oulton and N. J. Wilson. Pp. vi+210. (London: Whittaker and Co., 1909.) Price 4*s.* 6*d.* net.

(1) THE efficient organisation of students' work in an electrical engineering laboratory is a difficult task, and especially so with large elementary classes. Advanced students may be trusted with delicate instruments and left to arrange the necessary connections by themselves, they require little supervision, and as their number is small this is easily given. With elementary classes the case is different. It is obviously impossible to let all the men do the same tests simultaneously, since that would require multiplication of apparatus beyond the financial capacity of most institutions. Hence tests of different kinds must go on at the same time, and since the demonstrator cannot personally supervise every one of these different tests from its beginning, it is important that the students should get very clear instructions in print. It is also important so to arrange the tests that they shall, with students of average ability, take about the same time, and to arrange the work generally with the precision of a railway time-table, because otherwise students will drop out of their order and fail to get the full benefit of the course. All this, and the necessity to adapt the work to the class of students attending and to the equipment which happens to be available in any particular institution, tends to make the instruction somewhat cut and dried in character, and this is likely to detract from its educational value.

The author, who has evidently experience of these difficulties and the way to make the best compromise possible between conflicting requirements, has, in the third volume of this series of physical and electrical engineering laboratory manuals, given us an excellent guide to laboratory work of this kind. He does not believe in the use of special apparatus, but very rightly teaches his students to make the tests in the laboratory very much in the same way that they will have to adopt when they get into practical life, that is, by the use of ordinary commercial instruments. He also adopts the principle that tests must be so arranged that only two, or at the outside three, men are necessary for any one test.

The subject-matter is divided into three parts, which roughly correspond to the City and Guilds of London syllabus for the "elementary stage" and the "ordinary grades" of direct and alternating current engineering. We thus get in the first part Ohm's law, the Wheatstone bridge, calibration of instruments, fuse testing, some simple magnetic tests, and experiments with a small motor. In the second part we come to heating of wires, potentiometric measurements, more advanced magnetic testing, characteristics of dynamos, secondary batteries, photometry, losses in dynamos, and so on. The third part deals mainly with the fundamental relations of alternating currents, graphic methods of representing these, and some very simple tests on alternators. Transformers and motors are not dealt with.

In an appendix are given mathematical and physical tables which will be found very useful, not only by the student, but also by the practical engineer. So far as the student is concerned, some of these tables should bring home to him a sense of reality of his work. Students are apt to consider their class-work as something purely scholastic and detached from practical life. If, then, a student, after having in his work found some physical fact such as the fusing current of a certain wire, the E.M.F. of a given cell, or the power per candle required by, say, an Osram lamp, and then turns to the tables at the end of this book to see how his determination agrees with the figures there given, he must get the impression that what he has done in the laboratory has practical importance, and this conviction will give him additional interest and pleasure in his work.

(2) This book is intended as a guide in testing electrical generators and motors. In the preface the authors point out that it is impossible to give "all the theory that the subject entails," and that the reader must therefore also consult some of the many text-books. This is obviously right; nobody can expect to find in a book which is primarily an instruction how to test the whole of the theory of electrical machines, but some fundamental theories must be given, and in this respect the book falls short of what the reader has a right to expect. The authors give some sort of theory, but it is neither closely reasoned nor always clearly expressed. The latter defect may to some extent be due to their adoption of some terms which give one the impression of being a kind of technical jargon employed in a particular shop or laboratory, though not generally found in scientific books. For instance, if we are told to take a "locked saturation" it is not immediately obvious that we have to determine the relation between starting torque and voltage of an induction motor; nor is it very clear what a "pressed down reading on the scales with the power off" might mean. On p. 34 we read that "C.B. is the leakage current and proportional to the current in the motor." Further that it is "required to overcome the counter E.M.F. due to leakage."

These are of course merely unfortunate ways of expressing certain ideas which the authors have correctly in their minds, but it is irksome for the reader to have continuously to exercise his ingenuity in order to find out what it is the authors really mean. In some cases this task looks almost hopeless, as, for instance, when on p. 7 we find that for a star-connected motor the "total current" is $\sqrt{3}$ times the current per phase, and on p. 8 we read that the "total current" is $\sqrt{3}$ times the "current per terminal." What the authors may mean by their term "total current" is not otherwise explained, and the reader can only surmise that it is merely a conventional way of introducing a current which is proportional to the line current. The introduction of such a conventional term is, however, quite unnecessary, as is also the introduction of the term "apparent efficiency" (p. 30), which has no physical meaning, since it is the ratio of voltamperes, which is not power, to watts, which is power. The authors also distinguish between "real horse-power" and "brake horse-power," and thus give the reader the idea that brake-power is not real power, whereas they merely mean to distinguish between the electrical power input and the mechanical power output of a motor. This is quite clear from the text, but why puzzle the reader by using new or misapplying old terms?

The efficiency tests described are all direct, that is to say, input and output are measured and their ratio calculated; the authors think this less inconvenient than some method of determining efficiency by the measurement of lost power, or, as they call it, the "loading back" method. This may be true so long as one has to deal with very small machines, but most practical engineers prefer to test large machines by some differential method. One counsel given by the authors should be followed in testing every kind of machine, namely, to plot results as the test proceeds, so that doubtful observations may be eliminated before the test is finished and the apparatus dismantled. The tests described comprise a 50-horse-power induction motor, a 500-kilowatt generator, a 300-kilowatt rotary converter, a 75-horse-power single-phase railway motor, a 450-kilowatt direct-current generator, a 40-horse-power direct-current motor, and an enclosed railway type of motor of only 12 horse-power. These tests are explained very fully, and the results are given in tables and curves, which are carefully compiled. The reader having once accustomed himself to the authors' peculiar nomenclature (such as "rack" for rheostat, and the terms alluded to in the first part of this review) will find no difficulty in following the sense of the text, and will derive some benefit from the book by following the examples given if he has to make similar tests.

Gisbert Kapp.

THE PHYSIOLOGICAL ANATOMY OF PLANTS.

Physiologische Pflanzenanatomie. By Prof. G. Haberlandt. Vierte neuarbeitete und vermehrte Auflage. Pp. xviii+650. (Leipzig: W. Engelmann, 1909.) Price 19 marks.

THE first edition of Prof. Haberlandt's well-known work appeared in 1884, so that (as the author points out) it has already reached a respectable antiquity, as the age of scientific text-books is reckoned. But, even before 1884, Haberlandt was beginning to be known for researches of a kindred sort, *e.g.* in the protective adaptations in seedlings (1877), and on the relation between structure and function illustrated by the assimilatory tissues (1880). By persistent work in this general direction he has made himself the recognised authority on "physiologische Pflanzenanatomie." Haberlandt dedicated his first edition "mit dem Ausdruck freundschaftlicher Verehrung" to Prof. Schwendener.[1] This was appropriate, because it was Schwendener, in his celebrated work, "Das mechanische Prinzip, &c.," who "raised anatomico-physiological research above the level of casual tentative experiment, and marked it out, once for all, as a definite department of science."[2]

Structure in relation to function is an old subject of inquiry, but it was pursued on theological rather than on scientific lines before the publication of the "Origin of Species," and Haberlandt's work is the direct outcome of that book. At first, however, adaptation was principally studied in the external characters serving for fertilisation, dispersal of seeds, &c. The meaning of histological peculiarities was neglected, or strangely perverted, as, for instance, in the comparatively recent dogmas that vessels do not serve as water-pipes, or stomata for gaseous exchange. Schwendener's work showed, in the most unexpected and brilliant way, the value to the plant of such a neglected point as the sectional outline of its mechanical tissues. After this the study of adaptation could not be confined to obvious macroscopic points, and Schwendener's work led up to the classification of tissues according to their physiological character, which forms the basis of Haberlandt's book.

Since the first edition (1884), Haberlandt's book has flourished and increased, as may be shown by the simple process of counting the pages. Edition i. contained 398 pp.; edition iv. 650 pp. Edition i. had 139 figures in the text, and these have increased to 291. This represents the legitimate growth of the subject, and it is to be noted that Haberlandt, from the extent of his own work, is well fitted to make use of the researches of others. Huxley has well said that only a man who knows the raw material of science at first hand can judge of the amount of "speculative strain" that the elements of a given problem will bear. It is this sort of knowledge that makes Haberlandt an admirable critic and exponent of the work of others.

If we compare the present volume with the first edition, the most striking point in which the modern book differs from its ancestor is the presence of a chapter on sense-organs." Botanists will be glad to have, in a compass of 50 pp. or so, a full discussion of the scattered controversies on this subject. Haberlandt's statolith theory of the sense-organs for the perception of gravity, and of the lens-function of the epidermis in relation to heliotropism, are the most speculative of his views, and are by no means universally accepted, but the most sceptical can hardly refuse to admire the skill with which these exciting hypotheses are upheld.

F. D.

[1] The present dedication bears the additional words "on the completion of his 80th birthday."

[2] Haberlandt's preface to his first edition, p. viii.

OUR BOOK SHELF.

The Fauna of British India, including Ceylon and Burma. Edited by Dr. A. E. Shipley, F.R.S. Dermaptera (Earwigs). By Dr. Malcolm Burr. Pp. xviii+217; 10 plates. (London: Taylor and Francis; Calcutta: Thacker, Spink and Co., Ltd., 1910.)

This half-volume is the first addition to the "Fauna of India" published since the regretted death of Col. Bingham; and Dr. Shipley, the new editor, reviews the arrangements made for forthcoming volumes in progress.

Dr. Burr, since the death of De Bormans, has made himself the recognised authority on the small and hitherto somewhat neglected order Dermaptera or Euplexoptera, often treated as a family (Forficulidæ) of the Orthoptera, and is at present engaged on a monograph of the earwigs of the world, of which the present volume may be regarded as an excerpt.

It is not many years since the total number of Forficulidæ described from all parts of the world was less than a hundred. Earwigs are not insects that are assiduously collected, or always easy to find, if not specially searched for; but in the present work Dr. Burr enumerates 135 species for British India alone, divided into 51 genera, 14 subfamilies, and 5 families. He treats the earwigs as a distinct order, under the name Dermaptera.

The author's preface relates chiefly to types, and to the various sources supplying material for this work. By an oversight, the British Museum, to which Mr. Burr has always had free access, is not alluded to in this connection, though in the table of species at the end of the introduction a column is devoted to indicating those in the national collection. The main part of the introduction is devoted to structure and habits, and is of great value, and the bibliography is also tolerably full; but we notice one extraordinary error under Westwood—"Rözel's Himalayas" for "Royle's Himalayas."

The technical part of the work is executed in the usual manner of the "Fauna Indica." The appendices offer us instructions for collecting and preserving earwigs; abbreviations of authors' names; and a useful glossary of terms. Of the ten plates, the tenth only is in colour; and there are sixteen text-figures representing various structural details.

Longmans' Wall Pictures. Flowers, Butterflies, and Moths. By Archibald Thorburn. Ten plates, each plate 2*s*. 6*d*.; set of ten plates in portfolio, 1*l*. 10*s*.

Descriptive Notes for Teachers, for use with Longmans' Natural History Wall Pictures. Notes on Flowers. By C. J. Longman. *Notes on Butterflies and Moths.* By W. S. Furneaux. Pp. 30. (London: Longmans, Green and Co., 1910.) Price 6*d*.

The attractive set of wall pictures published under the above title consist of ten coloured plates, reproduced from water-colour drawings by Mr. A. Thorburn. On each plate, measuring 18 inches by 14 inches—with the cardboard mount, 25 inches by 20 inches—two plants and two butterflies or moths are depicted. The series follows a monthly sequence according to the appearance of the butterflies and the flowering of the plants; one plate is allowed for April and May, and two plates for each month from June to September. So far as the plants are concerned, an ecological basis also exists; thus the April flowers, the primrose and bluebell, are denizens of woodland, the poppy and bluebottle are agrarian, and the purple loosestrife and water-mint are typical marsh plants. The butterflies represented are Fritillaries, Blues, Peacock, Red Admiral, and other common species. The pictures are very effective, as Mr. Thorburn has combined artistic rendering and setting with correct form and colour of the plants; the reproduction, too, is fully satisfactory, so that they form a most decorative series, eminently suitable for display in class- or schoolroom.

The descriptive notes to accompany the plates are useful, especially the descriptions supplied by Mr. Furneaux of the caterpillars which are not illustrated. The botanical notes present the systematic position of the plants, but do not sufficiently emphasise the ecological aspect; there is also correction required in the explanation of radical leaves and flowers.

Formation of Character. By Rev. J. B. S. Watson. With a Preface by Rev. G. P. Merrick, and a Foreword on Industry by Andrew Whitlie. Pp. 115. (London: H. R. Allenson, Ltd., 1908.) Second edition. Price 1*s*. 6*d*. net.

This handy little volume consists of pithy and stimulating addresses on such subjects as courage, temperance, industry, reverence, and the like. The author is chaplain of H.M. prison at Brixton, and has had exceptional opportunity for observing the disastrous result of lack of moral discipline and deliberate character-training in youth. He is strongly of opinion that between instruction in "religious knowledge" and the usual branches of secular education, instruction in manners and morals is apt to be neglected. Mere stuffing with knowledge is not culture, and the "religious" knowledge is too often a dead and dry acquaintance with almost meaningless metaphysical formulæ. There is much to be said for the contentions of the Moral Instruction League. Character is the important thing—not creed or dogma.

The book is just the thing to put into the hands of boys and youths, and will be interesting and helpful to teachers also. It contains a short preface by the Rev. G. P. Merrick (formerly Chaplain-Inspector of H.M. Prisons), and a foreword on industry by Mr. Andrew Whitlie, of the Commercial Bank of Scotland, London. A thousand free copies have been distributed to sailors by the chaplain of the Port of London, thanks to the generosity of T.R.H. the Prince and Princess of Wales and other subscribers.

Simple Jewellery; a Practical Handbook dealing with certain Elementary Methods of Design and Construction, written for the use of Craftsmen, Designers, Students, and Teachers. By R. Ll. B. Rathbone. Pp. xiv+280. (London: Constable and Co., Ltd., 1910.) Price 6*s*. net.

This is a useful manual which cannot fail to prove of great service to amateurs. It is mainly devoted to describing the methods of designing and making gold and silver ornaments from grains and wire, both round and flattened, nearly a hundred illustrations of such designs being given. Artistic questions chiefly occupy the attention of the author, but we notice some judicious remarks on the employment of acids in "pickling," while the instructions in the methods of using the blowpipe in "soldering" are very detailed and practical, being based on scientific principles.

Le Tremblements de Terre. By Dr. G. Eisenmenger. Pp. 187. (Paris: F. Alcan, n.d.) Price 60 centimes.

Some recent earthquakes, such as those of San Francisco, Valparaiso, Messina, and Provence, are described in vivid and popular language. The phenomena of earthquakes, their classification, causes and distribution, and the possibility of predicting their occurrence, are briefly considered. A book so cheap as this, if the facts were accurately given, would be useful at a time when the interest in earthquakes has become general.

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.*]

Colour of Water and Ice.

I HAVE read with much interest Sir Ray Lankester's letter on the colour of water in NATURE of March 17. I remember discussing this same problem in the case of ice with Sir Joseph Thomson when we stood at the foot of the great glacier at Glacier, B.C., during the western excursion of the British Association last summer. The rich blue colour of the hard, clear ice was remarkable, even in quite small pieces. The same blue colour is noticed when surface-ice, which has been formed slowly by conduction, is taken out of the St. Lawrence River. The blocks lose their colour when they are exposed for long to the light, and especially rapidly when exposed to sunlight. Coloured sediment and air cavities in the ice detract from the colour. I am inclined to believe that the colour of ice is a real absorption effect, due to the large molecular aggregates forming the structure, which absorb the long rays, and not a "blue sky" effect, as I suggested after seeing the blue ice of the glacier.

In the case of water, all the physical properties indicate the presence of complex molecular aggregates in solution, which become gradually reduced in number as the temperature rises. Thus the variation of specific heat, of density, of viscosity, and compressibility, all disclose an effect due to a gradual diminution of the molecular aggregates. I believe these are the same as the ice molecules, and constitute the absorbing medium which gives water its blue colour. Sea-water is particularly blue, and here we probably have added the effect of the salt molecules, in addition to the fact that the water is very clear.

Mr. W. H. Sherzer has shown (Smithsonian Report, 1907) that the blue colour of the water and ice of the glaciers of the Canadian Rockies is a real absorption effect. The blue colour is increased by the presence of minute white sediment, but not by coloured sediment.

If it has not been already tried, it would be very interesting to see what effect temperature has on the greenish-blue light transmitted through very pure water. If the colour is due to the presence of ice molecules, it should grow less as the numbers are reduced. I cannot help thinking of the beautiful blue colour of liquid air as soon as most of the nitrogen has boiled away; if this were due to the presence of complex oxygen molecules, such as ozone, it would be somewhat similar to water.

H. T. BARNES.

McGill University, Montreal, March 29.

Centre of Gravity of Annual Rainfall.

THE question whether Mr. Cook's suggestions in NATURE of March 31 have a practical value can be very simply settled. It is proposed to consider the month to month rainfalls at a place as a series of parallel forces, $p_1, p_2 \ldots p_{12}$, say, where the distance (X) from the beginning of the year of the corresponding "centre of gravity" is given by

$$X = \frac{p_1 + 2p_2 + \ldots + 12p_{12}}{p_1 + p_2 + \ldots + p_{12}}.$$

Now, if we assign arbitrary values to any ten, say, of the p's (and these ten p's could be selected in sixty-six ways), then, the position of the C.G. remaining the same, we have obviously a single linear equation in two variables to give us the values of the two remaining p's, and this equation can be solved in an infinite number of ways. Thus the same C.G. can be given by an infinitely varied arrangement of sizes of the p's, and therefore its position gives no indication whatever of the monthly distribution of the rainfall of the places referred to.

To illustrate by three simple examples. The absolute value of the elements is of no importance, and taking for convenience a rainfall of 36 inches, we might have the three following distributions:—

	A in.	B in.	C in.
January	3	0	12
February	3	0	4
March	3	0	2
April	3	6	0
May	3	6	0
June	3	6	0
July	3	6	0
August	3	6	0
September	3	6	0
October	3	0	2
November	3	0	4
December	3	0	12
Total Rainfall	36	36	36
C.G.	6·5	6·5	6·5
Rainfall Moment	234	234	234

Thus A, B, and C have the same annual rainfalls, the same C.G., and the same "rainfall moment." The question whether or not the seasonal distributions correspond to those of actual places on the earth's surface is not to the point, though, as a matter of fact, C approximates to the typical Levantine curve.

Thus places with very different rainfall distributions may have the same C.G. and the same rainfall moment, and the proposed method of comparing the rainfalls of various places appears to have neither a theoretical nor a practical value. The method may possibly have a certain critical value in comparing the yearly variations at a particular place, where there is but little change in type from year to year, and especially in such a country as India, where the seasonal rainfalls are exceptionally well marked; but this seems doubtful, and in any case the method could be used only in conjunction with the actual monthly values.

ANDREW WATT.

Scottish Meteorological Society, Edinburgh, April 6.

Certain Reactions of Albino Hair.

UNDER this heading in NATURE of March 24 (p. 96) Miss Igerna Sollas referred to some experiments of mine upon the hair of albino rats, in which she failed to obtain one of the reactions described in my note (Proc. Physiological Soc., March 27, 1909). It is, of course, not improbable that different albino rats may carry different chromogens, and that some of them may lack the one which, when oxidised with H_2O_2, gives a brownish colour. On the other hand, the failure may be due to the presence of some of the formalin, which may not have been completely washed away from the previous reaction.

There is one new observation which I should like to record here, since it bears upon the H_2O_2 reaction. The action of H_2O_2 is an oxidising one, and the production of a brownish tint may be interpreted as due to the oxidation of a colourless chromogenous body present in albino hairs. If this interpretation is right, other oxidising agents should produce a similar tint. During November of last year I casually placed two dead albino rats upon the top of one of my cages, these latter being kept out of doors. The rats were forgotten, and left exposed to the air for about a fortnight. During this interval the weather had been wet and warm for the time of year. Upon discovering them at the end of this interval, I noticed that on both rats the upper side, and part of the belly and back, had assumed the same sort of brownish tinge that H_2O_2 produces. The under side of both rats, which had been protected from the wet and light by its contact with the cage, was quite white. It thus seems possible to oxidise the chromogenous substance ostensibly present in albino rats by the oxygen of the air in the presence of continuous moisture. I do not think that light played much part in the reaction, since throughout this period it was very dull weather.

The mention of light brings me to another point in Miss Sollas's note. She says that prolonged immersion in the formalin fluid results in the destruction of the colour. I am inclined to think that this destruction does not depend upon the solution, but is due to the action of light. I noticed the same thing in my experiments; but, in addition, I was enabled to observe—because I kept my rats in flat vessels standing on a *blackened* bench—that it was only the upper surfaces exposed to rather bright sunshine that thus faded. The under surfaces remained as brilliant a yellow as before. To confirm this conclusion I placed all my rats, still immersed in the solution, in a dark cupboard, and the partially faded colour somewhat returned, but not, I think, quite to the same intensity as originally. So long as I kept them in the dark the colour was retained. Whether this would be so indefinitely I should not like to say; but certainly it lasts for several months.

The yellow tinge assumed by some albino rats is, I think, not a phenomenon of light action, as Miss Durham, quoted by Miss Sollas, seems to imply, so much as one due to age. It is possibly a manifestation of diminished metabolism and lessened oxidation. Of the several hundred albino rats which I have bred, I do not remember any within their first year showing this yellow tinge, while it has been a frequent observation that old rats (after about the first year), though they were kept in semi-darkness, manifested a very obvious yellow colour. I do not wish to commit myself to this as a positive statement, for I made no scientific records of the matter. I am speaking from general impression alone; but it is certain there is a marked contrast between the pure white hairs of young rats, about six to eight weeks, and those of some twelvemonth or older rats, all living under the same conditions as regards light.

With regard to Miss Sollas's experiments with the skins of guinea-pigs and with that of a single mouse, there are several considerations of interest that suggest themselves. Miss Sollas found, as I did, that albino mice give a negative result with formalin; but I subsequently found (Proc. Physiological Soc., October 23, 1909) that if piebald mice are treated with 5 per cent. nitric acid in 75 per cent. *spirit* and are placed in the dark, in about five days most of the white areas of the pelage turn to a beautiful rose-pink colour. The same is true of albino mice. These experiments were performed in the summer; but during one cold week last winter I repeated the experiment on a single black piebald mouse, and the colour-reaction failed to appear. Upon placing the vessel containing the solution and mouse in an incubator at 102° F., the rose-pink colour appeared. The dependence of this colour-reaction upon temperature is confirmatory evidence that the phenomenon is one of ferment action.

It would be interesting to see if guinea-pig skins, which fail to respond to the formalin reagent, would do so with the nitric acid.

GEO. P. MUDGE.

Biological Department, London Hospital Medical College, E.

The Electrification of Insulating Materials.

SOME time ago, while endeavouring to get a trustworthy method of producing static charges in a humid atmosphere, I had occasion to experiment with celluloid. Rolled celluloid sheet with the surface burnished was found very suitable. If a "tassel" be made of this material by cutting up a small piece of thin sheet into narrow strips, then by simply placing the "tassel" on a table and stroking with the fingers, strong electrification is produced. On raising the "tassel" the strips diverge, and remain divergent in a most striking manner.

A further curious effect was observed, that if two narrow strips of celluloid were rapidly pulled between the fingers they were both electrified, one of the surfaces in contact being positive, the other negative. At first no consistent results were obtained that might lead to an explanation of the phenomenon; some found the top strip always positive, some the bottom strip when the pieces were held horizontally. Later, however, Mr. M. McCallum Fairgrieve, of Edinburgh Academy, noticed that the order of electrification depended on whether the strips were bent upwards or downwards when pulled in a horizontal direction through the fingers. This seems to be the true explanation. Of the surfaces in contact, one is in compression, the other in tension; with celluloid the compressed surface is always negatively, the stretched surface positively, electrified. The effect is very apparent if the two strips are pulled slowly between the first finger and the thumb, and the strip in contact with the thumb will be + or − according as it is concave or convex to the thumb.

Of other substances investigated, paper, vulcanite, and shellac have the same property, and mica to a lesser degree.

I propose to investigate the phenomenon further, particularly with relation to electrification by compression and cleavage. In the meantime, I have made a small electrical machine in which three endless bands of celluloid run over pulleys. Suitable collectors are provided, and considerable + and − charges may be obtained. The charges are no doubt produced by the combined pressure and bending, as already explained.

WALTER JAMIESON.

Provanside Higher Grade School, Glasgow.

Effect of Varying Temperatures upon the Colour and Growth of Fur.

THE following may be of interest to readers of NATURE. Some time ago an ordinary all-black cat was accidentally shut up in a refrigerating chamber on one of the Orient Line mail steamers when the vessel was in Sydney Harbour. The chamber was not opened until the ship was off Aden, which is about thirty-two days out. When the cat was brought out it was scarcely recognisable. Its coat had become long and thick, and the fur on its back was nearly white. It had lost one ear through frost-bite.

The change in the cat's environment from the intense frost of a refrigerating chamber to the intense heat of the Red Sea was accompanied by a rapid change in the cat's appearance. The heavy white coat rapidly fell out, and by the time the ship reached London the cat had practically regained its normal appearance.

I did not see the cat, but have inquired carefully into the statements, and have had their truth vouched for by one of the directors of the Orient Company.

A. CAMPBELL GEDDES.

Royal College of Surgeons in Ireland, Dublin,

April 6.

April Meteor Showers.

IN the present year there is likely to be a greater amount of meteoric activity about April 18–19 than, as might be expected, a few days later. There will then be an interval of quiescence until April 26. Between the latter date and the end of the month several important displays become due. The following are details of the most interesting showers, as calculated by the writer, that occur during the period April 12–30:—

Epoch April 19, 14h. 30m. (G.M.T.), shower of second order of magnitude. Principal maximum April 18, 22h. 18m.; secondary maxima on April 19 occur at 1h. 12m. and 9h. 25m.

Epoch April 27, 21h. 50m., shower of twenty-third order of magnitude. Principal maximum April 26, 16h. 26m. On April 26 there are also secondary maxima at 5h. 20m. and 18h. 55m., and another on April 27, 6h.

Epoch April 28, 11h. 15m., shower of fourteenth order of magnitude. Principal maximum April 30, 4h. 25m. There is a secondary maximum on April 28, 17h. 30m., and two others on April 29, at 12h. and 20h. 20m.

Epoch April 29, 12h., shower of fourth order of magnitude; the principal maximum becomes due about April 28, 12h.

While there are three meteor showers that fall between April 26 and the end of the month, there is only one of any importance during the period April 12–25. In some respects this earlier isolated display is the more interesting, however, owing to its being of greater intensity than the others, and of a somewhat different character.

Dublin. JOHN R. HENRY.

THE BASUTO.[1]

SIR GODFREY LAGDEN has given us, in these two volumes under review, a valuable history of the rise of the Basuto nation in the Switzerland of South Africa, under the leadership of a great man—Moshesh.

The Basuto, under the sway of this remarkable personage, were for the most part compounded of clans of the so-called Bechuana peoples, yet the root of their present national name—Suto (the Ba- is merely the plural prefix)—seems to have been derived from the same tribe or district of north-eastern Zululand (Ama-sutu, Usutu) as that which gave rise to the present royal dynasty of the Zulu people, to which Cechwayo belonged. No doubt it sent other enterprising adventurers farther west. By one of these was founded the Ba-suto clan from which Moshesh arose, in the circumstances cited by Sir Godfrey Lagden on p. 19. Moshesh was not directly descended from the stock of some bygone Zulu adventurer, whose tribal name—Suto or Sutu—had been adopted by these Bechuana people, but from a distant relative of the same racial origin whose ancestors had remained in the Amahlubi country to the south. The grandfather of Moshesh, however, had been adopted as a son and successor by Sekake, a Bakwena chief (apparently descended on one side from the original Umu-sutu). This adopted son was called Pete. He was succeeded by his own son, Mokachane, who was the father of Moshesh (this name as it stands means "a woman's garment" in the Se-suto language, but Sir Godfrey states that it is more probably an abbreviation of "Mosheshwe," which he interprets as "shaver" or "leveller"). The birth of Moshesh must have taken place about 1792, at Monkhoaneng, in Northern Basutoland.

About 1815, Chaka obtained complete control over the Zulu Kafirs of Zululand and Eastern Natal, and commenced that series of bloody wars in which, at the lowest possible estimate, a million Bantu negroes perished: wars which started a series of convulsions amongst the negroes of South Africa, that only came to an end by the death of Lobengula in 1894, the capture of Gungunyane by the Portuguese in 1895, and the complete subjugation (by force and by diplomacy) of the Angoni Zulus of Western Nyasaland by Sir Alfred Sharpe in 1906.

Wave after wave of Kafir or Zulu invasion of Basutoland took place after 1820, and, but for the mountainous character of Basutoland and the valour and genius for warfare of the Boers, not even Moshesh could have saved the remnant of the southern Bechuana peoples who gathered round him. But he found in Thaba Bosigo—the "Mountain of Night," under the shadow of Mount Machache, in north-western Basutoland—a stronghold from which no force—black or white—ever availed to dislodge him. The Zulu conqueror, Moselekatsi, might, perhaps, have succeeded (in spite of one severe repulse) in taking Thaba Bosigo and establishing a secondary Zulu power in Basutoland (about 1832), but he could only have done this by surrounding the mountain and gradually starving out the Basuto clan. This purpose, even if he entertained it, was thwarted by the action of the emigrant Boers, who, by means of their firearms and system of laager camps (a defence of linked wagons), defeated Moselekatsi and drove him permanently beyond the Limpopo River.

Thus it was mainly the action of the white man which enabled the Basuto clan of the Southern Bechuana to expand into the Basuto nation. The emigrant Boers, after soundly thrashing Moselekatsi, saved from complete extermination the Bechuana peoples between the Kalahari Desert and Lake Ngami on the north and the Drakensberg Mountains on the south. The emigrant farmers themselves occupied, in the first instance, the less mountainous elevated plateaus to the north of the Caledon River.

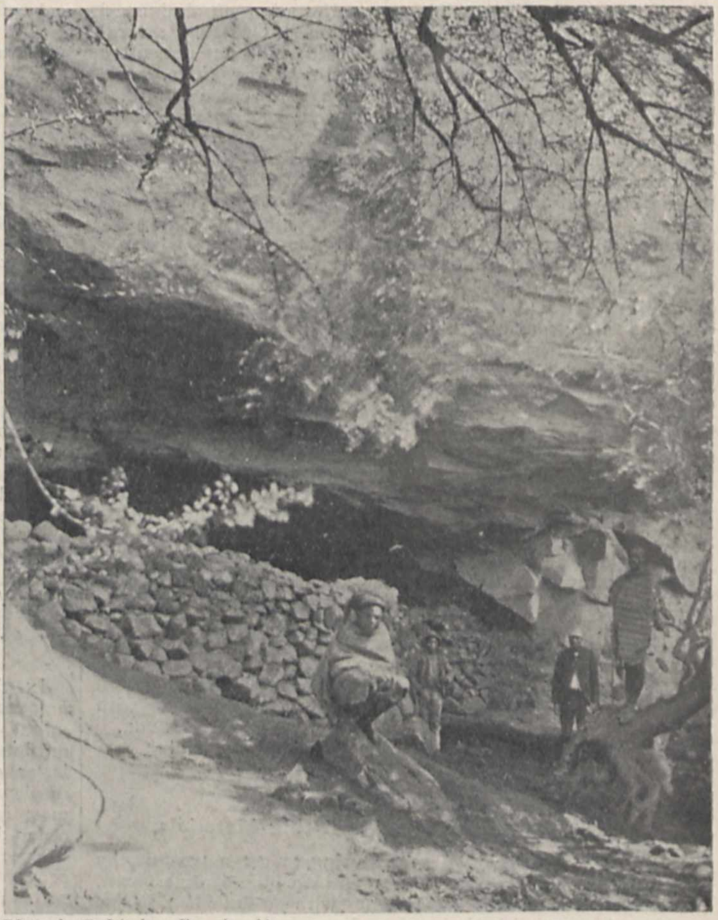


Photo. by T. Lindsay Fairclough]

FIG. 1.—Fortified Cave at Lebise Masupha's Berea. From "The Basutos."

But although Moshesh and his Basuto received the first missionaries (1833) gladly, and practically at no time put any opposition in the way of the spread of Christianity and education, they strongly objected to the Boers as settlers in what is now the Orange Free State. They wished to learn the wisdom of the white man, and, above all, to acquire his firearms and his horses (early in the 19th century they had begun that affection for the horse which has resulted in the re-

[1] "The Basutos; the Mountaineers and their Country." By Sir Godfrey Lagden, K.C.M.G. 2 vols. Vol. i., pp. xvi+338; vol. ii., pp. xii+339-690. (London: Hutchinson and Co., 1909.) Price 24s. net.

markable breed of Basuto ponies and the creation of a Basuto cavalry that has been, and will be, no negligible quantity in the forces of South Africa). Moshesh and his descendants, as soon as they saw a chance, entered into friendly relations with Moselekatsi in the far north, and his son Lobengula, with the kings of Zululand, and the more powerful clans of British Kaffraria and Northern Natal. In fact, no sooner were they relieved from the menace of Zulu conquest by the action of the Boers than they strove by many subtle means to push the white man as far away as possible from the centre of South Africa.

Their dislike of the British was quite as great as their dislike of the Boers. Between 1840 and 1852

[*Photo. by Capt. French.*

FIG. 2.—Ketane Falls and Gorge. From "The Basutos."

Moshesh and his chiefs made use of the British power to stave off a Boer conquest of their country. After that they attempted an aggressive attitude towards even the British, and inflicted on the soldiers of Sir George Cathcart a very serious repulse. From 1858 onwards they fought intermittently with the Orange State Boers (the Basuto being the aggressors), until at last, getting worn out in the struggle with these dogged white men, they invoked British protection in 1868. They were annexed as a Native State to the government of Cape Colony in 1872, but an attempt to disarm them brought on a fresh outbreak of warfare, in which the Cape forces gained no laurels and General Gordon's intervention proved futile. In 1884 Basutoland was disannexed, and has henceforth been directly controlled by the Imperial Government.

Since 1884, when the native negro population of this State (which is nearly the size of Belgium) amounted to about 170,000, the total number of the Basuto has risen to nearly 400,000 at the close of 1909. Education, under French Protestant and British Wesleyan missionaries, has made considerable strides. The country, in fact, is so prosperous that it is becoming a factor of increasing importance in the problem of South Africa. Basutoland (the reviewer thinks) should have been made—if the advice of the one or two statesmen-governors of South Africa had been listened to in the first half of the 19th century—the Empire State of South Africa, the principal stronghold in all that region of the white race; and ample territories farther north or farther south might have been allotted *then* to the few thousand Basuto, who asked for little more at that period than peace, security, and an inalienable right to a reasonable amount of land. Now, as things are constituted, Basutoland is emphatically a black man's country,[1] and from Basutoland radiates a vigorous impulse which will go far towards securing for the black man eventual terms of equal partnership with the white in the administration of the southern half of Africa. Lest we should be petty-minded and regret this, let us turn our eyes to the recently explored regions of Northern Rhodesia, portions of Nyasaland and Katanga (greatly denuded of indigenous populations by various causes) which now invite settlement, almost by the million, on the part of adventurous white peoples.

The volumes reviewed deal mainly with the history of this interesting Basuto people. They are well illustrated by good photographs, and the numerous pictures of the Basuto types show clearly the three negro elements, imperfectly fused, from which this section of the Bechuana peoples has been built up. There is that of the Bushman (who immediately preceded the Basuto as the indigenous occupant), of the ugly flat-nosed type of Forest Negro or Pigmy (which reappears elsewhere in South Africa), and finally the typical Bantu strain from East Central Africa which imparts to many of the Basuto faces refinement of outline and considerable brain capacity. The scenery of Basutoland (the reviewer writes from actual experience) is amongst the grandest of the world's landscapes, and Sir Godfrey Lagden has taken care to emphasise this by "Wort und Bild." The second volume closes with serviceable notes on the Suto dialect, and appendices of great usefulness to the student of Africa. The book is, however, of very great general interest.

H. H. JOHNSTON.

THE OCEANOGRAPHICAL MUSEUM AT MONACO.

AS stated in last week's NATURE, the inauguration of the Oceanographical Museum at Monaco took place on March 28, in the presence of representatives of the Governments and navies of France, Germany, Italy, Spain, and Portugal, and a great gathering of men of science of all nations, who were invited by the Prince of Monaco, and entertained as his guests in his ancient palace at Monaco and in various hotels in Monte Carlo. The inaugural *fêtes* lasted for four

[1] Note Sir Godfrey's remarks on this, p. 645, vol. ii.

days; they were planned on a scale of magnificence rarely attempted, and drew upon the resources of art in a manner which we believe has never been paralleled. It would almost appear as if the design were to show that science, no less than pleasure, was a fitting theme for the exercise of art as exemplified in painting, poetry, and music; and that, in any case, the dedication of a great international scientific institution, provided by the princely munificence of an individual, was no everyday matter, to be passed by unnoticed save by the specialists immediately concerned.

The inauguration was an arresting function, which could not fail to impress the most regardless pleasure-seeker in the gayest haunt of the Côte d'Azur with the thought that science, even in, perhaps, its least known department, was a thing of high importance. To us the fact that "someone had blundered" and no admiral of the British Fleet was there to join the high German, French, and Italian officers in offering a tribute to the scientific study of the sea was a cause of humiliation. It is little short of a disgrace that the country in which modern oceanography was created, and the navy the *Challenger* of which revealed the wonders of the ocean as a whole, were brought to the attention of the gathering only by the Prince's generous recognition in his inaugural address of British preeminence in oceanographical research, and in the name of the ship engraved on the façade of the new building. We know, of course, that the breach of international good manners was due to no intention on the part of the King or of the Prime Minister to inflict a slight upon a noble enterprise, but the effect was none the less deplorable, and on behalf of the British scientific public we desire to give expression to this feeling in the most emphatic way. The official representation of the Royal Society, the Royal Society of Edinburgh, the Royal Geographical Society, and the *Challenger* Society showed at least the good will and appreciation of British men of science.

It seems more appropriate to occupy this article with a short description of the museum itself than with details of the formal speeches at the ceremonial inauguration, the performance at the opera, the pageant in the harbour symbolising the landing of Hercules, mythical founder of Monaco, in a blaze of fireworks, and the concluding reception by the Prince in the Palace. One evening was devoted to a series of lantern demonstrations, by Lieutenant Bourrée, which proved of extraordinary interest on account of the kinematograph representation of the routine of work on the *Princesse Alice* in handling the various oceanographical instruments and appliances at sea.

The Prince of Monaco has devoted an increasing amount of time to deep-sea investigation since he commenced his observations on the Gulf Stream in the sailing-yacht *Hirondelle* in 1885, and, as a result of his work in that vessel, in the auxiliary steam-yacht *Princesse Alice,* and in his present splendid vessel *Princesse Alice II.,* he had accumulated, by 1898, so large a collection of natural-history specimens that he resolved to build a museum in which to house them. On April 25, 1899, the foundation-stone was laid on the southern face of the cliff which bounds the peninsula of Monaco, and the great building designed by M. Delefortrie has now been completed and equipped, and was formally inaugurated on March 28 this year. The first object has been greatly enlarged, and the Oceanographical Museum as it is established to-day contains more than the nucleus of a collection gathered from all investigators of all the oceans illustrative of the whole science of oceanography. On the face of the cliff the foundations of the museum are almost at the level of the sea. Two storeys are built facing the sea, with the rock as their rear wall, and the third storey is on the level of the rock forming the ground-floor of the main frontage, which faces north. The material is the extremely fine-grained white limestone of the La Turbie quarries, on the mountains behind Monaco.

The ground plan of the principal floor includes a central hall twenty metres square, with a wing on each side forty metres long by fifteen wide, the whole frontage being a hundred metres. The decoration of the front of the building includes representations in relief of deep-sea invertebrates and fish, and the whole is crowned by the Prince's arms and a gigantic albatross and sea-eagle. The names of the *Challenger, Talisman, Valdivia, Hirondelle, Princesse Alice,* and other ships which have become famous in the annals of oceanography are boldly carved along the front. Two great groups of symbolic statuary flanking the immense window of the landing on the upper floor represent Truth unveiling the forces of the world to science, and Progress coming to the rescue of humanity. The roof of the central part of the building, eighty-seven metres above the sea, forms a meteorological observatory, and the main roof, five metres lower, forms an immense terrace, measuring a hundred metres by fifteen metres. The entrance-hall, floored with mosaics representing the *Princesse Alice* at sea surrounded by trophies of deep-sea fish, contains the two great stone staircases leading to the upper floor, and unobtrusive doors leading to the stairs by which the director's room, library, laboratories, workshops, and aquarium on the lower floors are reached. It opens into a large square hall, lighted at night by an immense pendant representing a medusa, the lights in which are so disposed as to bring out the anatomy with extraordinary distinctness. Four smaller lights are encased in models of radiolarians very exactly reproduced.

A marble statue of the Prince in yachting costume, leaning on the rail of his yacht, occupies the centre of the hall; this remarkably fine portrait, executed by M. D. Puech, was presented by a number of the sovereigns of Europe and other admirers of the Prince. Great doors to right and left open into the two wings of the building, each forming a lofty hall, lighted by windows along each side, which may be shaded or darkened as required. The western hall is at present fitted as a meeting-room for functions, and here the ceremony of inauguration and the banquet took place. The platform at the west end is surmounted by an immense painting showing the slaty-blue ocean heaved into a long swell, with the white form of the *Princesse Alice* in the background. Electric lights in clusters, representing seaweeds and marine animals, hang from the roof, and the ceiling is frescoed with views of the sea and ships.

The eastern hall is occupied by a collection of oceanographical apparatus and specimens of marine zoology, arranged in a provisional way. The collection includes several whale skeletons, Arctic and Antarctic seals, models of fish, and a vast number of specimens in preservatives. The labels are written in French, English, and German, and give sufficient details of the exhibits to enable a visitor to appreciate the remarkable character of many of the specimens.

On the upper floor, the central hall contains models of the *Princesse Alice I.* and the *Princesse Alice II.,* showing the arrangements for sounding and for working the zoological apparatus. There is a whale-boat exactly as used by the modern whaler, with the gun throwing the explosive harpoon at the bow, and the full equipment of harpoons, lines, and lances. The eastern hall on this floor will ultimately be devoted to physical oceanography and to deep-sea apparatus. Here there is a great collection of dredges, tow-nets, showing the various devices for opening and closing at a given depth, the deep-sea traps with which the Prince has revolutionised the method of obtaining animals from the greatest depths, and many other appliances, either as used or in the form of models. At present a part of the room is occupied by a collection of specimens illustrating marine industries, such as fishing, sponge-gathering, collecting pearls, as well as the use of pearl-shell, coral, tortoise-shell, and similar products. The western hall is not yet arranged, but serves at present for classifying the various collections of mollusca, bottom-samples, &c., which are being dealt with.

The purpose of the museum is to have all the principal collections in duplicate, one set for exhibition, the other for purposes of study. The aquariums have already been utilised for the purpose of physiological and biological researches, and the little steam-vessel *Eider* is available for students to familiarise themselves with the methods of practical oceanography. This little steamer, of twenty tons displacement and sixty horse-power, is fitted for working to a depth of 2000 metres, and is being used for the detailed study of the portion of the Mediterranean in the immediate vicinity of the museum.

The Oceanographical Museum, under the direction of Dr. Richard, to whose admirable description of the building and the collections we are much indebted, is only one part of the Oceanographical Institute which the enlightened munificence of the Prince of Monaco has called into existence. With the object of arousing interest in scientific marine studies in France, the Prince started a series of lectures at the Sorbonne in 1903, and in 1906 he gave perpetuity to these courses of lectures by purchasing land which was much wanted for the extension of the university buildings and presenting it to the French nation, together with a building specially devoted to university instruction in oceanography. This building is now nearing completion, and will probably be opened in the present year, or at latest in 1911. Needless to say, the university and the French Government accepted the gift with lively gratitude. Three professorships have been created in connection with it, M. A. Berget having the chair of physical oceanography, M. L. Joubin that of biological oceanography, and Dr. P. Portier that of the physiology of marine life. The administrative council, under the presidency of the Prince, includes the names of several highly distinguished Frenchmen, but the committee for perfecting the institute is international, and includes representative oceanographers of all countries, Great Britain being represented by Sir John Murray, Dr. W. S. Bruce, and Mr. J. Y. Buchanan.

During the course of the Monaco gathering four important international committees met, each with the Prince as chairman, and, considering how his time was filled with State ceremonies and hospitality, it is only extraordinary enthusiasm, as well as most unusual physical strength, that enabled him to preside hour after hour, with unfailing courtesy and constant tact, over proceedings conducted in three languages. The committees were those for perfecting the Oceanographical Institute; for research in the Mediterranean, in which we understand that the Italian Government will take an active part; for research in the Atlantic, where international cooperation is hoped for, to be organised at a future meeting to be convened by the Oceanographical Institute in Paris; and, finally, for the preparation of a new edition of the Prince's bathymetrical chart of the oceans. It was decided in the new edition of this chart to suppress the indication of the nature of the bottom, which is often fallacious, to add contour lines and certain physical features on the land, and to revise the terminology.

By his researches the Prince of Monaco has won for himself a place in the foremost rank of men of science, and by enshrining the results in the monumental buildings at Monaco and Paris he has invested his labours with permanent value for all time. His modesty and earnestness greatly impressed all those who took part in the proceedings here described, and, if a proof of this is demanded, it is enough to say that no one in authority mentioned the cost of the works, which is usually a prominent feature in the description of any benefaction.

THE RECENT GROWTH OF POPULATION IN WESTERN EUROPE.

IN his inaugural address as president of the Royal Statistical Society, delivered in November last and published in the Journal of the Society for December, Sir J. A. Baines deals in detail with the growth of the population of western Europe during the thirty years 1870–1900. The review covers the sixteen countries of western Europe properly so-called, excluding Russia, the countries of south-eastern Europe, and the "half-way" States of Hungary, Galicia, and Poland. In 1870 the population of western Europe so defined amounted in round numbers to 192 millions, a total which had increased by 1900 to 239 millions—an increment of nearly 25 per cent. But, as shown by the table below, the rate of increase was very different in different countries.

Country	Total percentage increase of population 1870–1900	Average annual rates of increase per thousand, 1870–1900		
		Natural	Census	Leakage
Sweden	23·2	11·7	7·0	4·7
Norway	28·9	13·9	8·5	5·4
Finland	53·3	13·9	13·2	0·7
Denmark ...	36·1	12·9	10·3	2·6
Holland	43·2	13·1	12·0	1·1
Belgium	33·3	9·8	9·6	0·2
Germany ...	38·1	12·5	10·8	1·7
West Austria ...	24·4	7·8	7·7	0·1
Switzerland ...	24·2	7·9	7·2	0·7
England ...	43·2	13·0	12·0	1·0
Scotland ...	33·1	12·8	9·6	3·2
Italy	21·9	9·4	6·6	2·8
Spain	12·8	4·9	4·0	0·9
Portugal ...	24·2	9·9	7·3	2·6
France	6·0	1·4	1·9	+0·5
Ireland	−17·6	6·1	−6·5	12·6
Total	24·6	8·7	7·4	1·3

France and Ireland are both very exceptional; the population of Ireland actually decreased by nearly 18 per cent., while that of France increased by 6 per cent. only. In the Scandinavian countries, the increase ranged from 23 per cent. in Sweden to 36 per cent. in Denmark and 53 per cent. in Finland; in the central group from 24 per cent. in western Austria and Switzerland to 43 per cent. in England and Holland. In all countries except France, the natural rate of increase, by excess of births over deaths, has been greater than the actual rate of increase, the average annual rate of increase by excess of births over deaths amounting (as shown by the second column of the above table) to 8·7 per thousand of the population, while the census only shows an average annual increase of 7·4 per thousand. The loss, or "leakage," has been greatest in Ireland, and next greatest in Norway and Sweden; in all countries save Italy the rate of loss was greater in the decade 1880–90 than in either the earlier or the later decade—in fact nearly three times as great—but the continuous increase in emigration from Italy has placed it of recent years at the head of the emigrating countries (Ireland excluded).

In all the countries considered, both birth- and death-rates have fallen, and in the majority, especially those countries (as Holland, Germany, and Austria) in which the death-rate at the commencement of the period was high, the fall in the death-rate has exceeded the fall in the birth-rate, as shown by the table below; the natural rate of increase was therefore greater at the end than at the beginning of the period, in spite of the fall in the birth-rate. England is one of the exceptional countries, for the death-rate, even at the commencement of the period, was moderate, and the fall in the birth-rate has rather more than kept pace with the fall in mortality.

Country	Mean annual death-rate per 1000[1] 1871–1900	Mean annual birth-rate per 1000[1] 1871–1900	Decline per cent. in rates between 1871 and 1900	
			Deaths	Births
Sweden	17·2	28·9	10·4	11·2
Norway	16·8	30·7	4·1	2·3
Finland	21·0	34·7	11·2	13·0
Denmark ...	18·3	31·2	10·8	3·9
Holland... ...	21·2	34·3	24·3	11·4
Belgium... ...	20·8	30·5	15·0	10·2
Germany ...	24·8	37·3	18·3	7·7
West Austria...	27·6	35·4	13·3	6·5
Switzerland ...	21·1	29·0	19·1	8·7
England ...	19·6	32·6	14·9	15·5
Scotland ...	19·8	32·6	13·4	12·3
Italy	27·1	36·5	19·0	5·4
Spain	30·6	35·5	3·6	2·2
Portugal... ...	*22·1*	*32·1*	—	—
France	22·4	23·8	9·3	12·6
Ireland	18·2	24·3	1·1	13·2
Total	23·8	32·5	13·7	6·6

[1] Figures in italics are partly estimated.

The factors contributing to the fall in the birth-rate, which has recently attracted so much attention, are analysed in detail by Sir Athelstane Baines. For the most part it is clearly due to a fall in the fecundity of married women of reproductive age. The proportion of women of reproductive age to the population has in many countries (as in the United Kingdom) slightly increased, in other cases remained almost steady or fallen very little. The proportion of such women who are married, as shown by the table below,

Country	Number married per 1000 women aged 15–45[1]		Legitimate births per 1000 married women, 15–45[1]	
	1870	1900	1870–80	1890–1900
Sweden	420	411	278	268
Norway... ...	436	418	302	301
Finland	*502*	471	*285*	292
Denmark ...	450	463	268	259
Holland... ...	440	446	345	321
Belgium... ...	409	471	338	252
Germany ...	471	504	319	285
West Austria...	*448*	473	295	271
Switzerland ..	419	442	288	266
England ...	496	469	292	235
Scotland ...	435	420	311	271
Italy	520	539	286	269
Spain	*562*	557	*262*	259
Portugal ...	420	452	—	259
France	531	552	195	159
Ireland	401	325	306	288
Total[1]	490	500	276	249

[1] Figures in italics are partly estimated.

has fallen in all the Scandinavian countries save Denmark, but has increased in all the countries of the central group, except England and Scotland. The births per thousand married women of fertile ages, on the other hand, have fallen in every country, with the sole exception of Finland (and perhaps one should add Norway), and most markedly in the central European group.

"The thirty years included in my survey," Sir Athelstane Baines concludes, "have been generally characterised by a moderate rate of growth of population, interrupted until towards the end of that period by considerable emigration, since reduced, except in one or two cases. People marry a little more than they did a generation ago, and, in most of the countries reviewed, they marry earlier; but the growth in the relative number of the married has been accompanied by a material decline in their output of children. Illegitimate unions, also, whether less frequent than before or not, at least contribute less to the tale of births. The community is therefore almost everywhere becoming an older one, with a gradually decreasing basis for the coming generation. Thanks to a general improvement in hygienic conditions, fewer succumb to disease, especially in early life, and the mortality having decreased more rapidly than the fertility of the population, the excess of births over deaths is relatively not below, but, on the whole, indeed, a little above that which prevailed at the beginning of the period."

PROF. HANS LANDOLT.

On March 15, Geheimrat Prof. Landolt, the Nestor of physical chemists, passed to his rest, full of years and of honours. How few are left now of that ardent band who, in the early 'fifties, came under Bunsen's inspiration in romantic Heidelberg!

In a brief notice it is impossible to give an adequate picture either of the man or of his deeds. One is glad to think, however, that his devotion to science will be recognised in the memorial lectures by which the various societies strive to do honour to the memory of distinguished investigators.

Hans Heinrich Landolt was born in Zürich in 1831, and began the study of chemistry in the university of his native town. His *Wanderjahre* were spent in Breslau, where he graduated, in Berlin, where he studied under Rose and Mitscherlich, and, finally, in Heidelberg. His progress in the academic career was rapid. He became a Privatdozent in Breslau (1856), an extraordinarius professor in Bonn (1858), and an ordinarius professor in Bonn (1867). He then proceeded to the Technische Hochschule in Aachen. In 1880 we find him in Berlin, where he occupied the chair of chemistry in the Landwirtschaftliche Hochschule until, in 1891, he succeeded Rammelsberg as director of the second chemical institute of the university. When old age came upon him, his enthusiasm did not wane; he was active to the last.

Landolt's researches were by no means confined to one branch. In organic chemistry he studied, for example, compounds of arsenic and antimony, the action of potassium amide on various carbon compounds, and the chemical changes in the flame of coal gas. In inorganic chemistry he dealt with subjects such as phosphine, solid carbon dioxide, ammonium amalgam, thiosulphurous acid in aqueous solution, the interaction of bromine and nitric oxide. It is, however, on his pioneering experiments on molecular refraction and optical activity that his fame as an investigator will last for all time. With the exception of the contributions of Biot, very little of importance had been done on the measurement of the specific rotations of optically active substances until the field was taken up by Landolt in a series of papers which are models of exactitude. As a consequence of the experience he gained, workers in stereochemistry are indebted to him for numerous improvements in the technique of polarimetric observation.

He was engaged during the last twenty years of his life on the fundamental problem as to whether a change of mass during a chemical action can be effected by the ether possibly taking part, as it might be conceived to do by the appearance or disappearance of electrons or by the disintegration of atoms. The final result of these experiments, which demanded on the part of the manipulator the exercise of extreme patience, and involved the most exact measurement, was a confirmation of the law of the conservation of mass.

It may be added that Landolt's "Optisches Drehungsvermögen organischer Substanzen und dessen praktische Anwendungen" and his "Physikalisch-chemische Tabellen" (with Börnstein) are classical works of reference.

In a land where men of science are held in honour, it was natural that Landolt's services as a teacher and investigator should be appreciated to the full. Although he himself was the most unassuming of men, and although his work was not of the kind to bring him into the glamour of the footlights, it fell to his lot to receive an unusual number of high distinctions. He was held in esteem and affection by all who had the privilege of his acquaintance.

ALEX. MCKENZIE.

PROF. R. ABEGG.

PROF. RICHARD ABEGG, whose untimely death, in his forty-second year, was referred to in these columns on April 7, was one of the most distinguished representatives of the second generation of physical chemists. It was at the end of a ballooning expedition on April 3 that, whilst attempting to land, the balloon in which Prof. Abegg had journeyed from Breslau to Köslin caught in some bushes and tilted, with the result that he was thrown out and sustained a fracture of the skull, from which he expired in the early morning of April 4.

Abegg studied chemistry at Kiel, Tübingen, and Berlin, and devoted himself at first to organic chemistry. He took his degree, as a student of A. W. von Hofmann, in 1891, with a dissertation on amidochrysene, but the far-reaching results then recently achieved in the field of physical chemistry attracted him, and led him into post-graduate work in the laboratories of Ostwald, Arrhenius, and Nernst.

As assistant to Nernst in Göttingen from 1894 to 1899, Abegg devoted himself to most of the problems of physical chemistry. The action of kathode rays on various salts, the silver germ theory of the latent image, measurements of the depression of freezing points and the osmotic pressure of concentrated solutions, and electrochemical problems in turn claimed his attention, but his theory of electro-affinity, which was formulated along with Bodländer, marks his greatest achievement at this stage of his career. In 1899 Abegg went to Breslau University, where he was soon made an extraordinary professor. Here he continued his work, but a good deal of his time was absorbed by editorial duties. The theory of electro-affinity led to much work on complex ions, which was carried out in conjunction with pupils from all parts of the world, including England, Russia, Japan, America, and Australia, and this work in turn led to the formulation of his theory of valency.

Abegg acted as editor of the *Zeitschrift für Electrochemie*, and at the time of his death had edited about half of a "Handbuch der anorganischen Chemie." It is to be hoped that the work in connection with this Handbuch is so far advanced as to ensure its completion. In connection with analytical chemistry, along with Prof. Herz, Abegg published his "Chemisches Praktikum," which marks an initial step in the application of the ionic theory to the early stages of qualitative analysis, a step which had been indicated by Ostwald in his "Wissenschaftliche Grundlagen der analytischen Chemie."

At the London International Congress of Applied Chemistry, Abegg was appointed on a committee to consider the annual publication of tables of physico-chemical constants, and he attended a meeting of this committee held in Paris last October. Last October Abegg was appointed director of the Physico-Chemical Institute at the new Technische Hochschule at Breslau, which is to be opened next October in the presence of the Emperor.

Finally, a word as to Abegg's genial personality. He made his students feel like colleagues, and was always available with suggestive advice. If we place Abegg in the second generation of physical chemists, he has done his duty by the third generation, and his death will be mourned as a personal loss in all parts of the world.

SIR WILLIAM BOUSFIELD.

ALL friends of education will deeply deplore the loss of Sir William Bousfield, who died on April 7, in his sixty-eighth year. Although he had received the ordinary Oxford education, Sir William Bousfield's wide culture and sound judgment enabled him to see the growing importance of practical and scientific education, and to form correct conclusions on the advice, which he eagerly sought and acted upon, of scientific men. Elected to the London School Board, of which he was a member for six years, in 1882, he took the deepest interest in all problems connected with the improvement of elementary education, and, during his membership, he was chairman of the special committee which was appointed to consider the question of manual training. That committee took evidence from a number of experts, and it was mainly owing to its recommendations that the City and Guilds of London Institute and the Drapers' Company subsequently provided funds for a great educational experiment in the provision of manual instruction in a certain number of schools under the direction of the Board, which resulted, not only in the general adoption of handicraft instruction for boys, but also of domestic teaching in all girls' schools. The success of this experiment was largely due to the efforts of Sir William Bousfield, who, when he ceased to be a member of the School Board, became vice-chairman of a joint committee, under whose direction these important experiments were successfully carried out.

Associated with the Worshipful Company of Clothworkers by family tradition, he was appointed, in the year 1887, a representative of that company on the council of the City and Guilds of London Institute. Although the Institute was exclusively concerned with the development of scientific and technical instruction, Sir William Bousfield's advice proved of the greatest possible service to the several committees of the Institute charged with the different branches of its work. It is, however, in connection with its technology committee—of which he was, for many years, first vice-chairman and subsequently chairman—that his loss will be most felt. In the solution of the many difficult problems with which the department of technology has had to deal, Sir William was able to render great assistance, and, of recent years, as chairman of the board of examinations of that department, which was charged with the preparation of schemes of instruction in every branch of technology, his help was greatly appreciated. The continuous development of the work of that department, not only in the United Kingdom, but also in the colonies, was largely due to his clear judgment and full appreciation of the value to artisans and others of the technical instruction which was thus encouraged.

It is, however, in connection with efforts for the improvement of girls' education generally that Sir William's name will be best remembered. To the work of the Girls' Public Day School Trust, over which he presided, and which owed its success largely to his efforts, Sir William devoted himself without sufficient thought of the strain upon his health and energies. All who have had the privilege of acting with him recognise the extent to which his courtesy of manner and wise counsel enabled them to overcome difficulties arising frequently from conflicting interests. Of his services to the cause of charity organisation and social reform this is not the place to speak, but there can be no doubt that all those who are now occupied in the promotion and improvement of sound education in this country are the poorer for his loss.

NOTES.

We announce, with deep regret, the death of Sir Robert Giffen, K.C.B., F.R.S., on April 12, at seventy-three years of age.

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

The council of the Linnean Society at its last meeting decided to award the Linnean gold medal to Prof. Georg Ossian Sars, professor of zoology in the University of Christiania, in recognition of his eminent services to zoological science. Prof. Sars has been a foreign member of the Linnean Society since 1899.

Mr. C. Bird, headmaster of the Rochester Mathematical School, and the author of text-books on geography and geology, died on April 11 at sixty-seven years of age. He was three times president of the Rochester Naturalists' Club, and was a Fellow of the Geological Society.

A joint meeting of the American Society of Mechanical Engineers with the Institution of Mechanical Engineers will be held this summer in Birmingham and London. The meeting will open at Birmingham with a reception by the Lord Mayor of Birmingham and the members of the local committee on Tuesday, July 26. Following the meetings at Birmingham on July 26–28, the members of the American Society of Mechanical Engineers will be entertained in London. A conversazione will be held at the institution on the evening of July 28, and the following day will be devoted to the reading and discussion of papers in the morning and a dinner in the evening.

Columbia University, New York, is about to lose, by his resignation, the services of Dr. Charles F. Chandler, who has held a chair of chemistry in that institution since 1864. The completion of his academic career will be signalised by a banquet to which he will be entertained in the Waldorf-Astoria Hotel on April 30 by a number of the leading American chemists. On that occasion Dr. Chandler will be presented with a bronze bust of himself, and there will be created, as a permanent memorial, a Chandler testimonial fund in aid of the library of the Chemists' Club.

A number of changes in the organisation of the mines inspectorate and mines inspection districts have just been approved by the Home Secretary, who has followed the recommendations of the Royal Commission on Mines. In connection with these changes, the following appointments have been made:—Dr. W. N. Atkinson, divisional inspector for the new South Wales district; Mr. W. H. Pickering, divisional inspector for the new Yorkshire and North Midland district; Mr. H. Johnstone, divisional inspector for the new Midland and southern district; and Mr. W. Walker, divisional inspector for the new Scotland district.

A general discussion on the constitution of water will be held on Tuesday, April 26, at the Faraday Society. Prof. James Walker, F.R.S., will preside. The discussion will be opened by Prof. Walden, of Riga, followed by the reading of short papers by Prof. P. Guye, Mr. W. R. Bousfield, K.C., and Dr. T. M. Lowry, and of communications sent by Prof. Nernst and Mr. W. Sutherland, of the University of Melbourne. In connection with the discussion, and particularly in honour of Prof. Walden, a dinner of the society will be held on the following evening, Wednesday, April 27, at the Trocadero Restaurant, London, W. The president of the society, Mr. James Swinburne, F.R.S., will preside.

The progress of the recent eruption of Etna is shown in the following summary of Reuter telegrams from Catania:—*April* 7.—The eruption of Mount Etna continues. The stream of lava from Cisterna Regina is advancing slowly, while the stream from Monte Nocilla has considerably increased. It is now 300 metres in width. *April* 8.—One lava stream is increasing in speed, and has entered the Fusara district, travelling at about nine yards an hour. *April* 11.—Several of the Etna craters continue in active eruption. The flow of lava from the Fusara crater has ceased, but the streams from Monte Sona and in the Bottari plain are still advancing.

In connection with the aviation week to be held at Verona in the first fortnight of May, it is proposed to organise a first International Congress on Aërial Locomotion. On the scientific side the movement has received the support of Profs. Angelo Battelli (Pisa), Giovanni Celoria (Brera Observatory), Giuseppe Colombo (Milan), Count Almerigo di Schio, Dr. Enrico Forlanini, Prof. Luigi Palazzo, Prof. Righi (Bologna), Prof. Vito Volterra (Rome). Hitherto there have been few opportunities for interchange of ideas between those interested in the theoretical and practical aspects of aërial navigation, and the proposed congress should afford a valuable opportunity for effecting a closer rapprochement between workers who are studying the problem from widely different points of view.

The Sheffield meeting of the British Association will open on the evening of Wednesday, August 31, when Prof. T. G. Bonney, F.R.S., will assume the presidency in succession to Sir J. J. Thomson, F.R.S., and will deliver an address. On Friday, September 2, the first evening discourse will be delivered by Prof. W. Stirling, on "Types of Animal Movement." On Monday, September 5, the second evening discourse will be delivered by Mr. D. G. Hogarth, on "New Discoveries about the Hittites." The concluding meeting will be held on Wednesday, September 7. A reception will be given at the Town Hall by the Lord Mayor (the Earl Fitzwilliam, D.S.O.) on Thursday, September 1, and a reception will be given at the University on Tuesday, September 6. A number of garden-parties will be arranged, full particulars of which will be announced later.

THE Argentine Scientific Society is organising an International American Scientific Congress, to be held in the city of Buenos Aires on July 10–25. This congress will form one of the items of the programme arranged to commemorate the centenary of the revolution of May, 1810, which brought about the independence of the Argentine nation, as well as that of other nations of South America. Dr. J. F. Alcorta, President of the Argentine Republic, is the president of the congress, and Prof. N. B. Moreno and Mr. E. M. del Pont are the general secretaries. The work of the congress will be done in eleven sections, each having a number of subsections. The sections and the presidents appointed are as follows:—engineering, Mr. L. A. Huergo; physics and mathematics, Dr. M. R. Candioti; chemistry, Dr. A. Quiroga; geology; anthropology, Dr. F. Ameghino; biology, Dr. A. Gallardo; geography and history, Dr. F. P. Moreno; economics and statistics, Dr. E. S. Zeballos; military science, Brigadier-General P. Riccheri; naval science, Rear-Admiral M. J. G. Mansilla; psychology, Dr. H. G. Piñero. All communications should be addressed, according to circumstances, to the president of the executive committee, Mr. L. A. Huergo, or to the president of the committee of propaganda, Mr. S. E. Barabino, care of the Argentine Scientific Society, 269 Calle Cevallos, Buenos Aires.

A "PHOTOGRAPHIC ARTS AND CRAFTS EXHIBITION" is open for this week only at the Royal Horticultural Hall, Vincent Square, Westminster. It is an excellent and representative show of modern photographic apparatus and materials, and includes a pictorial section, in which may be seen some of the finest portrait work, and examples of the applications of photography to various technical purposes, such as criminology, metallography, photomicrography in colours, &c. Demonstrations, lectures, and kinematograph shows are given from time to time. With regard to cameras, the chief fact that strikes one is the total absence of the large cameras that were familiar some years ago, often specially made for exhibition, and instead of them there are innumerable small cameras, some excessively small, and others of more moderate size, but all designed to give the utmost portability with efficiency. Messrs. Marion and Co. show one that takes plates 1¾ inches by 2⅜ inches, and folds into a rectangular block that weighs only 6 ounces, and is about half an inch thick, including the lens and shutter. Messrs. Adams and Co., Messrs. Houghtons, Messrs. A. E. Staley and Co., and other firms show cameras nearly, if not quite, as compact, and some of these are of a quality of workmanship that leaves nothing to be desired, and when provided with a first-class lens give pictures that will permit of considerable enlargement, so that a really efficient camera may now be the constant companion, in fact as well as in name, of naturalists and travellers, without the feeling that it is something extra to be carried. The present tendency to develop in tanks for predetermined times is obvious in the many models of apparatus for this purpose. The Standa Company has a new pattern in which the rack that carries the plates is hinged so that it will open out, and, if suspended by one end, allows free access of air to the surfaces of all the plates, a convenient method of drying them. Colour photography is represented by Messrs. Sanger Shepherd and Co., Messrs. Lumière, and Messrs. Wratten and Wainwright. Telephoto. lenses are shown by Messrs. Dallmeyer, Messrs. Staley and Co., and others. There are altogether about seventy firms exhibiting, excluding the pictorial section. A lecture on "Spirit Photography" is given three times daily, illustrated by some alleged "real spirit" photographs, as well as by examples of what is possible by well-known methods.

IN *L'Anthropologie* (January-February) Prince Georges Cantacuzene describes a collection of eleven skulls from a primitive cemetery at Corneto, near Civita-Vecchia. Of these he gives a detailed series of measurements, and the result of his investigation is to confirm the view that the old Roman race was composed of several divergent types.

IN the *National Geographic Magazine* for February Mr. Byron Cummings describes the great natural bridges in Utah. They are the result of a disturbance of the vast strata of red and yellow sandstone underlying that region, which left natural obstacles through which the rivers have worn their way. One of them is the Edwin Bridge, a graceful structure with a span of 194 feet and an elevation of 108 feet. Finer than this is the Augusta Bridge, combining massiveness with graceful proportions. It is 222 feet high and 261 feet between the abutments. Still greater, if not so well proportioned, is that which the Indians know as Nonnezoshi, or "Stone Arch," the greatest natural arch as yet found, measuring 308 feet in height and 275 feet between the abutments. In some places the process by which these natural wonders were formed may still be seen in action.

MAJOR STANTON, late Governor of Khartum, in a lecture recently delivered before the Colonial Institute, quoted in *Travel and Exploration* for April, notices a curious fact about the jerboa, or kangaroo rat. "It is found in considerable numbers in places miles and miles away from any water or even dew, and I was at a loss to understand how these little animals could exist through the ten months of drought. It appears, however, that after the scanty rains a small wild melon, of bitter taste but full of juice, flourishes in the desert. The jerboa, as soon as the melon is ripe, bites off the stem and proceeds to dig away the sand under the melon, so that it gradually sinks below the level of the ground. The constant wind soon covers it over with 6 to 8 inches of sand, which protects it from the scorching sun and from drying up. When all other moisture has evaporated, the jerboa goes to his larder of melons, and drinks the juice of these till the rains come on again. One jerboa will bury as many as forty of these little melons to last him through the dry season."

L'Anthropologie (Tome xx., No. 5) contains an interesting article by Dr. R. Verneau on three skulls discovered by M. Mansuy in the cave at Pho-Binh-Gia, in the oldest beds yet explored in Indo-China. This cave is situated 400 m. west of the village of the same name and 75 kil. north-west of Lang-Son (Tonkin). All three skulls are of the same ethnic type, and apparently belonged to a race of more than medium height. The most complete is that of a male, of which the mandible has also been obtained. A detailed description of the three skulls is given. The complete male skull is dolichocephalic (index 73·47), slightly phænozygous, with a rather narrow but well-curved forehead, somewhat prominent parietal protuberances, and the supraciliary arches are prominent only in the region of the glabella. The chief characteristic of the head is its disharmony, in which respect the old Indo-Chinese race approaches the Cro-Magnon race of the Reindeer period, the Grimaldi type of the mid-Quaternary age, and Lagoa Santa man, the most ancient type yet known in South America. The skulls of Pho-Binh-Gia are certainly not

Mongol. They seem rather to be representatives of the primitive Indonesian type, of which the Miao-tse and Khâs, as well as various peoples in the East Indian Archipelago, are descendants. The skulls appear to belong to the white rather than the yellow branch of the human race, which fact supports M. de Quatrefages's theory (which has been accepted by other students) of a white element having lived once in the continental regions of the Far East. The implements associated with these remains are of a Neolithic type; ornaments and pottery are rare. The absence of bones of large edible animals in the archæological layer leads to the conclusion that the ancient troglodytes of Pho-Binh-Gia were mainly vegetable feeders, but they also fed on fresh-water molluscs. It is proposed to make a fresh investigation of this important cave.

THE whole of part vii. of vol. cxviii., Abt. iii., of the *Sitzungsberichte* of the Royal Vienna Academy of Sciences is devoted to a relatively long article by Mr. O. Straeker on the plica longitudinalis of the duodenum, with its associated papilla, in man and the lower mammals, these remarkable structures being discussed in detail from the morphological, histological, and physiological standpoints in a number of species.

A SPECIAL exhibit has been made in the hall of the Natural History Museum of the mounted skin and skeleton of the specimen of the monkey-eating eagle (*Pithecophaga jefferyi*) recently living in the Zoological Society's Gardens, and the only example of its kind hitherto exhibited alive in England, and probably in Europe. This splendid eagle, it will be remembered, was discovered by the late Mr. J. Whitehead, and described, as a new genus and species, by Mr. Ogilvie-Grant in the *Ibis* for 1897, its nearest relative being apparently the South American harpy eagle (*Thrysaëtus harpyia*). Great credit is due to Mr. Rowland Ward for having made a complete mounted skin and skeleton from a single bird.

CONSIDERABLE interest attaches to a letter in the *Field* of April 2 from Mr. C. W. Stockley on rhinoceroses living for long periods in Somaliland without water. They inhabit certain parts of the Bur Dab, where, during the dry season, there appear to be no pools over a considerable area, the two nearest known drinking-places being thirty-three and forty-five miles distant. To these pools it is believed the rhinoceroses make only very occasional journeys. Such moisture as they require is obtained by eating the leaves of an aloe locally known as *dur*. Beisa oryx, on the other hand, maintain existence in the thirstland by eating a small kind of gourd, called by the Somalis *unun*; but kudu, which likewise go without drinking for long periods in this country, browse on *dur*.

WE have been favoured with a copy of an excellent little illustrated guide to elk and ptarmigan shooting in Norway, by Mr. Erling Hiorth, published, in English, at Christiania. Brief accounts are given of the haunts and habits of the two species, together with full information as to sporting localities, hotel-accommodation, tariffs, game-regulations, suitable clothing, &c. The pairing-season of elk in Norway commences about September 20, and the stags shed their antlers the following February, and begin to grow the new ones in May, which are clear of the velvet in August or September. The antlers begin to degenerate after the twelfth year. Highland elk are stated to differ from those of the plains by the slight development of palmation in the antlers. The calves, either one or two at a birth, are born in May.

WE have received vol. xii. of the third series of the *Anales del Museo Nacional de Buenos Aires*, the contents of which include Dr. Ameghino's paper on Diprothomo, already noticed in NATURE, as well as several articles by Mr. Juan Bréthes on South American Diptera and Hymenoptera, and a long one by Mr. C. Spegazzini on Argentine Mycetozoa. In two articles from the succeeding volume (xx. of the complete series) Dr. Ameghino describes a young tapir-skull from Tucuman as a new species under the name of *Tapirus spegazzinii*, and likewise adduces evidence considered to prove the existence of a prelacteal dentition in the genus. The Tucuman tapir differs from *T. americanus* in its shorter and wider nasals. The presumed existence of a prelacteal dentition is afforded by the presence of small dental caps overlying some of the teeth of the milk-series.

THE alien problem has long since been acute in Great Britain in the case of human bipeds, and it promises ere long to become so as regards their feathered analogues, for the additions to the list of "British" birds are becoming appallingly frequent, the two latest, according to the April number of Witherby's *British Birds*, being the lanceolated warbler (*Locustella lanceolata*), a specimen of which was shot in Lincolnshire on November 18, 1909, and the Corsican woodchat (*Lanius senator badius*), of which an example was killed in Romney Marsh on June 20 of the same year. The former species breeds in Kamchatka, Japan, and Saghalin, and appears never to have been previously recorded from western Europe, so that it has nothing whatever to do with the British fauna. To exclude such stragglers from the British list seems impossible, as there is a gradual transition from these to species which are more regular visitors. At the same time, their inclusion is a great nuisance, as tending to swamp the proper fauna, and a satisfactory way of dealing with the difficulty is urgently required.

THE *Bulletin du Jardin Impérial Botanique*, St. Petersburg (vol. x., part i.), contains a list of fungi from the district of Moscow compiled by Mr. J. P. Petroff, and a note on the geotropism of some luffa fruits by Dr. N. Monteverde and Mr. V. Lubimenko. The latter refers to *Luffa acutangula* and other species, which it is stated acquire a positive geotropic tendency at the period when the fruits ripen with the purpose of casting the lid to allow of the escape of the seeds.

SYSTEMATIC articles in the *Kew Bulletin* (No. 2) are provided by a revision of the genus Myxopyrum, communicated by Mr. A. W. Hill, and a decade of new African determinations. Mr. C. E. Legat presents an account of a trek from Pietersburg in a north-eastern direction across the Zoutpansberg range in the Transvaal, undertaken with the object of studying the trees and shrubs growing in this little explored region. South of the range *Dombeya rotundifolia, Sclerocarya caffra*, and *Dichrostachys nutans* were frequently met with; *Copaifera mopane, Pterocarpus angolensis*, and *Adansonia digitata* were found to the north. A summary of Thompson's report on the forests of the Gold Coast directs special attention to arguments adduced as to the great influence of forests on physical and climatic conditions.

AN article on Chinese Rubi, by Mr. W. J. Bean, published in the *Kew Bulletin* (No. 2), gives particulars of some of the new species collected by Mr. E. H. Wilson. Their beauty lies chiefly in the stem and foliage, although one or two may, under cultivation, yield new fruits of good quality. *Rubus Veitchii*, noted as one of the most attractive, is a bush with purple stems and handsome pinnate leaves. *R. polytrichus* is a dwarf shrub without prickles, but densely clothed with hairs. *R. coreanus* is distinguished by its bluish-white stems, and *R. Parkerii* is an elegant climber. The opportunity of studying these and other Chinese species is afforded by the establishment of a border in the gardens among the collection of the Rosaceæ near the Pagoda.

A MAGNIFICENT botanical scene in the Lichiang range, situated in the big Yangtse bend in western Yunnan, is briefly described by Mr. G. Forrest in the *Gardener's Chronicle* (March 26). The limestone valley, at an altitude of 9000 feet, is the home of many Primulas, notably *Poissonii, denticulata* and *Forrestii*. The lower slopes of the range are covered with two dwarf evergreen species of oak and pines, and the cliffs are clothed with masses of Primula, Cremanthodium, Meconopsis, Gesnera, and other brilliant flowers. The pine belt ranges from 10,000 to 13,000 feet, where it gives place to rhododendron forest and scrub, and that in turn to Alpine pasture. The pine belt yields the finest and rarest plants, *e.g.* many species of Primula, Lilium (including *L. lophophorum*), Cyananthus, Codonopsis, and Androsace. The Alpine pastures also abound in magnificent plants, the most unique being two new densely-hirsute species of Saussurea, found on limestone rubble at a height of 16,500 feet.

REPORTS on various field trials with mangolds, swedes, and seeds hay have recently been issued from the Midland Agricultural and Dairy College. The trials are made on the usual lines, and aim at discovering the best varieties of the particular crops and the most suitable manures for use in the districts concerned.

ABOUT eight years ago sisal was introduced into British East Africa, and found to grow well. The quality of the fibre is satisfactory; its quantity is rather higher in the coast belt than in the highlands, but the cost of production in the latter case is less than in the former by reason of the better climate and cheaper and more regular labour supply. In the *Agricultural Journal of British East Africa* (vol. ii., part iii.) the whole problem is discussed, and although no definite conclusion is reached, there seems a prospect that the industry may be put on a sound basis.

IT is not unusual in some districts to use sawdust as litter for cattle, and as it would then form a constituent of the manure produced, its nitrogen-content is a matter of some interest. Mr. Kinch recently examined a number of samples, and the results published in part v. of the *Agricultural Students' Gazette* are as follows:—

	Nitrogen	Mineral matter		Nitrogen	Mineral matter
Oak...	... 0·155	... 0·20	Spruce	... 0·14	... 0·71
Elm...	... 0·27	... 1·38	Larch	... 0·18	... 0·25
Ash...	... 0·29	... 0·68	Red pine...	0·30	... 0·33

These figures refer to the dry matter. In its ordinary state sawdust might be supposed to contain about 10 per cent. of water, in which case the mean nitrogen content is about 0·2 per cent.

MESSRS. PEARL AND SURFACE have issued a further instalment of their applications of correlation methods to poultry problems as Bulletin No. 168 of the Maine Agricultural Experiment Station. The fertility of the eggs, measured by the percentage of infertile eggs, does not appear to be inherited and is to a large degree influenced by external circumstances. On the other hand, the "hatching quality" of eggs, measured by the percentage of fertile eggs hatched, is a character of altogether different nature, being innate, constitutional, and inherited. It is, however, adversely affected by heavy winter egg production, whilst fertility is not. The two characters are not entirely unconnected; there is a small but sensible correlation between them, and a hen the eggs of which run high in fertility will also tend to show a high hatching quality. Both are adversely affected by bad conditions of housing.

IN a lecture given at the Farmers' Club on February 28, Mr. W. Herrod said that the usefulness of the bee in connection with agriculture had not been recognised by farmers in this country until recent years, and even now many looked upon bees as they did on wasps, as insects to be avoided. In some countries the bee was rightly held in high esteem for its usefulness in the production of seeds and fruit. Most plants depend on insects for fertilisation, although in some it is done by the wind. Amongst insects, the whole family of bees are of the greatest use; next come butterflies and moths, while flies even do their share of the work, but it is more especially the hive-bee that is the blossoms' partner, by carrying the fertilising dust from one flower to another. After describing the inhabitants of the hive, Mr. Herrod mentioned how the workers collect the nectar and carry the pollen from one plant to another. He then quoted Darwin, who found that twenty heads of Dutch clover yielded 2290 seeds, but twenty other heads protected from bees produced not one. Then 100 heads of red clover produced 2700 seeds, but the same number of protected heads produced not a single seed. He also mentioned experiments made in America which tended to show the great advantage gained by the fertilisation of clover by bees. That bees are useful to the farmer even with ordinary farm crops, and that some farmers realise this, is proved by the fact that hives of bees are carried into bean-fields just after horse-hoeing, and the plants are about to bloom, so that they may be close to the crop to carry out the work of fertilisation.

PROF. GRENVILLE COLE has issued a description of the raised map of Ireland contained in the National Museum of Science and Art, Dublin. It is at once concise and interesting, and, even without the aid of the raised map to which it refers, may be read with profit by anyone requiring a short but comprehensive review of Irish geological history. The development of the surface features of the country as dependent upon geological events is followed from Archæan times. It is enjoyable reading throughout. The illustrations are good. Some are old friends, but are not the worse for that. All are well chosen.

THE records of horizontal pendulums frequently show series of small oscillations which, in their brief period and long continuance, are quite distinct from those produced by distant earthquakes. In previous papers Prof. Omori has established the remarkable facts that the mean periods of the principal groups of pulsatory oscillations are 4·4 and 8·0 seconds, and that they are approximately constant all over the earth. He has recently returned to the subject in an interesting report (Bulletin of the Imperial Earthquake Investigation Committee, vol. iii., No. 1, Tokyo) on the oscillations observed in the Japanese islands of O-shima and Hachijo, and in two neighbouring districts of Tokyo. The oscillations, he finds, occur more or less at all times on extensive quaternary plains and on large alluvial valleys, but very seldom, and only to a slight degree, at places on granite and Palæozoic rocks. In the islands the oscillations are of frequent occurrence, and their mean period is, as a rule, 4·3 seconds. At Hongo, in Tokyo, three periods exist, with mean values of 2·9, 4·5, and 7·5 seconds, but those with a period of 4·5 seconds occur four times as frequently as those of the longer period. The approach of a deep barometric depression is invariably accompanied by the production of marked oscillations which have a mean period of 4·5 seconds.

Similar instruments installed in two districts of Tokyo, 2·29 km. apart, one on high and hard ground, the other on low and very soft ground, showed that the pulsations at the two places differed not only in phase, but also in their mode of grouping, while the mean period and amplitude were nearly the same.

BULLETIN No. 405, issued in 1909 by the United States Geological Survey, consists of a full account of the prolonged and exhaustive investigations carried out by Dr. W. F. Hillebrand and Dr. W. T. Schaller upon the chemical and physical properties of the remarkably interesting series of mercuric minerals, viz. kleinite, montroydite, terlinguaite, eglestonite, calomel, and native mercury, occurring at Terlingua, Texas. Of these, all, save the last two, are minerals which were first discovered and are as yet known only at this locality. Montroydite, terlinguaite, and eglestonite were first described by Prof. A. J. Moses; he noticed yet another possibly new mineral, but had not at his disposal sufficient material for its determination. The outstanding mineral was subsequently studied by Prof. Sachs, who gave it the name kleinite, and announced it to be an oxychloride of mercury with the formula $Hg_4Cl_2O_3$. One of the most interesting results arising from Dr. Hillebrand's analyses is to show that the mineral has a more complex composition, and is, indeed, a unique example among minerals of the mercury-ammonium group of salts. The precise nature of the molecular constitution, however, still remains uncertain, and it is not known what part is played by the small but varying amount of water present; the mineral may possibly be a mixture of the chlorine compound NHg_2Cl with other salts of mercury. The homogeneity above 130° and the heterogeneity below that temperature, as revealed by the optical characters, show that kleinite must have been formed at a relatively high temperature. Careful tests failed to reveal the presence of nitrogen in any of the remaining minerals, but Dr. Hillebrand found that the formula for eglestonite should be Hg_4Cl_2O, and not $Hg_6Cl_3O_2$, as deduced by Moses from McCord's analyses. Dr. Schaller's careful goniometric examination confirmed the fundamental constants and the symmetry already found by Prof. Sachs for kleinite and by Prof. Moses for the other minerals, but added enormously to the number of forms discovered. Dr. Schaller, who is evidently a whole-hearted disciple of Prof. Goldschmidt, based his discussion of the forms on the harmonic law enunciated by that versatile crystallographer.

THE meteorological chart of the North Atlantic Ocean for March, issued by the Deutsche Seewarte, contains an account of the second attempt at utilising wireless telegrams for weather forecasts. The experiment was made in August and September, 1909, and the district of observation was restricted to 10°–30° W. longitude. The results tend to show that, so far as Germany is concerned, it is doubtful whether practical use can at present be made of the telegrams. The Seewarte considers that further study of the connection between the weather of any particular day in Germany and the preceding distribution of pressure over the ocean, and especially of the tracks taken by barometric depressions, is primarily necessary, and that this study can best be done by an examination of the daily synoptic charts which have been published for many years by the Seewarte and the Danish Meteorological Institute. We believe that similar telegrams were forwarded to the London Meteorological Office; the results, so far as this country is concerned, will no doubt be given in the committee's next annual report.

BULLETIN No. 36 of the University of Illinois consists of a paper on the thermal conductivity of fire-clay at high temperatures, by Messrs. J. K. Clement and W. L. Egy. The fire-clay specimens are cylinders 40 cm. long, 12 cm. in diameter, with a hole through the centre 3·5 cm. in diameter for the reception of a heating coil of nickel wire wound on a porcelain tube. The cylinders are further provided with two long holes 3 mm. in diameter parallel to the axis and extending to the central plane. Through these pass the platinum platinum-rhodium thermocouples, by means of which the temperatures at two points of the central plane are determined. The specimens are enclosed in a fire-clay furnace, which has an internal diameter slightly greater than the external diameter of the specimens. The heating current is measured by means of a Weston voltmeter and shunt, and the thermocouples standardised by means of zinc, silver, or copper freezing in a carbon crucible in a special furnace. The electromotive force of the couple is measured by potentiometer and galvanometer. Two samples gave constant heat conductivities of 0·0026 and 0·0036, respectively, between 300° C. and 800° C., one other increased from 0·0021 at 300° C. to 0·0023 at 700° C., while a fourth increased from 0·0024 at 400° C. to 0·0026 at 800° C.

AN illustrated article on the Royal Liver building, Liverpool, appears in the *Builder* for April 9. With the exception of the outer curtain walls, the building has been constructed entirely in ferro-concrete on the Hennebique system. Mr. W. Aubrey Thomas was the architect, and Messrs. L. G. Mouchel and Partners prepared the details of the ferro-concrete work. The building is 301 feet long by 177 feet 6 inches wide, these dimensions continuing up to the main roof at a height of about 170 feet above street-level. The domes surmounting the main towers are 295 feet above street-level, the extreme height from foundation-level to the topmost point being 360 feet, about the same as that of St. Paul's Cathedral. This huge building has eleven storeys up to the main roof, and six storeys in each main tower. From the structural point of view the building is essentially a monolith. Each floor was moulded at the same time as the corresponding columns and beams, so that the men engaged in setting up the framework of the next storey had the advantage of a continuous floor for the conduct of operations. The granite curtain walls constituting the exterior sheathing of the building are nowhere more than 14 inches thick, the weight being taken at each storey by lintels forming part of the general framework.

THE first of a series of illustrated articles on the construction of aëroplanes appears in the *Engineer* for April 8, and deals with the Farman biplane. This machine has the distinction of being the first to combine the rear planes for steadying purposes with ailerons or fins for obtaining lateral stability. Mr. Farman began his career in aviation as pilot of a Voisin biplane, a machine which depends for stability on its cellular construction. Farman drifted from the cellular aëroplane, and adopted the system of manual control which in various forms is now almost general. In the new Farman machines the planes have a supporting surface of 48 square metres. The older types have two planes of the same length, whereas the new machines have the lower plane shorter than the upper, the lengths being, respectively, 23 feet and 36 feet. The width and the height between the planes are equal, being each 6 feet 2¾ inches. Both ash and poplar are used in the construction. Most Farman biplanes are fitted with the rotary Gnome engine. A feature of the article is the numerous clear drawings of details given.

OUR ASTRONOMICAL COLUMN.

April Shooting Stars.—Mr. Denning writes:—"The gibbous moon will be present in the sky during the ensuing return of the April Lyrids, so that a conspicuously visible display can hardly be expected. The night of April 21 will probably be the time of maximum, but nothing can be definitely predicted as to the strength of the coming shower. It seems to vary from year to year in an irregular manner, and has seldom presented a rich display comparable with that of the August Perseids.

"In 1909 there were few of the April Lyrids visible, though the skies were very clear on the important nights of April 20 and 21.

"The shower is, however, a very brief one, and often evades English observers by occurring in the daytime or at a period of cloudy weather or bright moonlight. It is a system which certainly requires much further observation, though it seldom provides us with a spectacle of abundant and attractive character; but it may return at any time and present a repetition of the splendid shower witnessed in 1803, so that it should be carefully watched every year."

Halley's Comet.—The Cape Town correspondent of the *Daily Mail* announces that Halley's comet was observed, after its conjunction with the sun, at the Cape Observatory at 5h. 50m. a.m. on April 8. The comet was visible for ten minutes before becoming lost in the increasing daylight, and is reported as being brighter than when seen in February. The comet was observed at the Vienna University Observatory shortly before 5.0 a.m. on April 11, and was seen also at the Perth Observatory, Western Australia.

In No. 421 of the *Observatory* (p. 182) it is suggested that, as Dr. Wolf saw the comet as a naked-eye object on February 11, the estimated magnitude (9·0) given for the end of February must have been far too low; on the assumption that the brightness varies as $1/r^4\Delta^2$, the comet should be at least as bright as the first magnitude when near the earth on May 20.

The question of the comet's brightness during May is also discussed by Dr. Ebell in No. 4400 of the *Astronomische Nachrichten* (p. 140). Taking the recorded magnitudes, at various intervals from perihelion, during the apparition of 1835–6, and comparing them with those already recorded for the present return, Dr. Ebell finds that the apparent magnitude at the time of greatest brightness, May 21, may be about $-1·7$, or about equal to that of comet 1910*a* at its perihelion. On this basis the present magnitude is about 4·0, and the comet should remain a naked-eye object until about the end of July.

A photograph of the comet taken at Juvisy on February 12 is reproduced in the April number of the *Bulletin de la Société astronomique de France*; at that time the tail showed as a feeble, fine trace about 1½° long. Another photograph was taken on March 7 with nineteen minutes' exposure, but only a feeble image of the head was obtained. A drawing by M. Baldet, made on March 5, when the magnitude was estimated as 6·0, shows a V-shaped appendage, the angle between the two tails being 70°, and the southern tail being the faintest and shortest.

Reports from various countries emphasise the necessity for spreading sound knowledge concerning the comet. The suicide of a Hungarian farmer "on account of Halley's comet" is followed by a report from Odessa that in southern Russia there is a veritable popular terror, which is being exploited by unscrupulous persons for the purpose of obtaining money, for special prayers, &c., from the ignorant natives. We welcome, therefore, a brochure received from the Manila Weather Bureau, in which Father Zwack carefully analyses the alleged sources of catastrophe, and shows how utterly puerile they are. Such brochures, if printed in the vernacular, would do a great deal towards allaying excitement, which otherwise may lead to serious trouble.

Comet 1910*a*.—A number of observations of, and an ephemeris for, comet 1910*a* are published in No. 4400 of the *Astronomische Nachrichten*. Among the former are some, made near the end of January, by the late M. Charlois at the Nice Observatory, and an interesting set communicated by Dr. Ristenpart from the Santiago Observatory. At Santiago they picked up the comet about three-quarters of an hour before noon on January 19 (23h. 15m., January 18), and followed it until after 6 p.m.; at the time of the first observation it was only 7° east and 3½° north of the sun. Herr Castro, who made the position settings during the afternoon, noted a striking falling off in the apparent brightness of the comet during the 2½ hours he had it under observation.

The Galactic System, its Structure and Origin.—An interesting discussion of the galactic system, its structure, origin, and relations in space, is published—in English—by Dr. Karl Bohlin in No. 10, vol. xliii., of the *Kungl. Svenska Vetenskapsakademiens Handlingar*. Having observed a large number of nebulæ and clusters, and, in a previous paper, discussed the measures of the globular cluster M. 92, Dr. Bohlin was induced to take up the study of the distribution of the various classes of the heavenly bodies, and commenced with that of globular clusters. From this point of view he has studied the distribution of a large number of these objects, and concludes therefrom that their system is situated in the centre of the galactic system, for only on this assumption can their apparent clustering on one side of the galactic circle be explained. Extending the study to various other classes of celestial objects, the author evolves a systematic evolution of them which accounts for their apparent distribution and various forms. In this hypothesis planetary nebulæ originally consist of rotating luminous shells filled with very tenuous matter. These shells, breaking down at their poles, form apparent "ring" nebulæ with distinguishable nuclei. The galactic system is supposed to have been such a planetary nebula, having reached at present an advanced form of ring nebula, of which the system of globular clusters forms the nucleus; the spiral nebulæ, clustered near the poles, parts of the broken shell; and the Milky Way, the equatorial belt. Diagrams illustrating these distributions, and twenty-seven reproductions from photographs of various nebulæ, are shown on the six plates accompanying the paper.

Saturn's Satellites and Rings.—In No. 610 of the revived *Astronomical Journal*, now edited by Prof. Lewis Boss, Prof. Barnard records some measures of the eclipses of Saturn's satellites, made by him during 1906–8. The measures are given in detail, and some interesting notes on the dimming of the satellites Rhea and Dione, immediately before the final disappearance, are appended. In the case of the former the loss of light amounted to as much as 2·0 to 2·5 magnitudes. Measures of the relative distances of the satellites and of the position-angles of the rings during the same period are also given.

The System of ϵ Herculis.—From the investigation of a large number of plates taken at the Dominion Observatory, Ottawa, Mr. Harper has re-determined the orbit of the spectroscopic binary ϵ Herculis, and finds several departures from the elements determined from the 1907–8 spectrograms. The period, according to this later determination, is 4·0235 days, and is a varying quantity (the Journal of the Royal Astronomical Society of Canada, No. 5, vol. iii.).

THE GAZELLES OF SEISTAN.[1]

MAJOR R. L. KENNION, British Consul at Seistan, has had the good fortune to bring to light what are practically two new species of gazelle from the Kain and Seistan districts of eastern Persia, specimens of both of these, presented by Major Kennion, being exhibited in the Natural History Museum. Of the first of these species, typified by the mounted head of a buck from Kain, two notices by myself appeared in the *Field* newspaper for 1908 (vol. cxi., pp. 70 and 499). In the earlier of these it was compared to the Atlas or edmi gazelle (*Gazella cuvieri*) and Merrill's gazelle (*G. merrilli*) of Palestine, with the former of which, and probably also with the latter, it agrees in the presence of horns in the female. Compared with the type-skull of Merrill's gazelle figured by Mr. O. Thomas in the Proceedings of the Zoological Society for 1904, vol.

[1] Communicated by permission of the Trustees of the British Museum.

ii., p. 348, the head of the Kain gazelle differs by its larger ($11\frac{1}{4}$ inches) and more fully ringed horns, the number of rings in this specimen being sixteen, and also by their less distinctly S-shaped curvature in profile, and rather more sublyrate form when seen from in front. In the general contour of the horns, the characters of the face-markings, the very tall ears, and the large bodily size, this gazelle comes, indeed, very close to the edmi, and in all these respects differs from the goitred gazelle (*G. subgutturosa*) of western Persia, as it also does by the smaller extent of the white area on the buttocks, which does not reach up to the root of the tail, but is restricted to the inner sides of the thighs. In this latter feature, shown in a mounted specimen, the Kain gazelle agrees with the Indian *G. bennetti,* from which it differs by its superior size (shoulder-height of a fully adult buck probably about 28 inches), larger ears, and more distinctly sublyrate and slightly incurving horns.

In the second notice I compared the Kain gazelle with the Yarkand gazelle (which I regard as specifically distinct from the goitred species), and named it *G. yarcandensis kennioni,* not being then aware that it differed by the presence of horns in the female and the smaller amount of white on the buttocks. The name *kennioni* would stand as a specific title were it not that in the Proceedings of the Zoological Society for 1873, p. 317, Dr. Blanford described a horned female gazelle from Jalk, on the Baluchi border of eastern Persia, as a new species under the name of *G. fuscifrons.* In a paper published in the same volume, p. 545, this species was recognised as valid by the late Sir Victor Brooke, who particularly referred to the large size of its ears as a distinctive feature, especially as compared to *subgutturosa.* Later on, however, Dr. Blanford, in the "Fauna of British India" (where Jalk is stated to be in Baluchistan, although in "Eastern Persia," he had rightly referred to it as forming the southern edge of the Seistan desert), identified *fuscifrons* with *bennetti,* on the ground that a male obtained by Sir O. St. John appeared inseparable from the latter. From the fact, however, that the Kain district, which is the northern continuation of the Seistan desert, is the home of a large gazelle allied to *bennetti* in the presence of horns in the female and the small extent of the white area on the rump, but with larger ears and rather more sublyrate horns, there can be no doubt that this gazelle is no other than *fuscifrons,* which must be re-established as a species. *Gazella yarcandensis kennioni* therefore becomes *G. fuscifrons,* although Kennion's gazelle may be retained as the English name.

This being so, it is doubtful whether the Indian *G. bennetti* really occurs in Persia at all. In "Eastern Persia" Dr. Blanford stated that he obtained a male referable to that species from the Bampur district of eastern Persia (alluded to as being in Baluchistan), which differed from Indian examples only in some details of the horns, adding that he believed this gazelle to extend on the lowlands to the head of the Persian Gulf, while above the 3000-foot contour it was replaced by the goitred gazelle, distinguishable, even at a distance, by its lighter colour. From the new evidence it appears that the lowland gazelle of the Persian Gulf is *fuscifrons* rather than *bennetti.*

The second of the Seistan gazelles is represented by an adult male standing about 39 inches at the shoulder, and characterised by the great size of the ears, the marked incurving of the tips of the sublyrate horns, and the small extent of the white area on the rump, which does not reach the root of the tail. In most of these features this species resembles the Yarkand gazelle, as it also does in the absence of horns in the female, although it differs by the small extent of the white on the rump, which in the Yarkand species (plate v. of Blanford's "Mammals of the Second Yarkand Mission") is very large and ascends high up on each side of the root of the tail. This gazelle greatly exceeds *subgutturosa* in size, as well as in the much larger ears, less divergent horns, and the smaller white rump-patch, but resembles that species in that the male has a "goitre." Taking the mounted specimen in the museum as the type, it may be known as the Seistan gazelle, *G. seistanica.*

The foregoing species collectively indicate a transition from the edmi and *bennetti* type on the one hand, to that of the goitred gazelle on the other, as is indicated in the case of some of the Asiatic species by the following table :—

(*a*) Females horned; no goitre; tips of horns not distinctly inturned; rump-patch small.

(1) Indian gazelle—*G. bennetti.*

Height about 25 or 26 inches; ears moderate; no inturning of horn-tips.

(2) Kennion's gazelle—*G. fuscifrons.*

Larger, height probably about 28 inches; ears longer; horn-tips slightly inturned.

(*a'*) Females (except *marica*) hornless; a goitre; tips of horns distinctly inturned.

(*b*) Rump-patch small; face-markings distinct.

(3) Seistan gazelle—*G. seistanica.*

Very large; height about 29 inches; ears very long; horns sublyrate.

(*b'*) Rump-patch large.

(*c*) Face-markings; horns sublyrate; colour dark.

(4) Saikik, or Yarkand gazelle—*G. yarcandensis.*

About the size of last, but ears apparently shorter.

(*c'*) Face-markings nearly obsolete; horns divergent; colour in winter very pale.

(5) Goitred gazelle—*G. subgutturosa.*

Size small, 24 to 26 inches; ears short; females hornless; dark lateral band faint.

(6) Marica gazelle—*G. marica.*

Ears taller; females horned; dark lateral band distinct.

The African edmi, and probably the Syrian Merrill's gazelle, come in the first group. The Mongolian *G. gutturosa* is a larger member of the last group, distinguished by the small size and peculiar form of the horns of the bucks, which do not diverge after the fashion of *subgutturosa.* The Central Asia *C. przewalskii* is another allied type.

Certain immature gazelles from Eastern Persia now exhibited in the Zoological Society's Gardens as *G. subgutturosa* are apparently *G. fuscifrons.*

R. Lydekker.

BOURNES, OR INTERMITTENT SPRINGS.

INTERMITTENT streams break out in our chalk valleys when there has been a partial return to the conditions of rainfall prevailing during the period of the excavation of the valleys. The effect of a heavy rainfall is not seen immediately. A bourne may, indeed, break out during a temporary drought following. Its immediate cause is the rise of the saturation-level until it intersects the bottom of the valley. The water then rises out of the ground, and flows until the curve of saturation sinks by reason of the relief afforded by the flow. While still rising, the bourne will make its appearance at successive points higher and higher up the valley.

These bournes afford a valuable clue to the method of formation of dry chalk valleys. Given a period of greater rainfall, and the permanent rise of the saturation-level would give a permanent stream, with considerable powers of excavation. Flints lining the bed of the Croydon Bourne are covered with a calcareous incrustation, so that solution and corrasion would both do work in the formation of the valley.

The earliest record of the Croydon and other bournes has been traced by Mr. Baldwin Latham to Warkworth's "Chronicle," which shows that in 1473 "womere watere ranne hugely." Bournes rose at St. Albans, Lewisham, and Canterbury, as well as at Croydon. In Leland's "Itinerary" reference is made to a bourne at Drelingore, near Dover, and this was also flowing in 1904, the year of the last great flow of the Croydon Bourne. In Yorkshire, the vipsies or gipseys are apparently similar to bournes. "Nailbourne" is a name formerly given to them in Kent, or, with a corruption of the spelling, "Eylebourn." "Wellesbourne" and "Winterbourne" are also met with. The Hertfordshire Bourne, which has again been active this year, was formerly known as the Wenmer, or Womer. This is referred to by Camden as breaking out near Watling Street. Childrey (1661) says that it is popularly believed that it never "breaketh out but it foretelleth dearth and scarcity of corn, or else some extraordinary dangerous times shortly to ensue." This, indeed, was a very customary superstition in connection with all these bournes. Pestilence and plague followed them; but we can safely say that the share that they had in these results was to disturb the filth of previous years which had accumulated in their channels, and when they ran through undrained villages to scatter the germs of disease far and wide.

Croydon may be regarded as the centre of a number of bournes. In addition to that known as the Croydon Bourne, there is what was, no doubt, once its tributary bourne, the Merstham or Marlpit Lane Bourne. There was formerly one in the Wickham Valley, and others at Cheam, Carshalton, and Epsom. The Merstham Bourne, which is also flowing this year, yielded, according to Mr. Latham, 1,108,530 gallons a day on March 21 at Stoat's Nest. This now rises in a culvert which was made to receive the waters, when the springs ran high, in the building of Merstham Tunnel, and it follows the valley northward towards Croydon, but sinks into the ground, as it has from time immemorial, at Red Lion Green, Smitham Bottom. This disappearance has not yet been explained. If it continued a mile and a half further along the valley it would join the Croydon Bourne at Purley, and together they would proceed by the bourne culvert to swell the volume of the Wandle where it emerges from beneath Croydon.

The present flow of the Croydon Bourne is not so extensive as that of 1904, when its point of origin gradually receded from the grounds of the "Rose and Crown," Warlingham, and the gasworks, which became completely surrounded with water, to the Marden Valley, which it entered, as far as Bughill Farm. Thence the dry chalk valley winds away to the escarpment, and we may reasonably conclude that the stream formerly filled the whole valley. This year, although the gasworks at Whyteleafe have a fair amount of water in the field around them, the rising point has fallen short of Bughill Farm, and in the opposite direction has not reached Purley. Its yield was, however, reported by Mr. Latham as 2,300,980 gallons a day on March 21 at a spot below the "Rose and Crown." There is no regularity in the appearance of the bourne. It last was seen in the winter of 1903–4, and previously in 1897. There were annual flows from 1876 to 1883 inclusive, and it is interesting to note that Mr. Latham has accurately predicted the last fourteen flows from the rainfall measured in numerous stations on and about the Downs.

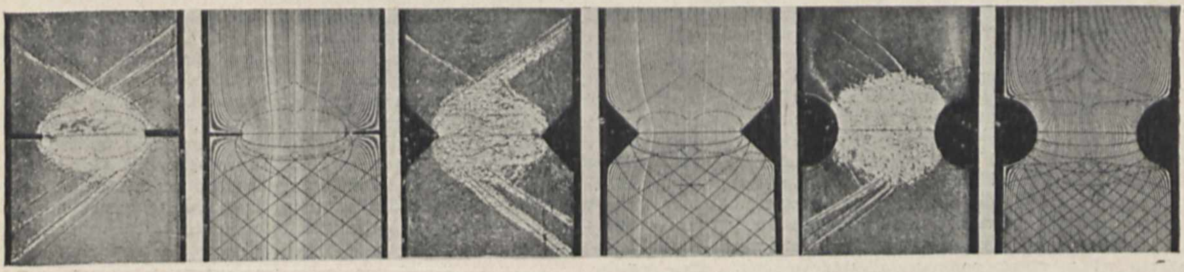
E. A. M.

STRESS LINES AND STREAM LINES.

THE general conditions of stress at any point in a loaded body have been reduced to certain mathematical equations, but there is considerable difficulty in applying these equations to any but the simplest cases. Experimental methods, therefore, are welcome, though they may give only approximations to correctness. One such method consists in deducing the stresses from the distortions produced by the load. The application of this method is frequently very difficult, but it has been simplified by the discovery and study of the phenomenon known as Lüders' lines.

Lüders' lines are markings which appear upon the surface of an iron or steel bar when permanently deformed, and they indicate the locality of the distortion. Observations show that these lines, in simple cases of loading, have an inclination of about 50° to the direction of maximum principal tension. Assuming that this inclination remains the same under more complex conditions of loading, it becomes possible to construct—at least in direction—the system of maximum principal tension from the lines of Lüders found upon a distorted piece. This method has been employed with some success, but it suffers from certain disadvantages. When the variation of stress is considerable, only those parts of the bar where the stress is greatest show any lines, unless the piece is so much deformed that the original distribution of stress is greatly altered. Thus the constructed stress system is either incomplete or inexact.

A more useful method is suggested by the similarity in the problems of elastic solids and of viscous fluids. Stress lines, which are lines of stress direction in a solid, possess certain points of similarity with stream lines, which are lines of flow direction in a liquid. In order to verify this connection, the comparison has been made between the stream system and the corresponding stress system for a number of two-dimensional cases.[1] The method employed consists in subjecting a steel bar of uniform thickness, but of varying width, to a tensile load, until a number of Lüders' lines are developed. The corresponding flow diagram is obtained, by means of the well-known Hele-Shaw apparatus, for a channel of the same outline as the bar. The position of one point on each line of Lüders is transferred to the flow diagram, and the form of a line of distortion passing through this point is constructed geometrically, assuming that the stream lines represent stress lines, and that the inclination of the lines of distortion to these is 50°. The constructed line is then superposed upon the corresponding line of Lüders; any divergence is an indication of a defective method or of faulty construction.



(1) (2) (3) (4) (5) (6)

Steel bars 2½ inches wide, ⅛ inch thick, reduced in width to 1½ inches by means of (1) two saw cuts, (3) two angular notches of 90°, (5) two semicircular notches. The light bands are the lines of Lüders. The fine dark lines have been transferred from the corresponding flow diagrams (2), (4), and (6).

The figures illustrate the results of three such cases. Although the correspondence between the constructed lines and the actual lines of Lüders is not perfect, due chiefly to certain inherent defects in the method, there seems little doubt that in these cases the stream-line system is a fairly accurate representation of the system of maximum principal tension.

G. H. G.

SCIENTIFIC KNOWLEDGE AND INDUSTRIAL DEVELOPMENT.

THE prizes and certificates of the successful students of the Bath Technical School were distributed by Principal E. H. Griffiths, F.R.S., of the University College, Cardiff, on February 2, when he delivered an address in which our educational system was discussed, and the value of technical education emphasised. We are indebted to the account of the proceedings in the *Bath Herald* of February 5, and to *Pen and Pencil* for November, 1909, for the facts contained in the following summary.

[1] "A New Experimental Method of Investigating Certain Systems of Stress." By G. H. Gulliver. Proceedings of the Royal Society of Edinburgh, Session 1909–10, vol. xxx., part i. (No. 3).

The latter periodical, which is issued by the students of the Cardiff Technical School, published a short article dealing with the value of science in industry by Principal Griffiths, which he elaborated in his address.

Principal Griffiths said that personally he prefers the words technical education rather than technical instruction, because we want in a technical school to do something more than the beginnings of a trade; we also want to expand the horizon, increase knowledge, and increase their abilities apart from the increased power it gives the students of earning their living later in life. We are, he continued, passing through a time in which there are certain difficulties naturally arising. There is no doubt that in the last ten years there has been a marked change in the aspect in which the question of education is regarded by the people, and those who need it. In such a time of change, as well as the advantages, there are dangers. We are spending an enormous sum of money—26,000,000*l.*—from Imperial sources in educating children to read, write, learn arithmetic, and so on. Into the hands of these children weapons are being put, and then they are not taught how to use them. It is a fearful blot on the whole educational system of the country that we spend millions and millions of pounds in laying foundations, and do nothing further. A great portion of the money is wasted, and if it were not for the existence of technical schools and the continuation classes the situation would be worse still. The time must come, said Principal Griffiths, when, if the educational system of the country is to be used to the best advantage, it must be recognised that young people, on leaving primary schools, and not able to get the advantages of secondary education, must be compelled to give a certain portion of the time between the ages of sixteen, seventeen, and eighteen to studying something which may be of value to them in after life.

Dealing with technical education, he insisted that the prosperity of this country depends upon its industries, and that its industries are dependent on the application of science. The truth of the former statement, he said, will be generally admitted, but as regards the latter there is some scepticism. It is difficult, for example, to see the direct connection between the zoologist peering through his microscope and dissecting the minutest insects, and the progress of a great commercial undertaking. The connection is, however, close and real. Take, for example, that great work now in process of accomplishment, the Panama Canal. The man who successfully constructed the Suez Canal was defeated in Panama, not by the physical, or even the political, difficulties, but by malaria and yellow fever. It has been stated that in the enormous work which was done before the project was abandoned by the French, a human life was sacrificed for every cubic yard of earth excavated. This is now a story of the past, and the death-rate amongst the workers to-day but slightly exceeds that prevalent in many of the American States. How has this change come about? No small part has been played by the School of Tropical Medicine established by the University of Liverpool.

An elaborate and prolonged investigation, in the course of which valuable lives were unfortunately sacrificed, resulted in the discovery that the dissemination of both malaria and yellow fever is due to so insignificant a creature as a certain species of mosquito, a discovery which will undoubtedly have a profound effect, not only on such undertakings as the Panama Canal, but on the march of civilisation in the future.

It is interesting to reflect that this discovery, like many others which have profoundly affected the commercial community, has been made by men without any thought of financial return, but who have been prompted solely by their love of research and their desire to add to the common stock of knowledge of mankind. It is not too much to say that every increase in natural knowledge will ultimately prove to have its use and application in the affairs of daily life.

Faraday was the first to establish the fact that an electric current may be generated by the movement of a conductor in a magnetic field. When he first exhibited at the Royal Institution the crucial experiment which vindicated his reasoning in this matter, a lady afterwards inquired, "But if so, Prof. Faraday, what is the use of it?" His reply was a memorable one, "Madam, will you tell me the use of a new-born child?" Reflect for a moment on the fruits of Faraday's discovery. True, numerous improvements have been made in the practical application of the principle by many workers, but all the applications of electricity which are now so frequent as to be regarded as familiar are based on the production of electricity by the expenditure of mechanical energy. Wherever a dynamo is used, there you have an application sprung from the brain of Faraday.

Mr. Stanley Jevons has made an approximate estimate of British capital invested in electrical undertakings which may be regarded as dependent on the mechanical generation of electrical power. It is safe to say that at least 185,000,000*l.* of capital are thus employed, and profitably employed, not only in increasing the comfort and welfare of the population as a whole, but in affording employment which otherwise would be wanting.

Examples of a similar kind could be multiplied almost indefinitely; but they are mentioned not so much to establish a proposition as to direct attention to the importance of scientific investigation, not only on its academic side, but also from a practical point of view.

It is by a recognition of this truth that Germany has in recent years outstripped us in some respects in the industrial race, and it is to such institutions as our technical schools and the laboratories of our colleges that we must look for the supply of men who are in the future to restore, if possible, the supremacy which seems to be passing from us. It must be remembered that not only must research receive encouragement, but we must train men in whom this country, as compared with both Germany and the United States, seems somewhat deficient—men who have sufficient scientific knowledge and ability to comprehend the discoveries of others and to apply such discoveries to the practical affairs of life. Men who can act as intermediaries between the laboratory and the market-place it is the special mission of our technical schools to supply.

In conclusion, Principal Griffiths commented on the fact that the man of business is not now as cynical of science as once he was, and, observing that no scientific discovery is useless, he added that there is nothing more likely to advance science than the institution of technical schools.

AËRONAUTICS.[1]

Any sensation of "wind" felt in a dirigible balloon is only that due to the independent speed of the balloon. It will always be the same, whether it be a following or a head wind, neither more nor less intense, because the surrounding wind is nothing but a movement of the atmosphere in which the balloon is submerged. Relatively to the ground below, a dirigible balloon may be going with the wind at 100 miles per hour, or against the wind making headway only at five miles an hour. If its engine be working at the same power in each case, the speed of the vessel relatively to the atmosphere is the same. Its envelope is only calculated to sustain the speed of which its engines are capable, and its stability depends upon a certain pressure of air not being exceeded. Bear in mind that wind is a body of calm air moving more or less rapidly. To the aëronaut wind does not exist. He is in calm: the earth is moving. A dirigible balloon may be in a current of air moving, say, from west to east at twenty miles per hour. With whatever speed it may be capable of, the balloon can move freely about in that current. The flow of air is always from the bows to the stern, and it is always of exactly the strength given by the independent speed of the airship.

No analogy of any marine vessel except the submarine is of any use to us; for in the ship you have either got a sail giving you leverage on the air, or you have the leverage of your keel or propeller giving you power against the wind. An airship cannot "tack" after the manner of a marine vessel. Nothing is to be gained by adopting a zig-zag course.

In mechanical flight the action of the air on the upper

[1] Abridged from Reports of Cantor Lectures delivered at the Royal Society of Arts by Mr. C. C. Turner and published in the Journal of the Society.

side of a plane has nothing whatever to do with lifting power. For instance, there is the familiar experiment with paper sometimes brought forward to show that the air passing over the back of the plane lifts it. As Phillips believed, it creates a vacuum on the upper rear extremity, and the paper naturally is pressed upwards; but let me explain the fallacy of the argument which seeks to show that the upper side of the plane therefore gives lifting power. If that piece of paper were free in the air, it would not matter how hard one blew on its upper surface it would not lift. It is only when it is held, in fact; and

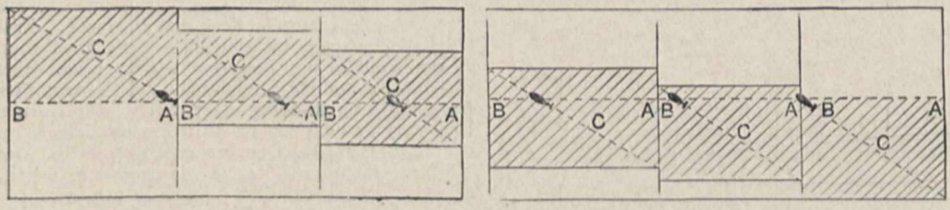


FIG. 1.—Course of Airship against Side Wind. A, starting-point. B, destination. The shaded portion is a moving body of air, *i.e.* the wind. The diagonal line, C, is the path of the airship with regard to the air. The dotted horizontal line is its path with respect to the earth.

the lifting power is derived entirely from the expenditure of energy. The harder one blows the more it lifts. The power to rise is derived entirely from the energy with which one blows, or, in the alternative of a plane being driven through the air, entirely from the energy of the motor. There is no lift at all without the expenditure of power by the engine.

Scarcely any of these theories of the action of the air on the back of the plane have been mathematically formulated. Indeed, we are only on the threshold of the science.

No analogy of the behaviour of other fluids is of much use when we come to deal with the air. The air is not

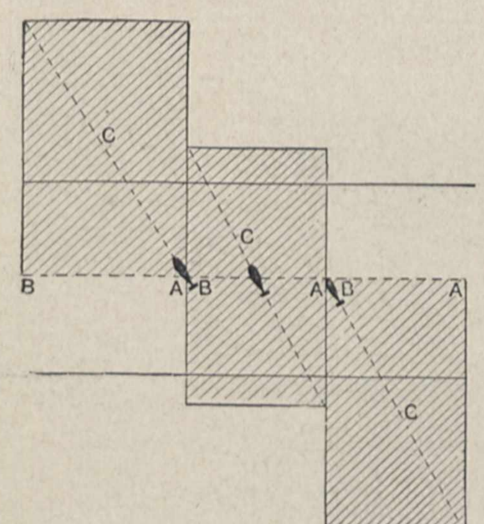


FIG. 2.—In this case the wind is stronger, *i.e.* a longer body of air passes in the same time. The airship therefore has farther to travel with regard to its passage through the air and takes longer in order to arrive at B. Apparently, while the airship keeps to a much greater angle, it moves along the dotted line A. B.

a perfect fluid. It is a very turbulent fluid. There are vortices and reverse movements at the back of the plane. Practically nothing is known of the mathematics of the subject. The leading mathematicians are silent, and I have observed that the only theorists putting forward their conclusions as if they were capable of scientific proof are minor men of science. It is very necessary at present to keep an open mind. Sir George Greenhill and Mr. Horace Darwin, who have been appointed to the Aëronautical Advisory Committee, have not yet issued any statement as to their researches—not that they are unwilling, but probably because they are unable at present to speak with any certainty.

It seems a long way from cricket to flying, but a remark by Mr. P. F. Warner in an article on modern bowling the other day suggests an important consideration for aviators. The great cricketer was discussing "swerving" balls, and he said, "The heavier the air the greater the cushion, and in the thick, smoke-laden atmosphere of Sheffield or Bradford Hirst will swerve infinitely more than in the clearer and brighter climate of Sydney, Adelaide or Johannesburg." It is scarcely necessary that we should point out the application to flight. An aëroplanist who found it easy to sustain flight at twenty miles an hour when near the ground might, on attaining an altitude of 4000 feet, find it necessary to increase his speed to forty miles an hour, or, rather, he could never get so high unless his engines were capable of giving the increased speed.

An attempt to secure some measure of stability is to place the planes at a dihedral angle, as in the Antoinette monoplane, in which the wings extend from the body in the form of a shallow V. This method was also formerly used by Blériot, but the tendency nowadays is to have horizontal and even slightly concave surfaces for the sake of the economy of surface involved. Now if Blériot reverted to the dihedral plane, he would have to make his machine two or three feet longer on each side. The dihedral plane is also wasteful of power. Instead, as we have seen, he relies entirely on the wing-warping arrangement for stability.

Cocking tried an inverted parachute in order to secure a steady fall instead of the swinging movement which all parachutists have to endure. It is true Cocking's apparatus gave way under the strain, but in any case it is quite certain that he did not give large enough diameter to his parachute, made on that principle, to sustain him.

This brings us to the discussion of a rather contentious point—that of the suspended centre of gravity. We have seen how early gliders depended below the sustaining planes. Now, in the Antoinette the weight is carried on

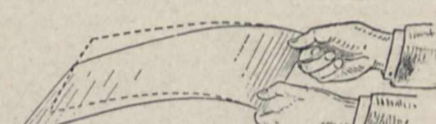


FIG. 3.—A Paper Experiment. The effect of blowing on the forward edge of a curved plane. Dotted lines show how paper rises.

the same level as the sustaining surface. Well, in the Blériot cross-Channel machine the centre of weight is slightly below the sustaining surface. In the Santos-Dumont it is considerably below. In the newest Blériot it is also well below, and in the Chauvière monoplane it is as much as 3 feet below. Now from what has been already said it will be seen that this secures stability only in the very smallest degree, and that the weight would have to be 30 or 40 feet below in order to secure the desired effect; and then you could never get the driving power necessary; but it is probable that M. Blériot, M. Santos-Dumont, and M. Chauvière, in constructing their machines in this way, have an eye, not to improve stability, but to other advantages. By this method they can obtain various constructional advantages, above all, a continuous leading edge by which they greatly economise lifting power. In short, they manage with a smaller machine. They make no effort, be it noted, to rely any less upon their wing-warping arrangements.

An aëroplane must travel at a certain speed to support itself at all. To enable it to rise to a higher altitude the power must be increased. There is, of course, a margin of variability; but beyond this margin merely to point the elevating rudder at an increased angle is insufficient. You can obtain ascensional power at the expense of speed, but there is a point below which the speed must not be reduced.

There is, as we have seen, a natural speed for an aëroplane, and this natural speed is only elastic within limits. A remarkable variation on one machine was shown by M. Delagrange at Doncaster. With a cross-Channel Blériot, to which he had attached a 50 horse-power Gnome motor, flying with the wind, he flew at a rate of forty

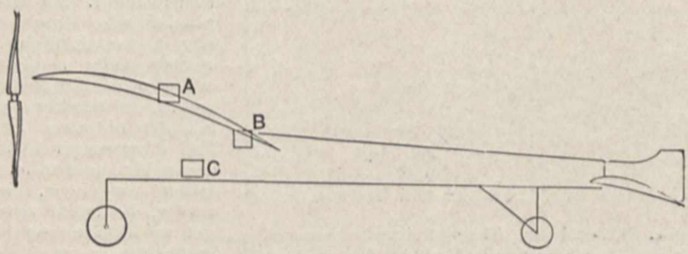


Fig. 4.—Position of Pilot. A, Antoinette, R.E.P. B, Blériot. C, Santos-Dumont.

miles per hour. On the very next day, in a dead calm, with the same machine, he flew at the rate of fifty miles an hour. The difference, which was equivalent to 20 per cent., was due to the fact that he was getting more work out of the motor. On the same type of machine, with a 25 horse-power Anzani motor, the best speed was only about thirty-three miles per hour. M. Delagrange said he could vary the speed 30 per cent. Another instance of driving a flying machine with increased power has been provided by M. Santos-Dumont, who put a 40 horse-power motor to his little monoplane, which gives about 300 per cent. more than the usual proportion of power to lifting area.

Now to obtain great variability of speed we shall have to have lifting surfaces that can be enlarged and diminished at will, and correspond with different engine-power.

The most scientific attempt to obtain the variable plane area is on the Chauvière monoplane, in which, while, in present designs, the leading edge remains rigid, the plane is quite flexible, and the rear edge can be let forward or pulled back by the tightening or slackening of cords, so that the width of the plane is either narrow or broad. When narrow, for high speed, the pressure of the air bulges the plane to an increased curve.

As to the development of the flying machine, differentiation will, in the main, respond to certain demands. We can clearly foresee development with both monoplane and biplane.

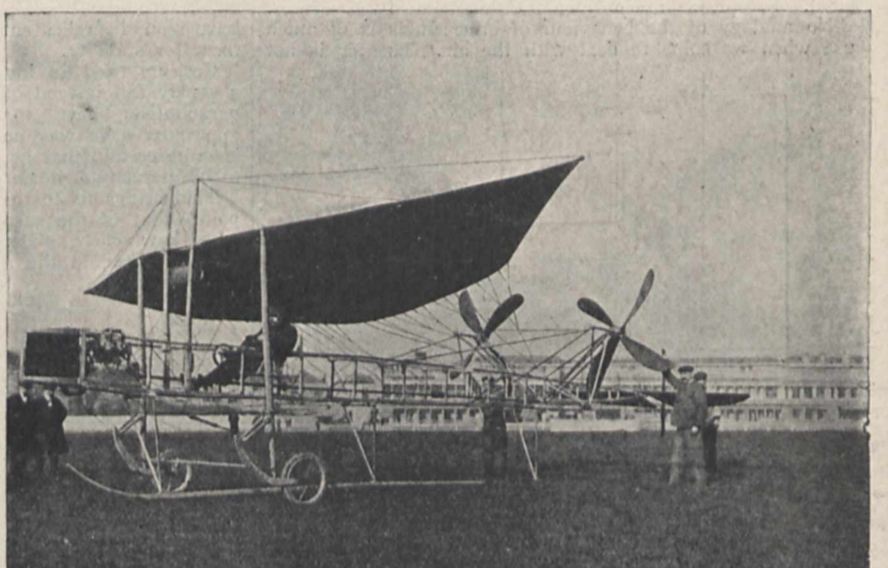


Fig. 5.—The Chauvière Monoplane. An attempt to embody the principle of the variable lifting surface. The plane has a rigid leading edge, but is itself simply a sail. In flight the pressure of air underneath gives it a camber. The rear edge can be slackened and tightened at will to suit different speeds, the sides alternately or in unison.

The racing aëroplanes will probably be monoplanes with comparatively small lifting surface, high speed giving the necessary lifting-power. The racing aëroplane will not carry a great weight, and the power of the engine will be required for driving at a great speed without more waste of energy than is unavoidable. It is, of course, an axiom that the greater the speed the less the waste of power. Monoplanes will very probably develop into a permanent racing type.

The near future will see machines in which three or four passengers can be carried, and in which the control can be in the hands of two pilots. Sooner or later we shall get the machine attempted with two motors instead of one; and quite certainly we shall have the machine with variable lifting surface and variable power.

We know that an aëroplane can descend safely on to water. M. Latham did that in his attempt to cross the Channel. Soon we shall have machines that can ascend from water.

The use of dirigible balloons, especially in this country, where strong breezes are common, calls for airship harbours at frequent intervals. Probably shelter walls capable of being turned round to the wind in any direction will be used. Each will have a staff of attendants, and the walls will not always be standing erect, but will be so made that they can be run up in a few minutes whenever an airship approaches and signals its need. To have them every ten miles or so all over the country always standing would be intolerable.

An airship has nothing to fear from any wind while she is in the air, but on landing even an ordinary breeze may wreck her. It is all very well for the Germans to show us what they can do with dirigible balloons, but in the great central plain of Europe there is comparatively little wind. They are not handicapped as we are; but in this country so frequently and quickly do strong winds spring up that it may be doubted whether any airships that could not be quickly deflated would be of use. We may discover that we can only employ the semi-rigid and the non-rigid balloon. The rigid balloon at Barrow may be a big blunder after all.

A NATIONAL SYSTEM OF TECHNICAL EDUCATION.[1]

The problem of remedying the admitted inefficiency of our present methods of technical education, and of invigorating the industries of this country with progressive scientific spirit, while at the same time increasing the

[1] From a paper read before the Association of Teachers in Technical Institutions (West Yorkshire Branch) at Leeds, on April 2, by Dr. Robert Pohl.

supply of skilled workmen, is of the greatest national importance, and is a problem the solution of which, in view of international industrial competition, becomes daily more pressing. It is only natural, therefore, that expressions of discontent with the present conditions, and suggestions for improvement, should be heard from many sides; they come, not only from the educationists, but also from the employer, the representatives of the working classes, and the ratepayers, and with especial force from the social reformer; finally, we hear from Cabinet Ministers themselves that legislation on the subject is under consideration.

If we proceed to analyse the expressions of opinion, as revealed during the last twelve months in special papers, presidential addresses, reports and discussions, too numerous to refer to individually, there is a clear indication that, barely concealed under a superficial diversity of view-point, the ideas have already crystallised round two fundamental principles which are certain to form the basis of all future constructive work.

These are:—(1) There should be a thoroughly organised system of technical education, leading up from the primary and secondary schools to the technical school, and having, as its crown, the technical university, every stage of the system being in intimate contact with the next, so far as possible without overlapping, and the educational work must be carried out in the closest possible cooperation with the employer. (2) This system should be a national one; that is to say, the Board of Education should not only inspect and supervise the individual institutions, but should ensure proper coordination; extend by law the leaving age for children, when and where necessary; enlist by all available means the cooperation of employers, and introduce a uniform system of examinations and degrees; and it should, from its exalted position, watch the working of the system, comparing it with that of other nations, and generally employing and developing the powerful weapon of technical education in the interests of the industries and the progress of the nation as a whole.

I take it as being agreed upon that the scientific leaders of industry require much more complete training than the rank and file of the industrial army, chiefly the additional training of strict scientific accuracy, of research, and originality. That in view of the numbers to be dealt with in both sections, respectively, there must be a large number of schools for the rank and file in close contact with local industries, and a small number of colleges for the officers. This means decentralisation in the case of lower technical schools, and centralisation for the technical universities. I have dealt in a previous paper with the Prussian technical universities (Nature, April 15, 1909, vol. lxxx., p. 205). How does Prussia attend to the needs of the rank and file? There were, in 1909, 23 national engineering schools, 24 national building schools, 7 national art and artisan schools, and 45 State-supported municipal technical schools of different kinds, including 6 textile schools and 7 higher textile schools. Most of these institutions do no evening work, and the students pass through systematic courses extending over several years. During this time they are not in contact with practice, except that the building students, making the best of climatic conditions, frequently work in summer and study during the winter months, and that other students sometimes do practical work during the summer vacations. Generally speaking, however, the students are not in contact with practice. I also incline to the view that there has been too much centralisation in this branch of technical education. As a consequence, there is a lack of intimate contact with local industries, and insufficient amalgamation of theory and practice. Furthermore, most of these schools do not really train skilled workmen and artisans, but what may be termed the non-commissioned officers of the industrial army. The courses are somewhat expensive, and, through the almost complete absence of a system of scholarships, they cater more for the middle classes than the working classes. Another defect, and a very serious one in my opinion, is the absence of systematic cooperation between these schools and the technical universities, whereby students of exceptional ability would be sent up to the latter.

In England the corresponding educational work is overwhelmingly carried on in evening classes, and, though in principle I am in the fullest agreement with those who object to all evening work and wish it transferred to the day, I cannot but admire the magnificent work now done under the course system in evening schools, and the most valuable and unique features of the same. What are they? It is, first and foremost, the intimate and continued contact of the students with practice which infuses their daily work with heightened interest derived from the application of their studies, and, on the other hand, reacts on the teacher and makes the courses, though they must remain theoretical, yet of a thoroughly practical nature and best suited to the needs of the local industries. It is, secondly, the complete elimination of the bitter disappointment which many day students, in proud possession of first-class certificates and diplomas, now experience when they find that they cannot secure any suitable employment. This "sandwich" or "half-time" system, which we so justly condemn when it is applied to primary education, is, in my view, the ideal system for the training of the industrial rank and file. I am therefore of opinion that those who desire to see the present evening work abolished, and the day schools developed on the German lines, are very ill-advised. Whatever we do, let us retain the great feature of the English principle, that is, the concurrent training in factory and school. Let us make the present evening courses much more efficient by establishing proper cooperation with the employers, and by reducing the hours of labour, so that it becomes possible gradually to shift the centre of gravity from the evening to the day. Thus we shall obtain all we are striving for without losing the great features I have emphasised, as well as the truly democratic spirit of the present system and its hold on the masses of the population. In advocating progress in this direction, we shall work in harmony with the enlightened employer and with the trades unions, and we have on our side the powerful influence of the social reformer as expressed in the reports of the Poor Law Commission. Indeed, the President of the Board of Education, in a reply to a deputation from the Trades Union Congress only a few days ago, indicated that legislation on these lines—including the raising of the leaving age and technical classes during daytime in cooperation with employers—is under consideration, and it remains to us to insist that the Bill shall be speedily produced and placed on the Statute book in a shape which conforms with our views.

We must convince employers that the developments which are shortly to take place are first and foremost in their own interests, and we should insist that definite provision be made in the promised Bill for an advisory board to be attached to each technical school, such board to have subcommittees representative of the chief local industries and trades; but there is a further, and, if possible, more important point to be considered. The technical school, as thus firmly established by law, must not be an isolated unit in our educational system, but it must be a link in a complete chain. It must join at the bottom with the secondary school, especially with the technical secondary laid down as a desideratum in our resolutions of last year, and it should lead up to the technical university above. It is the need for an organic connection of the ordinary work with the highest form of technical education on which I wish to lay particular stress. No better form can I imagine for this link than that of a comprehensive and national scheme of maintenance scholarships, by means of which the students of exceptional ability and enthusiasm are lifted up and trained to be the scientific leaders and original workers.

What would be the cost to the nation of such a scheme? Assuming 250 national scholarships to be awarded annually, tenable for four years, value 75*l.* per annum and free tuition, we arrive at the trifling expense for this highly productive scheme of 75,000*l.*, about one-thousandth part of what we spend every year on unproductive armaments. Surely, looking at it from a business point of view, no sounder investment could be imagined, and there is little doubt that if the nation would institute this magnificent plan, the municipalities, the wealthy industrial and professional societies, and private benefactors, would come forward to expand it and make it more fruitful.

Thus we have arrived at the technical university, and in passing I will only remark that up to this level of technical education there is every likelihood of Prussia having shortly to learn a great deal from England. The aspect changes completely, however, when we contemplate the higher branches. In the latter, in Prussia we find thorough organisation and efficiency; in England we find chaos and waste of energy and money. The explanation is simple: the Prussian technical high schools are national institutions, just sufficient in number for the needs of the whole nation so as to allow of intense specialisation in all branches. The many English institutions attempting higher technical work were founded by private persons, guilds, societies, municipalities, and whosoever liked to distinguish himself in this direction. The national Government has made the sad mistake of generously supporting all these well-meant efforts, so far with little regard, apparently, to the effect of the one on the other. The borough, and even the county, is far too small a feeding area for a modern technical university, with its large staff of specialised experts in all branches, training original workers, carrying out industrial research, and generally permeating the industries with progressive ideas.

How will it be possible to bring about the formation of such efficient universities? Without doubt, the difficulties of this task are formidable, yet they can be surmounted by a strong Minister of Education, and the accomplishment will earn for him the gratitude of generations.

As an introduction to a discussion on this particular question, one or two suggestions may perhaps be acceptable. Needless to say, decisive steps in the direction indicated must be preceded by an exhaustive inquiry of a Royal Commission into the whole subject. One of the aims of the commission would be to discover a ready means of correlating the work of universities with that of other institutions which, as yet, is non-existent. It may be found desirable that all Exchequer grants for educational purposes, without exception, should pass through the Board of Education in such a manner that the grant becomes an effective weapon of organisation. Another important point to be settled is the number of technical universities needed, and their respective feeding areas. I believe that three for England and Wales, one for Scotland, and one for Ireland, or even less, would be found to be sufficient for many years to come. Finally, the most difficult point as to the method of procedure will have to be decided.

It appears not unlikely that, as a result of the inquiry of the special Royal Commission appointed last year, such amalgamation may soon be brought about so far as London is concerned, and an early extension of the principle to the provinces would then be within the range of probability. The leading institutions at present existing in each university area decided upon would form the constituent colleges; they might have the first and second years' courses in common, which, of necessity, would be generally scientific and educational in character, including such subjects as national economy, industrial history, industrial legislation, patent laws, &c., but the higher branches would be distributed according to the nature of the institutions and the industrial activities of the districts. Thus the desired concentration of effort and of students would be secured, and, by a process of natural development, the formation of a large staff of specialists in each branch working in intimate contact with their respective industries.

Higher technical education in England, if developed on such lines, would have adopted only one important point from the Prussian system, that is, organisation on a national basis, a point which, in my opinion, is indispensable to success. Other and less important points of similarity, such as the uniform system of examinations and of legally protected degrees, would come as a natural consequence. In more than one regard, of profound importance, however, the English would be far in advance of any existing system, so far as my knowledge goes; first, in its democratic principle, culminating in the character of its students, who, gathered by a process of sifting and selection, represent the genius of the rising generation in whatever sphere it may have been born—a class, not of aristocratic idlers, but of enthusiastic workers. This ideal we shall approach only gradually, yet it is in sight, and we may accelerate its coming by advocating that the fees of the new universities for all except the scholarship students shall not be kept low, but shall be, at any rate, in proportion to the cost of such institutions. The scholarship students will thus predominate more and more, which makes it possible at the same time to adjust the number of highly trained men to the needs of the industries. We shall thus avoid excessive supply, which is a social and economic danger, and is a blame often, and not unjustly, attached to the German high schools; and, finally, the close cooperation of the new universities with the respective industries would be a unique feature. It would be maintained, not only, as in Germany, through the professors and lecturers, but through their advisory boards, and, what is perhaps most important, through the students themselves, who have been in contact with practice, not merely for a short term of pupilage like the average German student, but who have passed "through the mill."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Dr. Arthur Willey, F.R.S., director of the natural history museum at Colombo, has been appointed to the chair of zoology at McGill University, Montreal.

On Friday, April 22, the Education Bill restricting half-time employment will be considered by the House of Commons if the Government leave the day free. It is hoped that time will be found for the consideration of this important and long-delayed reform in the present Parliament.

The London Inter-collegiate Scholarships Board announces that an examination will be held on May 10 for twenty entrance scholarships and exhibitions of an aggregate total value of about 1500*l.*, open to men and women, and tenable in the faculties of arts, science, and engineering of University College, King's College, and the East London College. Candidates must have passed the matriculation examination of the University of London, or an examination accepted in lieu thereof, or be able to furnish some evidence of having had a sound general education. Full particulars and entry forms may be obtained from the secretary of the Board, Mr. Alfred E. G. Attoe, University College, Gower Street, London, W.C.

The Department of Agriculture and Technical Instruction for Ireland will in August next award not more than six industrial scholarships to persons engaged in industries, such as the woollen, linen, leather, and tanning industries. The object of these scholarships is to enable selected persons, who must already have been engaged in one of the higher branches of the industry, to take a full course of instruction in an institution providing special courses of an approved character, with the view of training them for the management of such an industry. The scholarships will be tenable at some higher institution, to be approved by the Department, in which the industry, and the principles underlying it, are taught. They will be of the value of 80*l.* each, and may be renewed for a second or a third year at the discretion of the Department. The Department will also award not more than six commercial scholarships to young men having a sound general education and some commercial experience. The object is to afford facilities for the holders to obtain training in some higher institution, approved by the Department, with the view of their employment as teachers of commercial subjects in Ireland. The commercial scholarships are of the value of 100*l.* each, and are tenable for two years.

On the occasion of the opening of the Carnegie Science Building at Acadia University, Wolfville, N.S., last October, Prof. H. A. Bumstead, of Yale University, delivered an address on the functions of a university laboratory. A reprint of the address is published in *Science* of March 11. After dealing with scientific studies from the disciplinary and ethical points of view, and urging that they are peculiarly adapted to the purpose of leading young men into the paths of careful, sensible, fearless, original thinking, he pointed out that laboratories have a much higher educational function to perform than merely to produce engineers or technical chemists or practising physicians; but Prof. Bumstead insisted most on the laboratory being a place for research. True research, real scientific pioneering, does not strongly appeal to the general public; its applications may be remote, it shows no immediate profit, its achievements are not spectacular, and are often too technical to be understood fully by any but experts. Thus it comes about that it must be encouraged and supported by the more enlightened fraction of mankind, and the chief agency through which this support may be given is the university or college. No other institution has been devised or seems likely to be invented which can perform the task so well. Research is not altogether a business, but an art as well, and that while organisation and division of labour may be the life of business, it is not the soul of art. To produce the highest results in scientific research there must be individuality and freedom, and there is room for far more individuality in a university laboratory than in any special research laboratory which has hitherto been established. Engaging in research is the best way and the only certain way for a teacher to keep himself alive intellectually and to retain his spirit and enthusiasm to the end. Even if the college he serves regards teaching and not research as its chief business, even then a professor must be given a reasonable amount of time and reasonable opportunities for research in order that he may keep his intellectual health, just as he is given time for physical exercise in order that he may maintain his bodily health.

When we directed attention about two years ago to the second part of the first volume of the Journal of the Municipal School of Technology, Manchester, a volume of 130 pages of reprints of papers written by members of the staff of the school during the years 1903–7, we expressed doubt as to whether the output of research from the school was adequate in view of the fact that the staff numbered 100. The appearance of vol. ii. of the journal, which contains nearly 300 pages, and covers the papers published by the staff during the year 1908 only, removes all possibility of doubt on this score, and shows conclusively that the educational authorities of Manchester are alive to the importance of creating an atmosphere of investigation throughout the school. Of the sixteen papers reprinted in the second volume, three deal with pure chemistry, and form part of the series on the relations between outer form and chemical structure with which Prof. Pope's name is so closely associated; six deal with cotton, the staple trade of Manchester; five deal with electrical engineering and its teaching; one with mechanical and one with sanitary engineering. This list shows that the most important departments are all permeated by the desire to advance the subject with which they deal, and we may hope for a long succession of volumes from the school like the one before us. In the note referred to above regret was expressed that there seemed to be little evidence that the larger polytechnics in and about London, and the technical schools in the great towns of the provinces, *e.g.* Birmingham, Glasgow, and Belfast, adequately appreciated the importance of making themselves, above everything, centres of research for the solution of those problems which the highly specialised processes carried out in each district are constantly encountering. Far too many of the institutions of this type distributed over the country are content to record the thousands who have been taught elementary science within their walls, when the record is but one of their failure to do anything more than fill in some of the most conspicuous gaps in the education of those who come to them from the primary or secondary schools of the district. It is necessary to urge such schools to leave elementary-school work to the elementary schools, and to make themselves efficient as centres for the higher work of teaching and research in the subjects which bear on the principal trades of the district. May the example of Manchester spur them on to a better use of their opportunities.

SOCIETIES AND ACADEMIES.

London.

Zoological Society, April 5.—Prof. E. A. Minchin, vice-president, in the chair.—R. H. **Whitehouse**: The caudal fin of the Teleostomi. The paper dealt with the structure of the caudal fin in about fifty different species of fishes, mostly Teleostei, and representative of nearly all the sub-groups. After each sub-group a few general remarks were added, and these were followed by a short summary of results dealing with definitions and the taxonomic value of the caudal fin.—T. M. S. **English**: Some notes on Tasmanian frogs. The paper was based on observations made during rather more than two years' residence in Tasmania.

Paris.

Academy of Sciences, April 4.—M. Émile Picard in the chair.—The president announced the death of A. Agassiz, foreign associate.—Wilfred **de Fonvielle**: The theory of Fontenelle relating to the constitution of comets. The author maintains the possibility of Fontenelle's view that the comet acts as a gaseous lens, and discusses Kepler's objections to this theory.—J. **Haag**: The spherical representation of certain families of Lamé.—René **Arnoux**: The longitudinal equilibrium and curvature of the carrying surfaces of aëroplanes. The effect of increasing the curvature of the supporting surfaces is to increase the power of support, but, at the same time, the resistance to translation is increased, and the longitudinal equilibrium becomes unstable.—A. **Votton** and H. **Mouton**: Havelock's relation between double refraction and the index of refraction. Havelock's formula has been verified experimentally by Skinner and McComb for the magnetic double refraction of eight liquids, and the authors have also verified it for nitrobenzene. This formula is based on the assumption that the field modifies the distribution, but it is also consistent with the hypothesis that there is an orientation of the anisotropic molecules.—F. **Croze**: The prolongation of the band spectrum of nitrogen in the extreme red and the infra-red.—V. **Crémieu**: A systematic error limiting the precision of the Cavendish experiment. A new method for the study of gravitation. The error is caused by a supplementary couple resulting from the bending of the supporting wire. A method is outlined by which this error can be eliminated.—C. **Chéneveau**: The specific refractive powers or optical constants of dissolved substances in very dilute solution. An interference method was used, and the error due to differences of temperature in the two vessels discovered and eliminated. Ionisation does not appear to have any sensible influence on the refractive power of a dissolved substance in solutions of which the concentrations are more than 0·5 gram per litre.—Louis **Wertenstein**: The paths of radio-active projections.—A. **Besson** and L. **Fournier**: The reduction of the chlorides of boron and arsenic by hydrogen under the influence of the silent discharge. Arsenic trichloride is reduced, and a substance is formed the composition of which corresponds to $As_{11}Cl$; this may possibly be a mixture of arsenic and a lower chloride than $AsCl_3$. No subchloride of boron could be obtained.—J. **Bougault**: The acid-alcohols of conifers. Juniperic and sabinic acids. Juniperic acid was proved to be $CH_2(OH).(CH_2)_{14}.CO_2H$, and sabinic acid

$$CH_2(OH).(CH_2)_{10}.CO_2H.$$

Thapsic acid, extracted by F. Canzoneri from the resin of *Thapsia Garganica*, was shown to be identical with juniperic acid.—Marcel **Delépine**: Some organic compounds spontaneously oxidisable with phosphorescence. Eleven substances are described which possess this property, all having in common the group (S=C—O—).—E. **Voisenet**: The detection of hexamethylenetetramine in musts and wines. The process is based on the fractional distillation of the acidified wine, followed by a colour test with albumen, hydrochloric acid, and nitrous acid. The latter is stated to be a specific test for formaldehyde.—P. **Vuillemin**: Materials for a rational classification of the *Fungi imperfecti*.—M. **Biéler-Chatelan**: A drainage effect.—H. **Bordier** and R. **Horand**: The action of the ultra-violet rays on trypanosomes. The action of the rays has been followed continuously under the microscope. The trypanosomes become rapidly granular, and their bodies, having the same refractive index as the surrounding medium, cannot be seen.—M. **Lecoq**: The toxic power of metalloidal arsenic. This is much less than that of corresponding quantities of arsenious oxide.—Emm. **Pozzi-Escot**: A bird of the runner family, confined to the high summits of the Peruvian Andes.—Charles **Nicolle** and L. **Manceaux**: The experimental reproduction of the pustule of the East in the dog. The possibly canine origin of this disease.—F. **Diénert**: The search for fluorescent substances in mineral waters.

DIARY OF SOCIETIES.

THURSDAY, APRIL 14.

ROYAL SOCIETY, at 4.30.—On the Viscous Flow in Metals and Allied Phenomena: E. N. da C. Andrade.—The Refraction and Dispersion of Argon, and Redeterminations of the Dispersion of Helium, Neon, Krypton and Xenon: C. and M. Cuthbertson.—The Action of the Radiation from Radium Bromide upon the Skin of the Ear of the Rabbit: T. O. W. Barratt.—A Physiological Effect of an Alternating Magnetic Field: Prof. S. P. Thompson, F.R.S.

ROYAL INSTITUTION, at 3.—The Himalayan Region: Dr. Tom G. Longstaff.

FRIDAY, APRIL 15.

ROYAL INSTITUTION, at 9.—The Chemical Significance of Crystal Structure: Prof. W. J. Pope, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—*Further discussion*: Compounding and Superheating in Horwich Locomotives: G. Hughes.—*Probable Paper*: A Research on the Hardening of Carbon and Low-tungsten Tool-steels: S. N. Brayshaw.

SATURDAY, APRIL 16.

ROYAL INSTITUTION, at 3.—Bells, Carillons and Chimes: W. W. Starmer.

MONDAY, APRIL 18.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Glacier Exploration in the Eastern Karakoram: Dr. T. G. Longstaff.

VICTORIA INSTITUTE, at 4.30.—Plato's Theory of Public Education in Relation to the Christian Doctrine of Human Nature: Rev. H. J. R. Marston.

ROYAL SOCIETY OF ARTS, at 8.—Modern Methods of Brick-making: Dr. A. B. Searle.

TUESDAY, APRIL 19.

ROYAL INSTITUTION, at 3.—The Modern Development of the Problem of Alcoholic Fermentation: Dr. A. Harden, F.R.S.

ROYAL STATISTICAL SOCIETY, at 5.

ZOOLOGICAL SOCIETY, at 8.30.—Notes on the Photophores of Decapod Crustacea: Stanley Kemp.—On the Varieties of *Mus rattus* in Egypt, with General Notes on the Species having reference to Variation and Heredity: J. Lewis Bonhote.—On an Example of Posterior Dichotomy in an Aylesbury Duckling: G. E. Bullen.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Use of Reinforced Concrete on the Wabash Railroad, U.S.A.: E. R. Matthews and A. O. Cunningham.

WEDNESDAY, APRIL 20.

ROYAL MICROSCOPICAL SOCIETY, at 8.—(1) Critical Microscopy; (2) What did our Forefathers see in a Microscope? E. M. Nelson.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Line Squalls and Associated Phenomena: R. G. K. Lempfert and R. Corless.—Daily Rainfall at the Royal Observatory, Greenwich, 1841–1903: W. C. Nash.

ROYAL SOCIETY OF ARTS, at 8.—Industrial England in 1754 (the Date of the Foundation of the Society): Sir H. Trueman Wood.

THURSDAY, APRIL 21.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Incidence of Light upon a Transparent Sphere of Dimensions comparable with the Wave-length: Lord Rayleigh, O.M., F.R.S.—On the Improbability of a Random Distribution of the Stars in Space: Prof. Karl Pearson, F.R.S.—The Total Ionisation produced in Different Gases by the Kathode Rays ejected by X-Rays: Dr. R. D. Kleeman.

ROYAL INSTITUTION, at 3.—The Himalayan Region: Dr. Tom G. Longstaff.

CONCRETE INSTITUTE, at 8.—The Effect of Sewage and Sewage Gases on Portland Cement Concrete: S. H. Chambers.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Hydro-electric Installations of Sweden: A. V. Clayton.

ROYAL SOCIETY OF ARTS, at 4.30.—The Arts and Crafts of Tibet, and the Eastern Himalayas: J. Claude White.

ROYAL GEOGRAPHICAL SOCIETY, at 4.30.—Dewponds: E. A. Martin.

LINNEAN SOCIETY, at 8.—The Seedling and Adult Anatomy of *Welwitschia mirabilis*: Miss M. G. Sykes.—Anthomyidæ auf den Seychellen gesammelt: Prof. P. Stein.—The Dermaptera of the Seychelles: Dr. Malcolm Burr.—The Pteropoda and Heteropoda collected by the Percy Sladen Trust Expedition in the Indian Ocean: Dr. J. J. Tesch.—Die Pilzmücken Fauna der Seychellen: Dr. G. Enderlein.

FRIDAY, APRIL 22.

ROYAL INSTITUTION, at 9.—The Telegraphy of Photographs, Wireless and by Wire: T. Thorne Baker.

PHYSICAL SOCIETY, at 5.—Further Tests of Brittle Materials under Combined Stress: W. A. Scoble.—The Magnetic Balance of Curie and Cheneveau: C. Cheneveau with A. C. Jolley.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The History and Present Method of Quay-wall Construction at the Port of Rotterdam: H. C. A. Thieme.

SATURDAY, APRIL 23.

ROYAL INSTITUTION, at 3.—Bells, Carillons and Chimes: W. W. Starmer.

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