THURSDAY, APRIL 28, 1910.

DYNAMICS IN ENGLAND, FRANCE, AND GERMANY.

(1) *Elementary Mechanics of Solids and Fluids.* By Dr. A. Clement Jones and C. H. Blomfield. Pp. vi+366+xvi. (London: Edward Arnold, n.d.) Price 4s. 6d.

(2) *An Elementary Treatise on the Dynamics of a Particle and of Rigid Bodies.* By S. L. Loney. Pp. viii+374. (Cambridge: University Press, 1909–10.)

(3) *Initiation à la Mécanique.* By Ch. Éd. Guillaume. Pp. xiv+214. (Paris: Librairie Hachette and Co., 1909.) Price 2 francs.

(4) *Die Mechanik, eine Einfuhrung mit einem metaphysischen Nachwort.* By Dr. Ludwig Tesar. Pp. xiv+220. (Leipzig and Berlin: B. G. Teubner.) Price 3.20 marks.

(5) *Vorlesungen über technische Mechanik.* By Prof. Dr. August Föppl. III. Festigkeitslehre, 4th edition. Pp. xvi+426. Price 10 marks. VI. Die wichtigsten Lehren der höheren Dynamik. Pp. xii+490. Price 12 marks. (Leipzig: B. G. Teubner, 1909–10.)

NEARLY five years have elapsed since the indefatigable Prof. Perry opened a discussion on the teaching of mechanics at Johannesburg. Mr. Blomfield is a teacher of considerable experience, and this book may be safely assumed to be the outcome of a study of this and other similar reports, combined with a practical knowledge of the difficulties of teaching boys, and of the requirements which a teacher has to satisfy on the part of examining boards over which, unfortunately, he possesses no power of control. There have been a few, but not many, books on elementary mechanics published since the Johannesburg discussion, and we naturally examine the present book with a somewhat hypercritical eye, in the hope of finding some indications as to whether any real improvement has been effected since then. Let us begin with generalities, and then descend to details.

(1) In the first place, a good deal of discussion has taken place as to how far the use of text-books is desirable in school teaching, the following alternatives being proposed:—

(*a*) No text-book.

(*b*) A text-book consisting of examples only.

(*c*) A text-book containing a complete exposition of the subject.

It is the opinion of many of the best teachers that a text-book should contain a brief but sufficiently complete outline of fundamental principles, but that examples should be the main feature. In this respect Messrs. Jones and Blomfield's book leaves nothing to be desired. It is very largely made up of examples, far more than any boy could work through in a reasonable time, and the teacher who wishes to adapt the course to his own requirements will only have to put a tick against those he means to set to his class.

In the second place, it is undoubtedly desirable, as the authors claim, to teach statics and dynamics simultaneously with hydrostatics, and it is important, not only that the three should for convenience be comprised in one book, but also that the simultaneous treatment should not give rise to serious difficulties in regard to logical sequence in any one of the subjects.

When, however, we examine the result we find that the mixture of the three subjects in each chapter leads to some rather striking anomalies, and the reader naturally asks, What has Atwood's machine got to do with the U-tube and the barometer? Why do Boyle's and Charles's law come in the same chapter with graphical methods? What connection exists between centres of gravity and Archimedes's principle, or between force diagrams and centres of pressure? Would not centres of gravity and centres of pressure go better in the same chapter? If, however, the authors seriously think that this somewhat heterogeneous mixture is found beneficial for teaching purposes on the ground that it keeps a variety of different ideas before the pupils at the same time, no doubt something can be said in its favour, and we should gladly defer to their views.

Passing to matters of detail, we naturally expect to find, in the examples, questions of a rather more practical character than in the older text-books. But the pupil who works through the questions might almost believe that there were only three acute angles in existence—30°, 45°, and 60°. Why is it that other angles so seldom figure in them? Every boy nowadays has his tables of logarithms, and the first thing he should do when he learns the parallelogram law and Lami's theorem is to calculate resultants, using the tables of log sines, &c. What is the use of teaching him statics if he can only apply the methods to three particular angles? But the absence of other angles is the more remarkable when we speculate as to the sources from which the questions have been taken, especially in view of the fact that Government examination papers have been consulted, and that in some of these, 30°, 45°, and 60° have, we believe, been taboo for some years past. Again, in the chapter on projectiles, a good many examples are to be solved by writing down the equations, but we have failed to find any attempt to make the pupil *draw the paths of projectiles by plotting.* Is not this calculated to produce the type of student who uses elaborate algebra to prove an almost self-evident result and generally fails? We have had abundant experience of such students' failures in simple projectile questions, and begin to wonder whether it would not be better to omit the subject altogether.

On the other hand, the book contains a good many things which we had believed were at last dead and buried. What is the use of telling a boy that if a particle is going north-east at 10 feet per second for one second "it has travelled a distance OL ($5\sqrt{2}$ feet) due E., and a distance LP ($5\sqrt{2}$ feet) due N."? If he has any common sense he ought to think that it would be equally sensible to say that two people starting from London and Cardiff at 2 p.m., with tickets from London to Cardiff and Cardiff to Glasgow, could get to their destinations simultaneously by the 2 p.m. London to Glasgow. It would be far better to omit all these old-fangled misstatements, including the one that "if a particle has simultaneously three velocities represented by the sides of a triangle it remains at rest," and merely to give the definition of component velocities in § 5, and some discussions on relative velocity.

Atwood's machine seems too fashionable to be omitted nowadays, but it would be better to bring friction up to the front before discussing the motion of a 10 lb. weight on a table, pulled opposite ways by weights of 1½ lb. and 2 lb. hanging over the edge, or a 4 lb. mass on an inclined plane. In the figure of the condensing pump the arrow seems to suggest that air enters the barrel when the piston is moving the opposite way. "Whole pressure," which is meaningless except for plane areas, again crops up on p. 217. When shall we see the last of it? The oar once more figures as a lever of the second class. It is to be wished that every person who placed it there would try pulling a boat out in shallow water with the ends of his oars touching the bottom and a boy on the bank holding the boat back with a string. Under "machines" the so-called "first and third systems of pulleys" crop up with their usual pertinacity. It would be interesting if those who take so much interest in these particular machines and ignore the crab were asked to arrange for lifting building materials to the top of a high scaffolding, and to watch the result when their instructions were carried out.

Our general conclusion is that if boys have to learn what is contained in this book they will be efficiently and well trained on these lines by following Messrs. Jones and Blomfield; but there are a good many things they had far better leave unlearned, and a good many other things they ought to learn instead. It should be mentioned that calculus is not used, and moments of inertia are not included in the scope of the book.

(2) Controversial questions regarding the teaching of mechanics do not enter so prominently in connection with Prof. Loney's book, for by the time its standard has been reached dynamics has practically become a branch of pure mathematics, while, on the other hand, the student has had a good laboratory course in physics or engineering. The book, in fact, pretty exactly fits the requirements of B.Sc. candidates in a modern university college in the third year of their curriculum. It deals with rectilinear motion (including resisting media), central orbits, motion about a fixed axis, uniplanar rigid dynamics, energy and momentum, a little three-dimensional rigid, Lagrange's equations, &c. There is always a difficulty with these students, because this ground assumes a knowledge of pure mathematics that they cannot acquire before their third year. The appendix on differential equations is useful in this connection. A few points will have to be attended to in a future edition. The equation of motion for varying mass (p. 130) does not generally hold when a body is *parting with* matter. D'Alembert's principle requires more explanation than is contained in the statement, "Now the internal forces of the body are in equilibrium among themselves, for by Newton's third law there is to every action an equal and opposite reaction." This explanation the lecturer can, however, give. But a most amazing and doubtless unintentional mistake is made on p. 302, where the equations of motion in three dimensions are given as $Ad^2w_x/dt^2 = L$ instead of Euler's equations. We should like to have seen a few more examples in which the answer leads to a definite conclusion in the form of a numerical result instead of so many algebraic formulæ connecting masses m, lengths $2a$, and angles θ. But such questions are, we admit, rather hard to collect, and the teacher and student should, therefore, be grateful for the flywheel questions on pp. 217–9.

Up till the present no one book has sufficed for students taking this course, and, indeed, there has been great difficulty in advising them as to what to get. Prof. Loney has done useful work in providing students with a suitable work, and when he states that he has verified every question, the task cannot have been an easy or profitable one.

In this revision, the paradoxical rough board on a smooth plane seems to have escaped notice in p. 210, ex. 2, while on p. 217 we have "A uniform rod AB is freely movable on a rough inclined plane whose inclination to the horizon is i and whose coefficient of friction is μ about a smooth pin fixed through the end A." "Coefficient of friction of a rough plane about a smooth pin" reminds us of the newspaper English so often quoted in *Punch*.

The treatment of centrodes is very useful.

(3) M. Guillaume's "Initiation" is stated to be one of a series intended to be used for teaching children. In this connection, the question arises, What is the age of the children contemplated by the author? In the editorial preface by M. C. A. Laisant four to twelve years is suggested. But, even after allowing for the differences between English and French children, the author's treatment of the subject seems too philosophical for such young pupils. As a preliminary preparation to the study of mechanics we have a chapter on "How Nature is Studied," the headings of the paragraphs being "Observation and Experiment," "Approximation and Simplification," "Need of Simplicity," "The Limits of Experiment," "Illusion," "Education of the Senses; Measurement," "Induction and Deduction." Illustrations are taken from the photographs of moving bullets, photometry, and so forth. In the next chapter, which deals with kinematics, we have a discussion of space, velocity, and acceleration graphs. The author in the preface considers that dynamics should be treated before statics. His argument might, however, very well be used the other way. He asks why the majority of bodies on the earth appear to be at rest, and points out that this is due to the existence of resistances such as friction, and remarks *inter alia* that if these forces are unknown at the time when statics is begun

this becomes an artificial science or a simple abstraction. Would it not, however, be equally correct to describe dynamics as an "artificial science or simple abstraction" because it deals only with what *would* happen if certain existing resistances were absent?

The subject-matter extends up to and including couples, circular motion, a little about properties of matter, such as elasticity and ballistics, and a final paragraph dealing with Jules Verne's hypothetical voyage to the moon.

It is not to be denied that "philosophy of science" is much more studied in France than in this country. It also appears that the book is primarily written for those who have to teach children rather than for the children themselves. All we can say is that a course of instruction based on this book would in all probability be far above the heads of English children of the ages contemplated.

(4) While Prof. Tesař has "said his own say" in his preface and metaphysical appendix, his object in the rest of the book has been to present the principles of mechanics in a clear and intelligent form, and to employ practical illustrations as far as possible. In both these aims he appears to have been very successful. He is careful to distinguish between forces (Kräfte) and force effects (Kraftäuszerungen), pointing out that the parallelogram law applies to the latter, and that its truth for any physical vector quantities is based on experience. His readers should learn to discriminate clearly between the formal rational dynamics and its applications to the practical study of mechanics. For want of this distinction the whole subject in less careful hands often becomes more appropriately describable as dogmatics. The practical illustrations are very instructive and suggestive. How many who have taught rigid dynamics have thought of working out the condition whether a bell will or will not ring when it is swung? The author gives practical calculations for a bell in Cologne Cathedral cast from the cannon captured in the Franco-Prussian War, which failed to ring until its clapper was altered in length.

(5) As has been previously pointed out in reviews, Prof. Föppl's treatises on technical mechanics are of a far more advanced character than the mechanics taught commonly to technical students in this country. Vol. iii., which includes a large portion of the mathematical theory of elasticity, now reaches us in its fourth edition. The new volume, "The Most Important Studies of Higher Dynamics," deals with relative motion, systems with several degrees of freedom, in particular compound pendulums, including the bell and its clapper, the gyrostat, and an outline of hydrodynamics. Under the gyrostat we have a detailed discussion of Schlick's ship governor, and in a circular issued with the book we are asked to point out that the Brennan mono-rail came too late to be included in the book, a short note at the end being all that was possible, as the whole of the text was already in print. It is, however, pointed out that the theory of the Schlick gyroscope is applicable with slight modifications to the mono-rail, some terms occurring in the equations having merely to be reversed in sign. Thus an interesting exercise is provided for those possessing the necessary mathematical knowledge, to go over the work introducing the necessary changes, and doubtless the next edition will see them in the text. G. H. Bryan.

HARDY TREES AND SHRUBS.

Trees and Shrubs of the British Isles, Native and Acclimatised. By C. S. Cooper and W. P. Westell. Vol. i., pp. xxxii+lxxxiv+108; vol. ii., pp. viii+261; 78 full-page plates by C. F. Newall. (London: J. M. Dent and Co., 1909.) Price, two vols., 21s. net.

Amid the torrent of books on gardening with which a patient public has been deluged during recent years, we have searched in vain for a really comprehensive and authoritative work on hardy trees and shrubs. Of mere book-making there has, of course, been no end. It is so easy to sit at a desk and boil down from Loudon, Sargent, &c., and from the copious literature in horticultural journals, sufficient to make a respectable-looking volume, without ever taking the trouble to turn over a leaf or dissect a flower on one's own account. But this method has its disadvantages. The same stale old errors are once again repeated, and to them our new author must, perforce, add some of his own. There has been too much of this kind of tree literature in the past, and it was with a feeling of pleasant anticipation that we turned to these two handsome volumes in the hope that a work had at last been written worthy of the subject.

That it marks a considerable advance on much that has appeared is certain, but its scope is somewhat limited, and the authors do not appear to us to have done the best that could have been done within the limits they set themselves. British trees and shrubs are done thoroughly and well, and those portions dealing with them constitute the most valuable part of these volumes. When the authors deal with what they term "acclimatised," as distinct from native, species, their work often suggests the study and the bookshelf, rather than the open air and the living tree. For it is by no means free from error, and at times shows a lack of intimate knowledge of the plants dealt with.

The book opens with an introduction in which the general subject is discussed pleasantly and suggestively. It is an attempt to interest the hitherto uninterested reader, not only in the more evident beauties of leaf and flower, but to get him also to appreciate those profounder beauties of trunk and branch and bud which we are afraid the average reader often does not discern, but which make the leafless woods in their season as full of delight to the real tree-lover as the full leafage of June. This part of the work was well worth doing and is well done.

Some fifty or sixty pages are then devoted to the discussion of injurious and useful insects, galls, and fungoid pests, with directions for the composition and application of various remedies. This, although useful, is too liberal an allowance for such subjects in a work running to less than 500 pages. Many insects are described and discussed individually which are not particularly troublesome, and might, at any rate, have been treated collectively. We see no mention of the beech-bark coccus, a pest which is causing grave concern both here and on the Continent among owners of beech woods. The remainder of the work is occupied by a detailed description of some 550 species of "native and acclimatised" trees and shrubs. A description of the characteristics of each natural order prefaces the description of the species belonging to it. This space, we think, might have been better occupied with a discussion of the genus. A description of the great order of Ranunculaceæ, for instance, has only a very general bearing on Clematis, and it was scarcely worth while to preface the description of the solitary rubiaceous species here dealt with by an account of the great order to which it belongs.

The old problem of the "popular" name has been met by a brave effort on the part of the authors to provide nearly all the plants they mention with one. If a species had not one before they appear to have invented one. But the result is not always happy. We hardly know whether such a name as "Narrow-leaved Jasmine Box" for *Phillyrea angustifolia* (p. 107) indicates too dull or too vivid an imagination, for this shrub has no relationship with the box, nor does it bear any resemblance to the jasmine either in leaf or flower. The very next species, *P. decora*, is called "Vilmorin's Mock Privet," which is neither pretty nor correct.

The descriptions are carefully done, although somewhat too technical for the amateur, as for example where the flowers of common oak are described as "monœcious, anemophilous, proterogynous," and where the fruit of magnolia is termed an "etærio of follicles." Still, accuracy is the chief thing, and we do not notice many serious lapses. One of the worst is the description of *Ceanothus rigidus* as a deciduous climber with alternate leaves (p. 48). It is a perfectly evergreen bush with opposite leaves. Then *Acer circinatum* is said to have "greenish-white" flowers. Anyone who has had a personal acquaintance with this tree could not fail to have noticed its drooping corymbs of reddish-purple flowers, which make it perhaps the most attractive of commonly cultivated maples in regard to blossom.

The number of cultivated species of hardy trees and shrubs now exceeds 3000, and it would be an impossible task to select one-sixth of these for treatment and satisfy everyone. Yet the selections here made betray an indifferent acquaintance with some groups. *Berberis empetrifolia,* a rare shrub seldom seen in good condition, is included, but of *B. stenophylla,* in some respects the finest of all flowering evergreens, not a word is said; and whilst a weedy shrub like *Stephanandra Tanakae* is described, a fine handsome bush like *Exochorda grandiflora,* its near relative, is ignored. But the worst instance of this defect in these volumes is the inclusion of the American plane (*Platanus occidentalis*). The authors say this is to be found in "parks, gardens, avenues," and that it is "usually larger and more rapid in growth than the Eastern plane" (p. 144, vol. ii.). We had thought it well known to all tree-experts by now that the American plane is absolutely worthless in this country. So far from being comparable with the Eastern plane, there is not, we believe, a single tree in these islands with a trunk 6 inches in diameter. All the trees so called are forms of *P. acerifolia,* the common plane of London. Thus is an old error dating from Phillip Miller's time, and continued by Loudon, again perpetuated. The cultural notes will be found useful, although an absence of personal experience is again at times evident, as when it is stated that *Cistus ladaniferus,* from the sun-baked hills of Spain and Portugal, is suitable for shady places (p. xxxi).

Whilst we have felt bound to point out the obvious defects of this work, it must not be supposed we are blind to its merits. These are many, and to the great bulk of the matter no exception can be taken. For the drawings of Mr. Newall we have nothing but praise; they are botanically accurate as well as artistic. The coloured plates are of unequal merit; the picture of *Magnolia conspicua,* for instance, is either wrongly named or badly coloured, but this we suspect is more the colour printer's fault than the artist's. The printing, typography, and paper are all admirable.

ANTEDILUVIAN CHRONOLOGY.

The Dates of Genesis. A Comparison of the Biblical Chronology with that of other Ancient Nations. With an Appendix on Chronological Astronomy. By Rev. F. A. Jones Pp. 333. (London: Kingsgate Press, 1909.) Price 5*s.* net.

THIS is one of those strange little works which are continually issuing from the clerical workshop with the aim of expounding the early chronology of the Bible. Mr. Jones has many glimpses of real knowledge of archæological science, and has evidently read widely on the subject, but not always wisely, and he perpetrates several blunders. The most patent impossibility in the book is the absurd date assigned to the building of the Great Pyramid, viz., 2170 B.C., on the authority of Sir John Herschel. This is utterly impossible, on historical grounds.

We do not know what to make of Mr. Jones's views of modern scientific knowledge of the beginnings of human civilisation. He seems to think that human beings were originally placed in the world in a highly civilised condition, and ingeniously explains away the damning fact of the gradual evolution of man's tools and culture from the Older to the Newer Stone age and then to the age of Metal. He says that the ancient flint implements may indicate not "an early period in the development of art," but

"express limitation of opportunity. Wanderers from a civilised centre would, unless possessed of considerable personal ability, soon degenerate into using the simple methods that are characteristic of savage tribes . . . the existence of these flint weapons, in outlying districts, may not be pressed so far as to prove a date as being long before more advanced civilisation in the great centres of population."

That is to say, Palæolithic implements are the tools of degenerate offshoots from the highly civilised prediluvian "patriarchals." For between the Palæolithic degenerates and the Neolithic degenerates came the Flood, which killed off all the extinct animals, such as the mammoth, which

"at all events, is not such an extremely ancient animal. Its remains are even to-day excavated, in some cases, as in Polar regions, with its flesh and hair intact."

It is difficult to know what to make of a writer who, in the twentieth century, believes, apparently, in the actual historical existence of Noah and his ark, and, by "combining the traditions of Jews, Arabians, and other nations with the story as told in the Hindu Puranas and the Sybylline [*sic!*] Oracles," arrives at the following interesting account, "which may or may not be true," of what happened about the time of the Flood (pp. 164, 165):—

"Mahaleel was a very distinguished man who married a widow in the line of Cain. His son, Jared, thus acquired a claim to the rulership of the world, and exercised it for some time with great distinction. He is said by some to be the great Sesostris of the Greeks. . . . Methuselah maintained the holy traditions, and for his sake the flood was postponed till his death had taken place. Noah was by distinction the righteous man. . . . The nation descended from Ham very quickly turned aside to the old idolatry, and worshipped their ancestors under various names. These may be traced in Egypt, Chaldea, Phœnicia, and elsewhere. The children of Shem became kings of Magadha, but the dynasty ended about 2100 B.C. Noah was soon deposed from his rule by his sons, and driven away from the territory occupied by them. According to one account he was last seen about 2000 B.C., and he was of a colour between white and ruddy, and bald-headed." (!)

FIELD ORNITHOLOGY.

Camps and Cruises of an Ornithologist. By F. M. Chapman. Pp. xvi+432. (London: Hodder and Stoughton, n.d.) Price 12*s*. net.

FOR seven years the author, with the assistance of artist and *preparateur,* devoted the nesting season of birds to collecting specimens and making field studies and photographs on which to base a series of what have been termed "Habitat Groups" of North American birds for the American Museum of Natural History. These groups are designed to illustrate not only the habits and haunts of the birds shown, but also the country in which they live. The birds, and, in most instances, their nests and young, are therefore placed in a facsimile reproduction, containing from 60 to 160 feet of the locality in which they are found, and to this realistic representation of their habitat is added a background, painted from nature, and so deftly joined to the foreground that it is difficult to distinguish where one ends and the other begins. A reference to the photographs of these groups, which form some of the illustrations of this delightful book of field ornithology, will convince anyone at once of the truth of this remark. Some of these panoramic backgrounds portray not only the haunts of certain American birds, but America as well.

In the pursuit of his calling the author has had the good fortune to behold some of the most interesting and remarkable sights in the world of birds. The object of the present volume is to perpetuate his experiences and studies by telling the story of the various expeditions of which the groups were the objects, adding such information concerning the birds observed as seems worthy of record, and illustrating the whole with many photographs from nature, and a number of the groups themselves. The result is one of the most readable as well as informing books of the kind we have had the pleasure of seeing.

With the exception of one chapter, the whole book deals with American birds. But this need not be a drawback in the mind of even those whose ornithological interests are almost wholly confined to British birds. The author remarks that next to their native birds there are probably none of more general interest to the average American nature-lover than the birds of England. This is partly due to sentimental reasons. But we can return the compliment, for others. One is that many American birds, although considered by systematists as distinct species, are so like European birds that for all practical purposes of the field ornithologist they may be considered the same, while others are absolutely identical. So that in reading a book about the habits of these birds in America we are learning something more about our own birds' habits, modified a little, perhaps, by a slightly different environment or by different conditions of life. This last comes home to us when we read the account of Gardiner's Island ("within one hundred miles of our most populous city"), where there are no rats and no cats, "the ogres of the bird-world," and hardly any "vermin" destructive to bird-life. This large island, containing 4000 acres, is a place of peace and plenty for the birds. The whole account of it is full of interest, but the most remarkable fact is that the osprey, which is *very abundant,* builds its nest often in lowly situations, and actually in some cases on the ground. A number of illustrations of the ospreys and their nests are given, the great piled-up heaps of sticks built by the birds which breed on the beach affording excellent chances of photographing the old birds at the nest.

Some birds are more get-at-able in the North-West than they are, say, in that almost unknown land, the marshes of south-eastern Europe. Take the great white pelican, for instance. It is a most difficut—nearly impossible—bird to study in Europe; but in many of the numberless lakes of Manitoba, Saskatchewan, and Alberta, invariably upon islands, white pelicans nest, a colony containing anything from a dozen to several thousand birds. This bird so closely resembles the European one that it used to be considered identical with it. The chapter on and illustrations of it are therefore very welcome, for the author saw a good deal of pelicans.

Perhaps the most interesting chapter in the book describes the flamingo—not, indeed, our pink flamingo, but the brilliant red species (*Ph. ruber*). However, a flamingo, so far as life-habits are concerned, seems to be simply a flamingo wherever he lives. It is here truly remarked that there are larger birds than the flamingo, and birds with more brilliant plumage, but no other large bird is so brightly coloured, and no other brightly-coloured bird is so large. When to these more superficial attractions is added the fact that little or nothing has hitherto been known of the nesting habits of this singular bird, one may, in a measure at least, realise the intense longing of the naturalist, not only to behold a flamingo city, but at the same time to lift the veil through which the flamingo's home life has been but dimly seen. Nearly forty pages are devoted to the lifting of this veil for the reader, and the account is illustrated by more than a score of pictures of the birds at and on their nests, and of the nests, eggs and the young in various stages; included among these are two beautiful coloured photographs of the adult birds, in one of which they are seen feeding their young in the nest.

It is quite impossible to find space even to enumerate all the contents of this charming book, but Florida, Bahama, the western prairies, California, and many other localities were visited by the author, and are here described. Lastly, we have a chapter on his impressions of English bird-life; and the impressions of such an experienced bird-man are distinctly valuable and informing, and will be read with the greatest interest by our field ornithologists. We cannot enter into them widely here. As he approached the coast of Wales the "boreal" birds he saw about the stacks and islands of Wales afforded convincing evidence of high latitude, and, at the same time, an admirable illustration of the faunally composite character of English bird-life, types Americans are accustomed to consider representative of northern and southern life-zones finding in England congenial surroundings. Unlike some visitors, the author was not too late to hear the nightingale; he was disappointed at first with the song of the skylark, but before leaving England found himself listening to it with increasing pleasure. None of the birds seen from the train impressed him more than the peewit. We read:

"The bird's size, form, and colours, its grace of carriage on the ground, and dashing, erratic, aërial evolutions, give it high rank as an attractive part of any avifauna; while its abundance, in spite of the demand which places thousands of its eggs on the market annually, is inexplicable."

This is all true, though most of the eggs come from the Continent; but a bird which can furnish Mr. Chapman with "a brand new sensation in bird-life" must be something we ought to be proud of.

The author visited various parts of England, and many of our famous sea-bird haunts. His pictures of these places (including one of Selborne) are delightful, and everything he has written about our avifauna is well worth reading. It is satisfactory to read that birds are more abundant here than they are in North America. The book is very full of illustrations, and they are excellent—far better than most of the photographs of this kind. But the heavily leaded paper on which it is printed makes it simply too heavy to hold without actual weariness!

O. V. A.

EXOTERIC PHILOSOPHY.

(1) *In the Abstract.* By N. Alliston. Pp. 156. (London: Swan Sonnenschein and Co. Ltd., 1909.) Price 2*s*. 6*d*.

(2) *Progressive Creation: a Reconciliation of Religion with Science.* By Rev. H. E. Sampson. In two vols. Vol. i., pp. xii+484; vol. ii., pp. vi+517. (London: Rebman, Ltd., 1909.) Price 21*s*. net.

(3) *Progressive Redemption.* By Rev. H. E. Sampson. Pp. xxiv+616. (London: Rebman, Ltd., 1909.) Price 12*s*. 6*d*. net.

(4) *Scientific Idealism, or Matter and Force and Their Relation to Life and Consciousness.* By W. Kingsland. Pp. xxiii+427. (London: Rebman, Ltd., 1909.) Price 7*s*. 6*d*. net.

THESE books have this much in common, that none of them bears the academic hall-mark. Of the three writers, Mr. Alliston is the most ambitious of a precise logic. His book consists of a group of essays on such various topics as "The Planetary Distances," "Materialism," "The Value of Things." His criticism of the first law of motion is perhaps the most original effort in the book. He is dissatisfied with a formulation which assumes that rest and frictionless motion are alike constant; he holds that frictionless motion would cease as soon as the original force should be exhausted. Mr. Alliston admits that the law as stated must be considered practically adequate; he does not attempt to make any inference, dynamical or metaphysical, from his criticism; and the essential proof for this inconclusive result, the explanation of how an ideal unhindered velocity would be diminished, he has not provided. Mr. Alliston's essay on materialism is a clear and simple re-statement of now commonplace criticism; he does not, however, sufficiently realise the difficulty of finding a moral differentiation between materialism and a spiritualism which does not promise the conservation of individuality. The book is pleasantly written, and might be turned over with interest and profit by beginners in philosophy.

The authors of the other works placed at the head of this notice have each made a bold attempt to reach the final synthesis which is supposed to be the goal of philosophy. Mr. Sampson's interest is, in the main, theological; Mr. Kingsland's effort is more purely philosophical. The system of the former, though presented with much ability, will, it is to be feared, strike most people as fantastic. He starts from the failure of science to account for evolutionary breaks and "missing links." This failure suggests to him that the facts covered by the current theory of evolution represent an interruption rather than an integral part of the great order of true evolution. That true order is, it appears, a progressive creation of beings who pass by successive reincarnations from lower to higher types, culminating at last in perfect Godhood. A condition of its continuity is the preservation of purity of type, a condition violated by our "Adamic" ancestors, who inter-married with an inferior kind. Sin then entered the world, catastrophic physical changes occurred, and our history since has been a struggle towards the ancient segregation, a "devolution." The incarnation of Christ was the essential effort of the whole Cosmos to redeem the earth. Mr. Sampson provides a cosmogony for the great spiritual order. The planetary circles and the zodiacal angles in their various relations define the home of the spirit in its various stages of development from the "atom" of original divine ætheric essence to the perfection of Deity. Into the elaboration of this scheme the author has worked much ingenious allegorisation of biblical story, and much mysterious symbolism from Astrologer and Rosicrucian. It is a not uninteresting and hence not unsuccessful attempt in mythology; at least it must appear so to all who do not possess, as Mr. Sampson seems to, the clue to the esoteric illumination of church and brotherhood.

Mr. Kingsland writes with much earnestness to show that truth, beauty, and goodness are only to be realised by man in his union with the Absolute, the one primordial substance, who is at once subject and object, whose nature can be expressed only in paradox, the eternal source and sustainer of all finite existence. We approach Him by ascent from plane to plane of existence—for He is essentially differentiated into planes variously approximating to His own self-sufficiency. For Mr. Kingsland individuality is an involution, and its extreme limit is physical determination; from that man is now evolving towards a realisation of the spiritual ego, which is the "universe" of many human personalities or incarnations. It again is but a phenomenal appearance of the spiritual form of humanity, the one "Divine Son," which is itself a phenomenon of the Absolute. Thus, though Mr. Kingsland professes a belief in immortality, it is necessarily an immortality in which individual experience is not preserved as individual. The temporal individuality must be merely a means for a higher life which transcends it; and, though the author may assert that we are at the same time ends, for the One is within us, this paradoxical conjunction has never satisfied man's moral demands for an end which is both personal and metaphysically genuine. The book is well written, and the exposition of recent scientific theory is admirable, but in the more metaphysical portions repetition is a great blemish.

OUR BOOK SHELF.

A Manual of Botany for Indian Forest Students. By R. S. Hole. Pp. xi+250+xxi+xx plates. (Calcutta: Government Printing Office, 1909.)

This work has been prepared primarily for the use of the pupils of the Imperial Forest School, Dehra Dun, in which establishment the author holds the post of forest botanist. The manual ought to prove a good text-book. It is quite up to date and is written in clear, concise language. Should a new edition be called for, and when one considers the object the work is intended to serve this will almost certainly be the case, the author will be well advised to treat systematic botany more fully than he has done in the edition before us. A compact synopsis of the natural families of plants to be met with in British India would be of great value as an aid to the student who will, when he has left the forest school, have occasion to make use of the "Flora of British India," or of one or other of the regional Indian floras based on that fundamental work. The author might also consider the advisability of adding a glossary to the work. Such an addition, besides being of considerable utility in itself, would have the further advantage of enabling him to relieve the morphological part of the work of a certain amount of purely terminological matter and at the same time of allowing terminology itself to be treated somewhat more completely.

Another point to which the author's attention may be directed is the somewhat meagre character of the illustrations. It is, of course, true that, especially at the outset, there is some difficulty in providing for the full illustration of a work published by Government and prepared for the special purpose which underlies the one under notice. So long as it is understood that the work is merely intended to assist the student generally while he is at the forest school, the want of illustrations in company with the text is not likely to be greatly felt. But the work ought to have, and no doubt will have, a further use. Most students will carry the work away with them when they leave the school, and will find frequent occasion in after life to refer to it and refresh their memories. It is then that the need for good illustrations, which help to restore faded ideas and their associations, will be most acutely felt.

In directing attention to these points we would, however, desire it to be understood that no reflection is intended either on the author or on his work as it stands; what appeals to us in making them is rather a purpose that the work, modified as suggested, is calculated to fulfil than the purpose which, as the author explains, it is intended to serve. That it should serve this latter and narrower purpose well we do not doubt, and Mr. Hole is to be congratulated on the presentation of a useful and serviceable manual.

The Light of Egypt, from recently discovered Predynastic and Early Christian Records. By R. de Rustafjaell. Pp. x+169. (London: Kegan Paul and Co., Ltd., 1909.) Price 10*s*. 6*d*. net.

Mr. de Rustafjaell's book is a curious mixture, as its title shows. It consists chiefly of a description of various Egyptian objects, some apparently owned by the author (though this is not made quite clear), others bought by him and sold later to the British Museum. These objects are illustrated by fine photographs. They are strung together by means of a general talk compiled by the author from various authorities, which is intended to give an idea of the "light" shed by Egypt upon early civilisation. So far, so good, and the work is not badly done; but the author also launches out into one or two theories of his own, which are hazardous. We may instance his supposed discovery of limestone "vessels" of "Palæolithic" age found with (undoubted) Palæolithic flints on the Theban plateaux. These objects are not artefacts at all, but merely either the hard matrices of flint nodules or else weathered siliceous masses. They are common enough on any Egyptian *gebel* of rough stones. Mr. de Rustafjaell has discovered nothing here. The translation by Mr. Crum of the Coptic manuscript sold by Mr. de Rustafjaell to the British Museum, and included by him in his book, is interesting. The Nubian manuscript also originally obtained by Mr. de Rustafjaell, to whom Mr. Griffiths sends a summary description of it, has already been published in facsimile by Dr. Budge for the Trustees of the British Museum. It is of great importance linguistically.

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.]*

Precursors of Magnetic Storms.

IN kindly noticing (NATURE, December 30, 1909, p. 259) my short account of the magnetic storm of September 25, attention was directed to the fact that what I called the precursor was experienced all over the world.

As I have little or no opportunities to compare our curves with others, may I be allowed to ask for information through the columns of NATURE?

I call a "sudden start" of the magnet a movement which occurs after several hours of perfect calm, and causes the trace to make a "sharp angle," that is, so sharp that I can unhesitatingly tell the time of the occurrence to the nearest two minutes. Many disturbances, large or moderate, have a "sudden start"—at least here.

My impression has long been that disturbances with a "sudden start" very generally have a kind of "preliminary tremor" some hours before the start; the curve, which we suppose to be quite smooth, is interrupted by a short movement, which lasts but a few minutes, after which the curve resumes its smoothness for the remaining hours. The tremor may be very small indeed, but the two characteristics, to be found on a smooth curve, and to be of very short duration, make it quite easy to point it out and tell the time.

The start of the "preliminary tremor" is in the same direction as that of the disturbance itself, at least as a rule.

I do not venture to hold an opinion as to the connection, fortuitous or otherwise, between the two phenomena, but I should be very glad to know whether the "precursor" is also observed in other countries. The following is the list of all the "sudden starts" of H during the last fourteen months of Zi-ka-wei (January, 1907, to February, 1908, inclusive), with the time of the start and that of the preliminary. A comparison with the curves of some other observatory is invited. Probably the traces will not be found so smooth as here, and some of my "sudden starts" will correspond to progressive starts, but on the whole I hope that a comparison will be possible.

I use Greenwich time.

	Sudden starts			Preliminary			Remarks
		h.	m.		h.	m.	
1.	Jan. 8	16	45	Jan. 8	1	45	
2.	,, 11	8	45	,, 10	3	10	H not quite smooth. D very smooth.
3.	,, 14	19	35	,, 14	10	30	
4.	Feb. 7	8	10	Feb. 6	23	55	
5.	,, 9	14	12				Curves not quite smooth.
6.	,, 14	4	37	,, 13	19	47	
7.	Mar. 10	5	3	Mar. 9	16	(?)	Curve not quite smooth.
8.	,, 11	17	23	,, 11	13	45	
9.	,, 21	13	33	,, 21	9	50	
10.	May 18	13	58	May 18	10	52	
11.	June 3	22	55				Curves not smooth.
12.	,, 18	3	42	June 17	17	20	
13.	July 10	14	23	July 10	11	0½	
14.	,, 25	4	18	,, 24	14	40	There is another preliminary at 3½.
15.	,, 28	0	12				Curves not smooth.
16.	Aug. 14	15	3	Aug. 14	11	0	
17.	,, 20	2	24	,, 19	13	30	
18.	,, 30	7	15	,, 30	5	8	And also 29 at 11h. 12m.
19.	Sept. 10	1	50	Sept. 9	15	0¼	
20.	Oct. 13	7	45	Oct. 13	0	0½	
21.	Nov. 21	10	45				The curve of H was lost, until 10h. But D does not show anything.
22.	Dec. 4	5	45	Dec. 3	20	57	
	1908						
23.	Jan. 27	13	48	Jan. 27	0	25	
24.	Feb. 22	12	8	Feb. 21	19	20	

If we put aside No. 21, we have twenty-three occurrences. In eighteen of these there is no doubt; in the three cases in which no precursor was found, and in the two more or less doubtful cases, the curves were not smooth, that is, the "start" was not quite sudden.

In Zi-ka-wei, during the fourteen months considered, the eighteen disturbances which began with quite a sudden start all had one or two preliminaries. The interval between the forerunner and the disturbance ranges from two to seventeen hours of perfectly smooth trace.

Zi-ka-wei, China, March 11.

J. DE MOIDREY.

Centre of Gravity of Annual Rainfall.

THE mere *a priori* criticism which Mr. Watt, in his letter to NATURE of April 14, has bestowed on my letter to NATURE of March 31, dealing with a large class of *concrete physical facts*, is, to my mind, far from satisfactory or sufficient. In the last sentence of my letter I anticipated that it might meet with some such "simple" algebraic criticism.

I did not, as is implied, assert that the use of the C.G. of the year's rainfall would dispense with the ordinary graphic representation of the monthly distribution, but that it appeared to be a convenient method for *comparing* the rainfall distribution at a number of stations in the same country for the same year, as well as at a single station, or for the mean rainfall of the same country, for a succession of years. Obviously, therefore, Mr. Watt's simple types of rainfall for his imaginary stations A, B, C, which belong to very different regions on the earth's surface, have no application, even in theory, to my "suggestions."

As for the practical character of my proposals, the following may be given. They are quite as useful as the comparison of the variation of rainfall with that of population for a decennium in India, which was the subject of a paper given some years ago in the Journal of the Royal Meteorological Society, London. A comparison of the variations in the C.G. of the mean monthly rainfall for the past 50 or 100 years with the agricultural results of those years in the British Isles, &c., for which the data may be available; an examination of these variations in connection with the much-discussed question of weather cycles, so commonly based on rainfall statistics; the detection of serious clerical slips in the tabulation of rainfall; the interpolation of the probable rainfall figures for a month in the event of a rain-gauge or measure-glass being temporarily unserviceable; the detection of the ignorant or inadvertent use of a wrong measure-glass—a matter of frequent occurrence in India, and possibly not unknown in this country.

Rain falls with such seeming irregularity of quantity and date, even in India—and much more so in this "unspeakable" Scotland—that it would appear *prima facie* impossible that there could be any approach to constancy of the date around which the whole year's rainfall balances. If we look at the tables of monthly rainfall for a large number of stations (in the same country) and see that the figures are not even approximately the same for the months or for the whole year, if we consider the difficulties connected with the measurement of rainfall, which are discussed in many of the volumes of "British Rainfall," it is surely surprising that, in spite of all these things, the reported year's rainfall should balance round a date which does not differ by more than a few days for a great many, if not all, the stations in any one year, and that for another year the displacement of this central date is so nearly the same for all of them. By merely looking at the monthly figures or at the graphs of those figures, we cannot accurately estimate either the central date or the amount of its displacement.

The causes which determine the times and amounts of rainfall for any place or country are known only in a very general way indeed. They are so elusive that investigators in their despair have even had recourse to sun-spots or comets' tails as a possible cause of special excess or deficiency of rainfall. They are so elusive that even in India, with its comparatively regular rainfall-seasons and with its special equipment of experts, the problem of correctly forecasting the monsoon rains either as to time or intensity is still far from complete solution. They are so elusive that the forecasting of rainfall even for three days in this part of the world is not yet conspicuous for its infallibility.

The importance of the laws of rainfall is so incalculably great that it is not extravagant to say that their discovery is the ultimate object of, and excuse for, the millions of meteorological figures that are published annually in all civilised nations. Hence the discussion of rainfall in all its aspects is worthy of encouragement, and in this connection the centre of gravity of annual rainfall may possibly, after all, be of some value. J. COOK.

Edinburgh, April 18.

I AM glad to read Mr. Cook's reply to my remarks, but believe that my criticism cannot be dismissed as a mere *a priori* one, and that it goes to the root of the matter. It is true that Mr. Cook illustrated his proposal in a most exhaustive manner, and that he did not suggest that his method might be of service in comparing the rainfalls of places in quite different climatic regions. But the general reasoning in the first paragraph of my former letter cannot be both correct and incorrect. Assuming it to be correct, it follows directly that even if we confine our attention to the records for a single station we might have the same C.G. for two years which differed greatly from one another as regards the monthly distribution of rainfall. In such a case, what possible significance could attach to the position of the C.G.?

I am heartily in sympathy with Mr. Cook's feeling that the discussion of rainfall in all its aspects is worthy of attention, but note that he himself does not maintain that his method is, but only that it may possibly be, of some value. It is certainly at first sight surprising that the calculated C.G. of rainfall for a large number of places for a given year in, say, Scotland should be very nearly the same, for the monthly rainfalls as ordinarily tabulated exhibit a bewildering complexity; but if the monthly values for the various stations are expressed as percentages of the year's total, the resulting picture is usually of a very simple and symmetrical character, which would lead one to anticipate that the C.G.s for the various stations would approximate closely.

ANDREW WATT.

Scottish Meteorological Society, 122 George Street, Edinburgh, April 22.

The Fertilising Influence of Sunlight.

THE beneficial effect of heat on soil is recorded by Virgil in the following passage, to which Mr. F. B. Smith has directed my attention:—

"Often too, 'tis good
To burn the stubbles and with crackling flames
Consume the empty stalks; whether from thence
The earth derives a hidden store of strength
And fattening food, or whether 'tis that fire
Rakes out the subtlest vice and sweats away
Excessive damp, or whether by the heat
New pores are opened and the choked are cleared," &c.
("Georgics," Bk. i., lines 100 *et seq.*).

It is interesting to learn from Mr. Fletcher (April 7) that the natives of Bombay, in certain circumstances, subject their soils to heat. Mr. Fletcher regards the explanation given by Dr. Hutchinson and myself as incorrect, and suggests that the effect is due to the destruction of some toxin. This was the first hypothesis we examined, but was found to be insufficient.

(1) Toluened soil (*i.e.* soil treated with a small quantity of toluene, which is subsequently allowed to evaporate *in situ* without washing anything from the soil) is more fertile and more favourable to bacterial activity than the original untreated soil.

(2) When an aqueous extract of untreated soil is added to the toluened soil, there is a still further increase in fertility and in bacterial activity. The same result follows when a minute amount of the untreated soil itself is added instead of the aqueous extract.

(3) When a larger quantity (5 per cent.) of the untreated soil is added a similar effect is produced for a time, then the bacterial activity begins to be depressed. This action increases, and finally the depression, both in bacterial activity and in fertility, is out of all proportion to the 5 per cent. of soil originally added.

Experiment (2) is conclusive against the hypothesis that a soluble toxin exists in the untreated soil which can be put out of action by toluene. For such a toxin should cause a decrease, and not an increase, in productiveness. Experiment (3) is equally conclusive against a relatively insoluble toxin; had this been present the depression should have shown itself at once, and should have been proportional to the amount of toxin, *i.e.* of untreated soil, added.

The *growth* of the injurious factor in experiment (3) seems to necessitate a biological hypothesis. Considering these and our other experiments in detail, Dr. Hutchinson and I see no way out of the conclusion that organisms are present in soil inhibiting the development of bacteria, and therefore of plant food. The organisms, whatever they are, must be larger than bacteria, or they would occur in the extract of experiment (2) along with the numerous bacteria there present—indeed, the beneficial effect of this extract was traced to the unweakened races of bacteria present, partial sterilisation having somewhat weakened the soil bacteria. Further, they develop more slowly than bacteria. As similar phenomena have been observed in all the soils examined, we are justified in supposing that the organisms are widely distributed, and constitute an important factor in soil fertility.

Mr. Fletcher's water-culture experiment is not germane to the point. A toxic body that occurred there would not necessarily come direct from the plant or be found in the soil. It is extraordinarily difficult to keep prolonged water cultures sterile, and until some attention is paid to the bacterial changes going on it is impossible to regard the results as proof of the presence of toxins in soils. Indeed, I know of no satisfactory evidence of their existence in normal soils. E. J. RUSSELL.

Rothamsted Experiment Station, Harpenden.

Pneumatolysis.

IT is thirty-nine years this month since NATURE, over diffident initials, published my first scientific communication that ever saw print. For more than thirty of those years I have been much interested in the physics of plutonic rocks. Quite recently an event has occurred which must be almost without precedent in science. The petrologists have apparently repudiated, with unanimity, what is an axiom beyond dispute with chemists.

For some years past the petrology of plutonic rocks has been based on the new doctrine of "pneumatolysis," or the solvent powers of gases over solids.

Perhaps the last published important work on chemistry is the English version of Ostwald's "Fundamental Principles of Chemistry," 1909. Referring in that work to a certain diagram, representing the behaviour of one solid and one gas, the author writes:—

"From this point the liquid phase exists in the presence of the gaseous phase to the end of the diagram, *because solid substances do not form solutions with gases*" (pp. 186–7). Italics mine.

I believe that every chemist will assent to the above statement. If a gas is to mix with a solid, as a solution, the solid must first be vapourised; but if this be so the greater part of twentieth-century petrology breaks down, because it is everywhere relying on the truth of pneumatolysis.

From the student's point of view the situation is as paralysing as it is stupefying, and there seems nothing to be done but to put away the microscope. It is no work for students to discuss first principles.

Southwood, Torquay, April 18. ARTHUR R. HUNT.

Anomalous Reading of Hygrometer.

MAY not the observation referred to in NATURE of April 7 (p. 165) be a very simple case of latent heat evolution by condensation when the atmosphere is supersaturated with vapour? I think I have seen the wet bulb registering a temperature higher than the dry bulb; but this explanation seemed at the time so obvious that I made no careful verification of the apparent phenomenon.

HUGH RICHARDSON.

Bootham School, York, April 11.

AMERICAN DESERT VEGETATION.[1]

THE popular impression of a desert as an endless plain of tawny sand, rainless, and utterly devoid of vegetation, or perhaps showing a distant oasis, bears but slight resemblance to the desert overlooked by the botanical laboratory near Tucson. Here considerable variety of vegetation prevails; in the streams and river aquatic plants flourish; along the river banks rise poplars and willows; on the alluvium of the "flood-plain" is mesquite-forest, in which acacias and another leguminous species, *Prosopis velutina*, live side by side with elder-trees and ash-trees; approaching the hills other types of vegetation appear in the dried water-courses, and on the gravelly and sandy slopes, in both of which sites grows the notorious creosote-bush (Larrea); while on the hills are found yet other plant-communities, including giant cacti and Fouquieria. In the winter and summer seasons of rainfall—scanty though this be—the scene changes like magic, for thousands of short-lived annual (ephemeral) herbs spring up and clothe the ground with fresh verdure that contrasts with the ashen or bluish-green tints of the bushes or bizarre succulents.

Variety of water-supply, of slope, and of soil (clay, gravel, sand, alluvium, hard pan, saline spots) evoke corresponding variety in the vegetation of this patch of desert, and render the site eminently suitable for a botanical laboratory and for the solution of ecological and physiological problems by observations and experiments on desert plants in their natural surroundings.

Desert plants are exposed to the danger of death from desiccation by reason, first, of the various intense climatic factors tending to cause excessive evaporation, and, secondly, by the scantiness of the water available for absorption by the roots. Hence even where water is abundant in the soil, as is the case near rivers, atmospheric factors militate against luxuriance of growth or multiplicity of species. In less moist soil desert-plants evade or withstand the danger of desiccation by their possession of peculiar characters that may be physiological or morphological and anatomical.

As regards physiological peculiarities, the desert plants that are capable of reviving after thorough desiccation are few in number and are limited to lowly organised types, such as lichens (yet these by no means lack protective arrangements, as is indicated in Dr. Fink's article on lichens in the volume under review). On the other hand, many flowering plants exhibit in their life-history a rhythm that enables them to thrive in the desert without the aid of any adaptive structural features. For instance, in deserts there are many ephemerals that spring up in the rainy season, and within a few weeks produce leaves, flower and fruit, and die. They evade the true desert conditions, and survive in virtue of their rapid completion of the life-cycle at a definite season. In the Egypto-Arabian desert there is but one annual rainy season, namely, in winter, and consequently only one annual crop of winter-ephemerals. Near Tucson, however, there are two rainy seasons—in winter and summer respectively—and corresponding crops of winter-ephemerals and summer-ephemerals. These two plant-communities consist of entirely different sets of plants, the seeds of which (according to the information in this volume) will not germinate at the particular rainy season during which they are wont to be inactive.

The structural characters enabling desert plants to exist have been dealt with by Volkens and other investigators, and additional details have more recently been supplied by workers at the Tucson laboratory. But the main value and novelty of the work conducted in connection with this laboratory lies in the investigation of the behaviour and physiological activity of representative species, also in the thorough

FIG. 1.—Right side of gulch near Laboratory, with generally south exposure.

[1] "Distribution and Movements of Desert Plants." By V. M. Spalding. Pp. v+144. (Washington: Carnegie Institution, 1909.)

analysis of the conditions prevailing and determining the precise local distribution of species and communities, including the changes taking place in the arrangement of the vegetation by colonisation and invasion.

In the various sections of the volume under review, interspersed in the discussion of general principles, we find many interesting details regarding certain species that we can piece together. For instance, we learn that the giant cactus, *Cereus giganteus*, which raises its fluted columnar stem up to a height of fifty feet, was shown by Mrs. E. S. Spalding to act as a vast expanding and contracting reservoir, as its ribs and furrows permit of bellows-like action. This plant, like some other desert-plants, possesses extensive shallow roots, which are very efficient collectors of water derived from feeble showers; for Mrs. Spalding found that after a rainfall of 0·5 inch "the stems expanded steadily for three weeks." Such a slight fall of rain would cause an appreciable increase in moisture only to a depth of less than four inches, so that the utility of shallow roots is clearly demonstrated, although so many desert plants have extraordinarily deep, relatively unbranched roots. In connection with the question of water supply, Dr. Livingston, in his valuable article on the soils, shows by means of curves that the effects of atmospheric precipitation on moisture in the soil regularly "lag" behind the actual falls of rain, so that, with certain depths of root, the plant does not immediately profit by showers, nor does it suffer, *pari passu* with absence of rain, from lack of supply of water. To return to the consideration of *Cereus giganteus*, Mr. J. C. Blumer clearly shows that individuals of this species, as of certain others, are more numerous on the southern slopes of hills. Inasmuch as other species show a preference for the more favourable northern slopes, there is a difference in the vegetation of the different sides of hills or gulches; and it is shown that on the northern side of the latter the difference tends to become accentuated with time, because the more numerous individuals and species present tend to cause an accumulation of humus and a consequent amelioration of the soil.

Fig. 2.—Left side of gulch near Laboratory, with generally north exposure.

The section of the volume dealing with the geology of the desert, written by a geologist, Prof. Tolman, seems in subject-matter rather out of place, as it abounds in diffuse and irrelevant generalities. Among these the statement that "Europe is behind America in the study of these newer phases of geology" would perhaps have been nearer correctness a dozen years ago.

One chapter differing from the others in being not particularly applied to Tucson desert is that on the origin of desert floras, written by Dr. D. T. MacDougal, who deals rather with the possible mode of evolution of biologic types than with the origin of the desert flora. He affirms that consideration of the known facts "leads to the inevitable conclusion that the form-characters, moisture-conserving capacities and resistance to desiccation, distinction of xerophytic species, must have made their appearance within comparatively recent geologic time." In the light of the geological evidence suggesting the former existence of deserts, and in view of the difficulty of geological preservation of the remains of desert-plants (except in oases or by rivers), such a conclusion seems open to the gravest doubt; and scepticism as to its correctness will be heightened by our knowledge, not only of the existence of xerophytic Cryptogamia and Phanerogamia of all ranks, but also of the distribution of such remarkably isolated types of desert plants as Welwitschia and Acanthosicyos. An additional consideration militating against Dr. MacDougal's conclusion is that xerophytic characters are evolved with considerable facility, as is demonstrated by the fact that various xerophytic communities (in deserts, for instance) in different parts of the world generally include a relatively large number of endemic forms that are definitely allied to and derived from the adjacent non-xerophytic flora.

In congratulating Mr. V. H. Spalding and his collaborators on this valuable contribution to our knowledge of the ecology of desert-plants, and on supplying ample justification for the foundation of a desert laboratory, we may perhaps be forgiven for adding a prayer to American botanists that when they use local or popular names of plants, they will, at least on first mention of these, also give the botanical names. The omission of this precaution causes botanists of other countries to lose more than time in the endeavour to learn what plant is being referred to. For instance, early in the volume under review, reference is made without any explanation to the "sahuaro," the "creosote-bush," "cotton-woods," the "ocotillo"; yet few, if any, European botanists would know the identity of all these, or that these names represent respectively *Cereus giganteus*, and species of Larrea, Populus, and of—the reviewer imagined that he remembered the generic name of the last, but has been compelled to interrupt this sentence and waste ten minutes in fruitless search.

Percy Groom.

NUBIAN ARCHÆOLOGY.[1]

The first publication of the Egyptian Department of the Pennsylvania University Museum, under the direction of Prof. Randall Maciver, is one that shows great promise for the future. Thanks to the enlightened financial support of Mr. Eckley B. Coxe,

[1] "Areika." By R. Randall Maciver and C. Leonard Woolley. With a chapter on Meroitic Inscriptions, by F. Ll. Griffith. Pp. 56+plates (Oxford: Letterpress and Plates printed by Horace Hart at the University Press, 1909.) Price 1*l*. 1*s*. net.

jun., Prof. Maciver has been enabled to initiate a programme of archæological exploration in Egypt which, if continued, will, under the leadership of this most competent archæologist, undoubtedly result in interesting and important discoveries.

Prof. Maciver has chosen for the scene of his work a portion of the Nile valley which has hitherto seemed most unpromising, the barren Nubia that lies between the first and second cataracts. The nature of the country, in which the river flows practically through desert, with only the narrowest fringe of cultivation along its banks, seemed to deny the possibility of any important ancient centre having been established there, and the temples that were erected by the river-side seemed to be the memorials more of Egyptian imperio-religious pride than of real civilising energy. There is little doubt that no serious attempt to seek for remains of antiquity in this region would have been made even now had it not been for the fact that the proximate raising of the level of the Aswân Dam threatened the drowning of the ancient banks for a considerable distance upstream, and the consequent destruction of any historical evidence that might be buried near them. The attention of the Service des Antiquités, the archæological branch of the Egyptian Public Works Department, was at once directed to the necessity of saving such historical evidence so far as possible, and the director-general of the Service, Sir Gaston Maspero, K.C.M.G., commenced the organisation of a general archæological campaign in Nubia. Mr. A. E. Weigall, the inspector of antiquities for Upper Egypt and Nubia, undertook a preliminary tour of his Nubian district, which resulted in the publication of a careful and detailed report on the archæological probabilities and possibilities of Nubia. Then the Survey Department started a thorough and comprehensive exploration of the whole district (including excavations under the direction of Dr. Reisner and Mr. Firth, which began its labours at Shellal, and is now slowly working southwards).

Nubian Castle near Amada: Period of Thothmes III. View looking from the North-east Corner. From "Areika."

Independent explorers were also summoned to the work. Prof. Garstang, of the University of Liverpool, carried out a season's work at Koshtamneh which was productive of interesting results. Unluckily, it has remained a ἅπαξ λεγόμενον. Prof. Garstang was drawn aside from the comparatively dull antiquities of Nubia to the more beautiful trophies to be found in the necropolis of Abydos, but he has now turned again southwards, to the Sudan, and time may yet bring him back to assist the researches of Mr. Firth and Prof. Maciver in Nubia. Prof. Maciver was last in the field, but has already made most interesting finds, which are described in "Areika," the volume under review. Assisted by Mr. C. Leonard Woolley, he has explored the region between Korosko and Amada, known as El Righa or Areika, which gives its name to the book. Here he has carried out three excavations; first, that of the castle of a Nubian chief of the time of Thothmes III., near Amada; secondly, that of a neighbouring cemetery of earlier date; thirdly, and most important of the three, that of a cemetery of Roman date at Shablul, opposite Korosko.

The Nubian chief's castle is a queer conglomeration of buildings of absolutely non-Egyptian and more or less negro type, showing all the negro's inability to think out or carry out a coherent plan, or produce any sensible building bigger than a simple hut. There is little doubt that the Nubian population is, and has always been, fundamentally negroid, and no doubt in ancient Egyptian days it was nearer the negro than it is now. The cemetery might, from the nature of the antiquities found in it, be dated to a period contemporary with the Egyptian predynastic period. But Prof. Maciver well points out that the barbaric culture of the Nilotes, which was raised and organised into a civilisation in Egypt before the beginning of the First Dynasty, continued in its primitive form in Nubia throughout history, and even now pottery not distantly akin to the prehistoric Egyptian is still made there. So that we cannot say that primitive remains in Nubia are necessarily primeval in date. This explains the phenomenon of the "Pan-Grave People" of the XIIth Dynasty in Upper Egypt. The isolated Egyptian settlements of this people, whose pottery is so closely analogous to that of the primitive Egyptians, but whose "Middle Kingdom" date is certain, were originally dscovered by Prof. Flinders Petrie. They remained an enigma until Mr. Weigall discovered that the earlier Nubian cemeteries were largely of "Pan-Grave" type, and that "Pan-Grave" pottery was common there. It was then supposed that the Egyptian "Pan-Grave" remains were the relics of Nubian conquerors at the time of the XIIth Dynasty. Prof. Maciver, following up the clue, supposes in the present volume that the Egyptian "Pan-Grave" people were Nubian potters imported into Egypt to make their special pottery (which was, in its way, finer than that of the Egyptians). To me it seems more probable that they were not merely potters, and I would see in them simply colonies of deported Nubians, brought back by the conquering Pharaohs of the XIIth Dynasty as the "living prisoners," trophies of their Nubian razzias which are often mentioned in the inscriptions, and settled in vacant lands of Upper Egypt.

The discoveries at Shablul are of importance as definitely identifying the products of a peculiar art, long known and correctly identified as of Roman date (it is especially well represented in the collections of the British Museum), as Nubian. The later specimens of the painted pottery of this style clearly connect on to the crude productions of the Coptic potters, and this was always seen, but Prof. Maciver and Mr. Woolley have shown that the same style, which is Nubian only, goes back well into the Ptolemaic period. Its earlier products are quite Egyptian or Greek in the choice of motives, but throughout the whole series there runs a note of peculiar originality of treatment which can only be due to the Nubian potter himself. This painted pottery is splendidly illustrated by coloured plates which accurately reproduce the originals. Its decoration is extremely interesting, and the comments of the authors themselves on it are most illuminating. But to quote the opinions on it of professors of artistic style who are evidently not gifted with much historical sense was unnecessary: Prof. Meurer's opinion that a certain design of a crescent with a cross (a modification of the *ănkh*, the symbol of life) on this Roman-Nubian pottery is a descendant of the Minoan Cretan motive of the Double Axe above the Horns of Consecration (so well known from Dr. Evans's discoveries at Knossos) is, frankly, absurd, and we wonder that our authors did not pass over it in respectful silence. As it is, their reviewers have to chronicle it with disrespectful mirth.

Prof. Meurer has supposed that the two designs are connected because they are alike, ignoring the absence of all known connecting links between them during the space of a millennium and a half. The only possibility of the Nubian design being descended from the Cretan would lie in an Egyptian adoption and naturalisation of the Cretan design in the time of the XVIIIth and XIXth Dynasties; and though the Egyptians did for a time take over some Cretan artistic ideas, they never took over the idea of the Double Axe above the Horns of Consecration; and naturally they did not, because they did not take over the worship of the Cretan gods, whose symbols these were (though cults akin to those of Crete may have been known in the Delta at an early period). We prefer our authors' own ideas without those of Prof. Meurer. Throughout their work they themselves had made only one remark which calls for criticism—the description of the *ănkh*, the symbol of life, as the "Nile-key." The *ănkh* was not a key, and had nothing to do with the Nile. It was a conventional representation of a man's girdle, with the tied ends hanging down in front.

The book concludes with a paper on the inscriptions in "Meroitic" form of the Demotic script, of which many specimens were found by the explorers, and its relation to the Meroitic hieroglyphic inscriptions, by Mr. F. Ll. Griffith. Mr. Griffith here makes the first step to a decipherment of both scripts, and has established several curious and unexpected facts with regard to them. This discussion of the relation of their language to the Nubian of Christian times, lately studied by Profs. Schäfer and Schmidt, is very suggestive.

In conclusion, Messrs. Maciver, Woolley, and Griffith must be congratulated on the production of a most interesting contribution to a little-known branch of Nilotic (if we may not, strictly, say Egyptian) archæology.

H. R. Hall.

FROM THE CAPE TO CAIRO WITH A MAGNETOMETER.

During the last twenty years a great many observers have carried on magnetic work in different parts of Africa. A summary of the results up to 1900 at the Cape of Good Hope has been collected and published by Prof. Morrison and the writer,[1] and one for Northern Africa by Mr. B. F. E. Keeling;[2] since 1898 a magnetic survey of South Africa has been in progress; between that date and 1906 observations were taken at more than four hundred stations by Prof. Morrison and the writer, with assistance at one time and another from Mr. S. S. Hough, Prof. A. Brown, Prof. L. Crawford and Mr. V. A. Löwinger. A report by the present writer on the work during this period, including a summary of the earlier work in Africa, south of the Zambezi, was published for the Royal Society at the Cambridge University Press.[3]

Notwithstanding the considerable amount of work done, there was, and still is, a lack of magnetic data for great tracts of what is now no longer geographically the unknown continent. With the purpose of obtaining some information in parts magnetically unknown, the writer submitted, in 1907, a scheme of work through Dr. L. A. Bauer, director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, to the trustees of that body. In this scheme he proposed to continue the line of magnetic stations already occupied between Cape Town and the Victoria Falls to Gondokoro, on the Nile. North of that it was not deemed necessary to observe, as the Survey Department of the Egyptian Government had already put forward proposals for a

1 "Magnetic Elements at the Cape of Good Hope." By Beattie and Morrison. (Trans. S.A.P.S., vol. xiv., 1903.)

2 "Magnetic Observations in Egypt." By B. F. E. Keeling. (1908.)

3 "Report of a Magnetic Survey of South Africa." By J. C. Beattie. (1909.)

magnetic survey of Egypt and the Sudan. It was intended also, should time permit, to make observations in German South-west Africa.

These proposals met with the approval of the trustees of the Carnegie Institution, and they allocated a sum of 2000*l*. for the work. In the first instance the proposals contemplated only one field-party with one observer; later, however, the writer modified his plan so as to include a second observer, in the hope of being able to have two field-parties. At his suggestion the Department of Terrestrial Magnetism in Washington appointed Prof. Morrison as second observer. The additional money necessary was provided by the Government Grant Committee of the Royal Society (250*l*.), and by Dr. L. S. Jameson and Sir Lewis Michell (100*l*.)

The work began at the end of November, 1908, when the writer left Ceres Road, in the Cape Colony, for Windhuk, in German South-west Africa. This journey lasted four months. During February and March of 1909 Prof. Morrison made observations along the railways in the northern part of the same region.

In April, 1909, repeat observations were made in Cape Colony and in Rhodesia, and Prof. Morrison also made observations between the Victoria Falls and Broken Hill, the then terminus of the Beira and Mashonaland Railways.

The two observers left Broken Hill in the beginning of May, and marched to Abercorn *viâ* Fort Rosebery. After Broken Hill the only means of transport was by porters; one set of instruments was carried from there more than 2000 miles, the other more than 1400, the whole distance being accomplished without mishap to any of the instruments.

At Abercorn the observers separated; Prof. Morrison proceeded to the northern end of Lake Nyasa, then down the Nyasaland plateau and the Shiré and Zambezi valleys to Chinde; from there he went by sea to Dar-es-Salaam, and made observations between it and the terminus of the railway which goes from that place inland. He was able to secure a number of observations which will be of great value for determining the secular variations of the magnetic elements in that part of the world. Finally, he made a number of observations along the Uganda Railway from Mombasa to Port Florence.

The writer went overland from Abercorn to Bismarckburg, a German station on the south shore of Lake Tanganyika. From there he marched to Tabora, an important town in German East Africa; observations could not be made along the shores of Tanganyika, as he had originally intended, because the steamer had temporarily ceased to run—the two white men on it, the captain and the engineer, having contracted sleeping sickness. From Tabora he journeyed overland to Bukoba, a German port originally founded by Emin Pasha, on the west shore of Victoria Nyanza; the march was continued along the west coast of that lake to Entebbe. At the latter place he found it was impossible to take the usual overland route to Gondokoro, on account of sleeping sickness; his caravan had to go *via* Albert Nyanza, and there be conveyed forty-five miles from Butiaba to Koba. The end of the porter transport was reached at Gondokoro, just a little more than 2000 miles from Broken Hill by the route followed. The work was brought to a close by the two observers once more meeting at Cairo, and comparing their instruments with those at Helwan and, finally, with those at Kew.

In addition to the observations taken along the routes mentioned above, a number of stations previously worked at in Cape Colony, the Transvaal, Natal and Zululand were again occupied in 1908; the cost of this was defrayed by a grant from the Royal Society (25*l*.) In all about 360 new stations were occupied, mainly in regions which formerly were known magnetically only slightly or not at all.

The instruments used for the above observations were the same as in the earlier work in South Africa (1898–1906), and were lent to the writer by the Royal Society, the Royal Observatory of the Cape of Good Hope, and the South African College. By means of the repeat observations, the results obtained in 1909 and in previous years can be reduced to the same standard; and, further, through the comparisons at Helwan and at Kew, can be compared with much that has been done in recent years in other parts of the world.

While making the preliminary arrangements for the journey, the writer received great assistance from the Governor of the Colony of the Cape of Good Hope, Sir Walter Hely-Hutchinson, who communicated with the authorities of the various territories it was proposed to survey, and obtained permission for the observers to enter them, and to enjoy while there special privileges.

In German South-west Africa the authorities allowed the observers to travel free of charge over the Government railways; the same facilities were given by the Cape, the Central South African, the Natal, the Rhodesian, and the Uganda railways; the writer had valuable concessions while travelling in the Sudan and on the Egyptian Government steamers and railways.

In addition to these facilities, the courtesy and hospitality of the English and the German officials did much to relieve the tedium and strain incident to work of this nature in such circumstances. The writer feels that a formal recognition such as this is but a poor return for the help so willingly and generously accorded.

In conclusion, it gives the writer great pleasure to have the opportunity of thanking Mr. R. S. Woodward, the president of the Carnegie Institution, and Dr. L. A. Bauer, director of the Department of Terrestrial Magnetism of that institution, for their advice and encouragement during the progress of the work, and in particular to thank the latter for the great interest he has taken in the reduction of the results, a work which is being carried out at Washington under his direction. J. C. Beattie.

SIR ROBERT GIFFEN, K.C.B., F.R.S.

The sudden death of Sir Robert Giffen on the morning of April 12, while on a tour in Scotland accompanied by Lady Giffen, is a great loss to economic and statistical science. He joined the Statistical Society in 1867, at the age of thirty, having then already acquired reputation as a writer on financial subjects in the *Globe*, the *Fortnightly Review*, the *Economist*, and the *Spectator*. He was elected a member of the council and one of the secretaries of the society in 1876, in which year he joined the Civil Service, and was appointed chief of the Statistical Department of the Board of Trade, and one of the delegates of the Government of England to the International Statistical Congress at Buda-Pest. He submitted to that congress "Considérations sous Forme de Tableaux pour la Préparation d'une Statistique internationale des Chemins de Fer," and was appointed a member of the permanent committee. To the Social Science Congress at Liverpool, in the same year, he contributed a paper on the causes and effects of the depreciation of silver, how far is it an evil, and what are the means of remedying the evil? In his official capacity, he devoted himself with zeal to rectifying and harmonising governmental statistics, and to diminishing the overlapping and cost of parliamentary returns. For example, he pointed out that the statistics of emigration were vitiated by the omission of any deduction in respect of the return of persons temporarily leaving the country; and he induced the Government to appoint a committee to consider the whole question of official statistics.

In 1878 he read before the Statistical Society an important paper on recent accumulations of capital in the United Kingdom, which is an excellent example of the comprehensiveness and accuracy of his statistical methods, and of his faculty of drawing trustworthy inferences from materials that at first sight appear insufficient. Great as was the increase of wealth which he had to record, he was sanguine enough to hold that it would be the fault of the English people if their progress were not in future even more rapid than in the past, and his forecast has been verified. In the same year he took part in the foundation of the *Statist* newspaper, and was the delegate of the Government to the International Statistical Congress at Paris.

In 1879 he contributed to the Statistical Society a treatise on the fall of prices of commodities in recent years, and undertook the duty of editor of the society's journal. The Treasury committee on statistics made its report, to which was appended an important memorandum by Sir Robert Giffen on the compilation and printing of the statistics of the United Kingdom. In 1882 he read a paper to the Statistical Society on the use of import and export statistics, and was elected president of the society. His inaugural address was on the utility of common statistics. In the following year the University of Glasgow, of which he had been a student, conferred upon him the degree of Doctor of Laws. His inaugural address to the Statistical Society for that year was on the progress of the working classes in the last half-century. It is characteristic of his thorough devotion to any duty which he undertook that he was present at every meeting of the society held during his presidency. In the year 1884 he was elected a member of the Athenæum club under the rule which enables the committee of the club to confer that honour on persons distinguished in literature or the arts or for public service. In 1885 he contributed to the Statistical Society's jubilee volume a paper on some general uses of statistical knowledge; and, in the following year, read to the society further notes on the progress of the working classes. In 1887 he was nominated by the International Statistical Congress at Rome as the English member of a committee on standards of value; and in the same year he was appointed by the British Association president of the section of economic science and statistics (section F) for the meeting at Manchester, and delivered an address on the recent rate of material progress in England. He also took part in the proceedings of a committee of the association appointed to investigate variations in the value of the monetary standard, and in the following year drew up the report of that committee. He afterwards became its chairman.

In 1890 Sir Robert Giffen took part in the formation of the British Economic Association, now the Royal Economic Society, and became a vice-president of it. In 1891 he was created a Companion of the Bath, and in 1892 elected a Fellow of the Royal Society. In 1894 the Royal Statistical Society (as it had then become) paid him the well-earned compliment of awarding him their Guy medal in gold as a recognition of his great services. In 1895 he took the second step in the ladder of the Order of the Bath, being promoted to the dignity of Knight Commander, and in 1897 he retired from the public service after a career of great usefulness and distinction, having taken a large share in the creation and development of the labour, commercial and statistical departments, of which he was the first controller-general. In 1900 he was elected president of the Manchester Statistical Society, and delivered an address; and in 1901 the British Association appointed him, for the second time, president of section F, and he delivered an address at Glasgow on the importance of general statistical ideas.

His separate published works were:—"American Railways as Investments" (1872), "Stock Exchange Securities" (1877), "Essays in Finance" (3 editions), "The Case against Bimetallism" (2 editions), "Economic Inquiries and Studies" (2 vols., 1904).

This formal record of a life spent in the study of subjects usually thought to be dry and uninteresting would not be complete if it were not supplemented by the statement that in personal character and private life he was one of the most genial of men.

NOTES.

The eighteenth "James Forrest" lecture of the Institution of Civil Engineers will be delivered at the institution on Wednesday, June 22, at 8 p.m., by Sir John Gavey, C.B., his subject being "Recent Developments of Telegraphy and Telephony."

A Reuter message from Washington states that the proposed American Antarctic expedition under the joint auspices of the Peary Arctic Club and the National Geographic Society has been abandoned for this year on account of lack of funds.

We learn from *Science* that Prof. R. P. Whitfield, curator in the American Museum of Natural History since 1877, and the author of important contributions to palæontology and geology, died on April 6, at the age of eighty-two years.

The death is announced, at sixty-one years of age, of Dr. C. B. Plowright, formerly professor of comparative anatomy and physiology at the Royal College of Surgeons, and the author of a standard work on fungi.

M. de Montefiore, we learn from the *Revue scientifique*, has given 150,000 francs to the Paris Academy of Sciences to create a new triennial prize of 12,500 francs to assist the progress of electrical science.

It is announced in the *Times* that a National College of Agriculture is soon to be established in Pretoria. General Botha has promised to set aside 100,000*l.* as a first instalment for the execution of the project, and the Town Council has unanimously decided to give the Government the whole of the town lands of Groenkloof as a site. The area comprises 3681 acres, and contains arable and pasture lands as well as a large plantation.

The Geological Society of France has this year awarded its Danton prize to M. Gosselet. The prize is given to the geologist whose discoveries are likely to benefit industry most, and was awarded to M. Gosselet for the part he has taken in the development of coal-mining in the north of France. The Viquesnel prize, intended to encourage geological research, has been awarded to M. Robert Douvillé for his stratigraphical work on the geology of Spain and his palæontological researches on the foraminifera and ammonites.

The Geologists' Association has arranged a Whitsuntide excursion to Swanage, Lulworth Cove, and Bournemouth from May 14–18. The party will leave Waterloo on Friday, May 13, at 4.10 p.m. The excursion to Lulworth Cove will be carried out only if the sea is calm, and should May 14 not be suitable for the excursion, the Lulworth visit will be postponed to May 18. Full particulars of the excursions can be obtained from Mr. W. P. D. Stebbing, 78A Lexham Gardens, London, W.

An event of importance in wireless telegraphy is the inauguration by the Marconi Company of a service for the direct transmission of public messages between their stations at Clifden, in Ireland, and Glace Bay, in Canada. Both the stations have been recently reconstructed, and communication will be kept up by them continuously both by day and by night. The latter fact is interesting as showing that the difficulties of transmission during the hours of daylight have been overcome. The system is a directive one, the aërials being so constructed as to emit waves principally in the required direction. The discharger used is of the type invented by Mr. Marconi, in which sparking takes place between metal discs cooled by being kept in rapid rotation. By causing the sparks to be formed between equally spaced projections on the discs, the trains of waves emitted are broken up in a regular manner so as to produce in the receiving telephone a musical note which can be clearly distinguished by the operator. The power used for sending is about 400 kilowatts. The service commenced on April 23 by an interchange of greetings between the Postmasters-General of Canada and Great Britain.

The present spring is proving peculiarly free from spells of really warm weather, and the summary of temperature issued by the Meteorological Office with its Weekly Weather Report shows that for the period of seven weeks ended April 23 the thermometer in the screen did not exceed 64° in any part of the United Kingdom, the highest readings ranging between 60° and 64°. At Greenwich there have, as yet, only been six days this year with a temperature of 60° or above, whilst to the same date last year there were eighteen days with a temperature of 60° or above. The rainfall for the first half of spring is less than the average in all districts, except in the north and east of Scotland and in the south-east of England, the greatest deficiency being 1·08 inches, in the south-west of England. Since the commencement of the year, however, the rainfall is everywhere in excess of the average, and in seven out of twelve districts the excess is more than 2 inches. The mean sea temperature round the British Islands is at present nearly everywhere colder than at the corresponding period last year, and at Kirkwall it is nearly 5° colder.

Thanks to the energy of Mr. C. E. Fagan, and the generosity of owners, a remarkably fine and representative series of trophies illustrating the big game of the Empire has been brought together and dispatched to Vienna for the forthcoming Sports Exhibition. The specimens lent by the Prince of Wales include the record head of the Javan rusa from Mauritius (where the species has been reduced), together with heads of tahr, markhor, musk-ox, and Newfoundland caribou. The Duke of Westminster is sending a magnificent Irish elk skull; Lord Burton an unrivalled twenty-pointer Scots stag; Lord Lamington a pair of Indian lion skins; Captain Collins, of the Wau Garrison, a head of a bull Sudani eland (one of three or four in this country), and Mr. F. C. Selous one of the last really fine heads of the typical South African white rhinoceros.

For the purpose of publishing the practical and scientific results obtained through the medium of the Entomological Research Committee (Tropical Africa), it is proposed to issue a journal, to be called *The Bulletin of Entomological Research*. The journal will contain accounts of the observations which have any bearing on the subject of economic entomology; descriptions of insect life-histories, with figures of their earlier stages; reports on practical methods for destroying or keeping in check any noxious species; papers by specialists dealing with the systematic classification of such groups as are known to be, or are likely to be, injurious to human beings, live-stock, or agriculture; and so forth. It is proposed to issue not fewer than four parts annually, and additional parts will be published whenever sufficient material is forthcoming. Further particulars may be obtained from the scientific secretary, Entomological Research Committee, British Museum (Natural History), Cromwell Road, London, S.W.

The report of the council and the proceedings of the Hampstead Scientific Society for the year 1909 show that the society has completed ten years of useful work. During the year with which the report deals, an astronomical observatory and meteorological station have been established on the top of Hampstead Hill. The Metropolitan Water Board allows the use for the purposes of the observatory and station of a portion of the surface of the covered reservoir near the Whitestone Pond. Arrangements have been made for the meteorological records to be taken twice daily, and the results are published in the monthly return of the Meteorological Office and in the *Hampstead and Highgate Express*. We notice that Sir Samuel Wilks, Bart., F.R.S., has been compelled, through advancing years, to resign the presidentship of the society, and has been succeeded by Prof. W. M. Flinders Petrie, F.R.S. The membership of the society now numbers 274.

Dr. Julius Kühn, professor of agriculture at the University of Halle, whose death was announced in these columns last week, was one of the band of workers who laid the foundations for the modern development of the scientific side of agriculture. He acquired a great practical knowledge of the subject in his early days when working as a farmer and, after his student days at Bonn were over, as manager of a large estate. This knowledge proved invaluable when, later on, he was appointed to Halle and devoted himself to the more scientific aspects of his subject. Perhaps his best known work is that in connection with the feeding of animals. It had for many years been customary to compare animal foods with one another in terms of "hay equivalents." The method was necessarily rough, and capable only of limited development. In 1859 Grouven introduced feeding standards based on the amounts of the various food constituents—protein, carbohydrate, &c.—required by the animal; knowing these data and the percentage composition of the foods, it was possible to make up rations suited to the different classes of stock. So attractive was this new view that a tendency arose to regard the feeding of animals as a merely arithmetical problem requiring only a knowledge of the standards and of the composition of foods. Kühn, however, insisted on the necessity of keeping the new work down to the solid ground of fact. Whilst recognising the value and importance of the standards, he also recognised the individuality of the animal and of the crops on which it feeds. His book "Die zweckmässigste Ernährung des Rindviehes," which appeared in 1861, and went through ten editions in the course of thirty years, thus had a steadying effect on the development of the subject. He also published a number of papers on the parasitic diseases of plants, and is remarkable for his early advocacy of the view that sugar-beet "sickness" is the result of nematodes, which can be destroyed by burning over the ground. His activity was great, and he continued publishing some of his manurial results even after the celebration of his eightieth birthday on October 23, 1905.

In *Revue des Idées* for March M. L. Bréhier, under the title of "Les Origines de l'Art musalman," discussing the recent investigations of MM. H. Saladin and G. Migcon, shows that Mohammedan art is not the result of a "sudden improvisation." It is due to the development by conquered races, Copts, Syrians, people of Mesopotamia, and Greeks, of ideas surviving from the Chaldæan-Assyrian periods, and, particularly in its repulsion against delineation of the human form, was a protest against Hellenism.

Much work has of late been done on the action of various organic arsenic compounds as trypanocides. Drs. R. P. Campbell and J. L. Todd find that arseno-phenylglycin is a more active trypanocide than atoxyl in the treatment of experimental infections of white rats by the *Trypanosoma brucei* (*Montreal Med. Journ.*, xxxviii., 1909, p. 795).

In the Journal of the Royal Army Medical Corps for August, 1909, Mr. P. D. Strachan and Lieut.-Colonel C. Birt summarise observations on the occurrence of Malta fever in South Africa. The disease has been met with in Orange River Colony, in Hanover, Beaufort West, Kimberley, and Steytlerville, Cape Colony, and in Bechuanaland, and there is a widespread epizootic of Malta fever among the goats of South Africa.

The *Philippine Journal of Science* for October last (iv., No. 5), which has only recently come to hand, contains matter of considerable medical interest. An attempt to extend the cutaneous reaction, which has been much used in tuberculosis, to leprosy, is reported by F. Calderon and V. G. Heiser. Fifty lepers were vaccinated with a glycerin extract made from excised leprous nodules. In two or three cases there was a doubtful reaction, but otherwise the vaccinations were in all respects like controls done with a glycerin extract of skin from a cholera patient. The filtration of immune sera (anti-tetanic and anti-diphtheritic sera) is the subject of a paper by E. H. Ruediger. The serum was passed through Berkefeld filters, and the filtrate was found to be just as active as the unfiltered serum.

The issue of the *Philippine Journal of Science* for November, 1909, vol. iv., No. 6, is entirely devoted to systematic zoology, Mr. A. Seale describing a large number of species of fishes as new, while Mr. C. S. Banks names four new Culicidæ and commences a list of the Rhynchota of Palawan, and Mr. L. Griffin communicates a synopsis of the snakes of the same island.

The April number of the *Journal of Conchology* contains Colonel Godwin-Austen's presidential address to the annual meeting of the Conchological Society in October last, in which emphasis is laid on the importance of a study of the soft-parts of land molluscs as the only means of determining the affinities of the various forms. Some interesting lines of evolution which have been worked out by these means in the Zonitidæ are quoted.

In the *Entomologists' Monthly Magazine* for June, 1909, Mr. E. A. Newbery adduces evidence to show that the scolytid beetle described in 1834 by Westwood as *Hypothenemus eruditus*, on the evidence of specimens in an old book-cover, and since then generally included in the British list, is really an exotic species, one of the habitats of which is the shells of Brazil nuts, while it has also been observed in book-covers from Java and Singapore. It had previously been recorded from tropical America in the "Biologia Centrali-Americani."

The March number of the *Museums Journal* contains a notice of the collection of Microlepidoptera, with the associated entomological library, recently presented by Lord Walsingham to the Natural History Branch of the British Museum. The collection, which contains about 45,000 species, against some 4000 previously in the museum, has been temporarily deposited in one of the new store-rooms at the base of the building, where it will gradually be arranged in proper order by the additional assistant specially appointed to take charge of it by the trustees.

In addition to an account of the progress of that institution during the year, the *Aarsberetning* of the Bergen Museum for 1909 contains an illustrated description of the personal relics of Claus Frederik Fastings, which were bequeathed to the museum at his death in 1791. Of the three papers in the third part of the *Aarbog* of the same museum, by far the longest is one, by Mr. O. J. Lie-Pettersen, on the fresh-water rotifer-fauna of Norway. The author has been collecting material for several years, and records a long list of species; but, although it is stated that previously very little was known on the subject, it is remarkable that not a single one of these is described as new.

The last number of the Journal of the Marine Biological Association of the United Kingdom (vol. viii., No. 5) contains a good example of the admirable work which is being carried on at the association's Plymouth laboratory. The director of the laboratory, Dr. E. J. Allen, and Mr. E. W. Nelson, have been engaged for some years past in experimenting on the cultivation of diatoms as food to be used in the rearing of various types of marine larvæ. By the use chiefly of modifications of Miquel's methods they have been able to make, by the addition of certain substances to sterilised sea-water, nutrient solutions in which it is possible to produce "persistent cultures" of a single species of diatom, or mixed cultures containing several species. In these cultures the diatoms multiply rapidly, and continue to thrive for long periods, sometimes extending over many months. The larvæ to be reared are placed after hatching in pure sterile sea-water; a sufficient amount of the nutrient solution is added, if necessary, and the water is inoculated with a suitable culture of diatoms; in some cases other unicellular organisms were used. By this means larvæ of Echinus were reared until long past the metamorphosis, being fed in the earlier stages upon the actively growing unicellular organisms, and after the metamorphosis on red seaweed. Larvæ of a sea-cucumber (Cucumaria) and a worm (Pomatoceros) were also successfully reared, and the method promises to be of great value to the experimental embryologist.

The controversy between Dr. Florentino Ameghino and his critics respecting the alleged human origin of the "burnt earths" of Argentina was commented on in Nature, vol. lxxxi., p. 534. The last paper then noticed was dated February 17, 1909. Since then, Ameghino has issued four others, up to March 19 of the present year; but it will be well now to await the elaborate memoir which is promised, and in which the evidence of hearths with bones of animals used as food will be set forth. The strong point about Ameghino's spirited and persistent defence is that he now makes it clear that he has studied thin sections of the earths and of numerous artificially prepared products. It is admitted on all hands that minerals from decomposed lavas abound in the Pampas earths, and thus would occur undestroyed in the products of their partial fusion. This was pointed out in the previous notice in NATURE, and the thoroughness of Ameghino's reply is shown by his references to this notice, and his correction of some of its statements, in his "Examen critique du Mémoire de M. Outes" (*Anales del Mus. Nac. de Buenos Aires*, 1909, p. 459). While Ducloux, and perhaps our own reviewer, seem allowed some saving grace, the work of Outes is said to contain "des hérésies scientifiques tellement colossales que personne ne peut croire qu'il les ait publiées de bonne foi." A paper issued on January 29 (*ibid.*, tomo xx., p. 39) provides a very useful summary, with long quotations, of previous work on these debatable earths down to 1907, and a bibliography of work from 1907 to 1909.

THREE new species of Echeveria from southern Mexico are described and figured by Drs. J. N. Rose and C. A. Purpus in vol. xiii., part ii., of the Contributions from the United States National Herbarium. It is suggested that two, *E. gigantea* and *E. subalpina*, will be found useful in horticulture as bedding plants.

BOTANISTS who are contemplating a summer holiday in the Alps with the view of collecting choice plants will be interested in two articles by Mr. H. S. Thompson, published in the *Gardener's Chronicle* (April 16 and 23), giving an account of the flora of Mont Cenis. Among the plants taken between Susa and the Hospice were *Telephium Imperati, Cytisus supinus, Dianthus neglectus,* and *Saponaria lutea*. Around the small Lac Clair, a wonderfully rich hunting ground, situated at a height of 9000 feet, the author found *Campanula cenisia, Arabis coerulea, Cortusa Matthioli*, and clumps of *Saxifraga biflora*. Altogether Mr. Thompson collected 180 plants growing above an altitude of 8000 feet, besides meeting with a rich flora at lower levels.

A CURIOUS gall on the Indian grass *Ischaemum pilosum* is described by Mr. L. A. Boodle in the *Kew Bulletin* (No. 3). It takes the shape of a cylindrical tube about 15 cm. long, resembling a slender goosequill, which, with a few scale leaves at the base, arises as an erect branch from the creeping rhizome. The gall caused by an insect, *Oligotrophus ischaemi*, is considered to be a greatly elongated internode. Various illustrations are given, including figures of the transverse section of the solid normal and hollow modified stem. Reference is also made in a short note to a method of preparing baobab trees as water reservoirs in the Soudanese province of Kordofan. The trunk is hollowed out to form a cistern about 20 feet deep and 10 feet in diameter; then a shallow basin is prepared round the base of the tree for the collection of water during the rain, from which it is transferred to the hollowed trunk.

THE annual report for 1909 of the Rothamsted Experimental Station is not so adverse as might have been expected considering the heavy rainfall and the low temperatures that prevailed through the summer. The yield and quality of wheat grain was poor, but the yields of barley and mangolds were above the average. A comparative test of nitrate of lime, cyanamide, nitrate of soda, and sulphate of ammonia, together with superphosphate in each case, was initiated with barley as the crop, which has yielded, so far, no practical difference in the results. The important investigations carried on by members of the staff in connection with the effect of partial sterilisation of the soil, the direct assimilation of ammonium salts by plants and the development of the wheat grain have already formed the subject of a reference in these columns.

THE annual report for 1909 of the Woods and Forests Department of South Australia appears in Nos. 4 and 6 of the Agricultural Journal of that colony, and shows that the possibilities of the situation are being realised. It is said that inquiries have been made from America for one million railway sleepers cut from red-gum; the contract could not be taken up, because the supply of red-gum for sleepers is rapidly being used up for Australian railways, but it is of interest as showing that even the United States are having to look about for timber supplies. The expenditure of the Department has been increased from 10,080*l*. to 17,575*l*.; the intention is to encourage in every way the planting of pine, gum, and other trees, even to consider the advisability of offering a bonus sufficient to cover the cost of the necessary attention to the trees for the first four or five years of their existence. Wasteful methods of handling mature timber are still in vogue; we are told that only about one-third of the timber on any given area is properly utilised, the rest being destroyed by axe and fire owing to the unsystematic and wasteful character of the lumbering operations.

THE marked increase of the sensitiveness of an instrument for detecting alternating currents of electricity when the free period of the instrument coincides with the period of the current was pointed out by Prof. M. Wien twenty years ago. The property has since led to the production of several forms of vibration galvanometer, and the theory of the instrument has to some extent been investigated. A more complete examination of the theory, and a comparison of the theory with the actual behaviour of three forms of the galvanometer, are to be found in a paper on the subject by Mr. F. Wenner in the February number of the Bulletin of the Bureau of Standards. A few new hints as to the design of the instruments are also given. In order to avoid giving the instrument a double period the moving system must be symmetrical. In bridge work the resistance of the galvanometer should be very much less than that of the bridge, and the back electromotive force developed in the instrument should be half that impressed on the galvanometer circuit.

THE Jesuit Fathers at Zikawei are to be congratulated on the addition to their observatory of a seismological station. During the months of January and February this year a Weichert pendulum of 1200 kilos. recorded twenty-six shocks. Twelve of these were also noted by an Omori pendulum of 15 kilos. Both instruments record on smoked paper. The difference in the number of records obtained from these two types of instruments is undoubtedly striking, but had there been at Zikawei an apparatus which gave a photographic record of earthquake motion it is probable that the total number of shocks noted would have been more than doubled. During this period at Shide, in the Isle of Wight, photographic recorders of the British Association type noted eighty-one disturbances. An instrument writing on smoked paper at that station, however, only recorded a few of these.

IN the second fascicule of vol. iv. (new series) of the *Annales de l'Observatoire royal de Belgique*, the geophysical results obtained at the observatory during 1908 are tabulated and discussed. The hourly values of the three magnetic elements are given in full with the times and values of the absolute maxima and minima, the differences, and the characters of the curves, morning and evening. Then follow valuable *résumés* in several forms, and lastly is given a series of notes directing special attention to the exceptional disturbances of the year, the curves for which appear amongst a number of excellent curves at the end of this section. Other sections deal with the solar observations—useful for comparison with the variations of the magnets—the soil temperatures at various depths, and the seismological records, making the work a valuable source of information to anyone engaged on geophysical problems. The previous fascicule of the same volume dealt with the material collected in 1907, and the index now published shows the contents of the volumes that have appeared, with interruptions, since 1834. In the preface M. Lecointe, the director, pays a fitting tribute to the conscientious and enthusiastic labours of Captain Louis Niesten, who, after thirty-two years' service, has retired from the observatory staff. Practically all the observations now published were made by M. Somville.

THE Wabash Railroad Company, U.S.A., was one of the pioneers in the use of reinforced concrete, and some of their methods of construction were described in a paper read at the Institution of Civil Engineers on April 19. This company commenced the use of this form of construction for bridges, culverts, subways, and retaining walls in 1902. Not any of these structures have required any repairs since they were built. They are very rigid under loads, and their appearance indicates that they will outlast any other kind of structure, and require no maintenance. Attempts have been made to determine the deflection in reinforced concrete structures due to train loads, but none can be detected under ordinary measurement. The unit stresses allowed are as follows:—for steel in tension, on net section of rod, 18,000 lb. per square inch; for steel, bond on deformed bars, 100 lb. per square inch; for concrete, compression in cross-bending, 800 lb. per square inch; for concrete, direct compression, 600 lb. per square inch; for concrete, shear (diagonal tension) in plain concrete, 30 lb. per square inch; for concrete, shear (diagonal tension) where the web is properly reinforced, 100 lb. per square inch. The concrete used consists of one part of Portland cement, two of sand, and four of stone or gravel. Prof. Talbot's rules were employed for proportioning the concrete and steel. The concrete was put in as a wet mixture, securing a more dense and homogeneous concrete, and imbedding the reinforcement better, thus preventing rusting of the metal.

MR. C. BAKER's classified list (No. 44, April) of second-hand instruments for sale or hire contains particulars of about 1600 pieces of scientific apparatus. The apparatus includes optical instruments of all kinds, and many other appliances and accessories required for instruction or research.

A SECOND revised edition of an excellent handbook, "Brazil in 1910," by Mr. J. C. Oakenfull, has just been issued by the author, 21 Clifford Terrace, St. Budeaux, Devonport. The work has been brought up to date, and is well illustrated by reproductions of photographs and several maps. There are many statistical details, and an appendix giving information as to salaries and cost of living. The main theme of the writer is that Brazil offers abundant opportunities for the activities of Europeans with capital.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN MAY:—

May 2. 4h. Mercury at greatest elongation (20° 55′ E.).
,, 8h. 32m. to 10h. 57m. Transit of Jupiter's Satellite III. (Ganymede).
4–7. Meteoric shower before sunrise from Halley's comet?
8. 17h. Sun eclipsed, invisible at Greenwich.
9. 11h. 59m. to 14h. 26m. Transit of Jupiter's Satellite III. (Ganymede).
10. oh. Mercury 1° 18′ N. of the Moon.
11. 11h. 52m. Minimum of Algol (β Persei).
14. 8h. 41m. ,, ,, ,,
18. 14h. Halley's comet transits the Sun's disc.
23. Moon eclipsed, partly visible at Greenwich.
14h. 33m. First contact with penumbra.
15h. 47m. ,, ,, shadow.
15h. 57m. Moon sets at Greenwich.

THE TOTAL SOLAR ECLIPSE OF MAY 8, 1910.—This eclipse, which can be observed from Tasmania, is not a very favourable one, because the sun at the critical time is only about 8° above the horizon. Mr. Frank McClean, however, who has made considerable preparations for observing it, is already in Tasmania, and has collected a party of eight observers to help him utilise the numerous instruments he has taken out with him. The point he has settled upon as his observing station is situated in the south-west part of the island, namely, Hixson Point, Bramble Cove, Davey. In a cable to Dr. Lockyer, dated April 19, 11.55 a.m., he states:—"Sunday extensive scrub fire within four feet instrument tent. No damage." While on the occasion of his successful expedition to Flint Island in 1908 his chief enemy was "water," he has now had to combat "fire." Little is known at present about the site, but in a letter to the recipient of the cable he writes that one of his party "is as strong as a horse," and will be exceedingly useful "when we have to clear the 200-feet high trees out of the way and carry the packing cases up a 600-feet hill." It will thus be seen that he is making every endeavour to secure as good a site as possible, and it is hoped that his energy will be rewarded with success.

HALLEY'S COMET.—Reports from a number of places state that Halley's comet has been seen as a fairly bright object, under favourable conditions, with the naked eye. Cloudy weather has seriously interfered with English observers, but the comet was seen, and estimated to be of the second magnitude, at Greenwich on the morning of April 25, and was followed until nearly sunrise. According to the *Times* report, it was probably seen with the naked eye, and photographs were secured with several instruments. Owing to the brightness of the sky, exposures of one minute only were possible, and the resulting plates show only the nucleus and coma, with no reference stars. The appearance of the comet was that of a small whitish cloud with a brighter nucleus. The *Times* also states that good positions of the comet were secured by Dr. Ristenpart, at Santiago, on April 12, 15, and 21, and that he has re-determined the time of perihelion passage as April 19·6803 (G.M.T.), about an hour later than was determined by Mr. Merfield. Observations by Mr. Ryves at Saragossa, Spain, on April 21, showed, from naked-eye comparisons with γ Pegasi, that the magnitude was about 2·7. Mr. Innes also reports a naked-eye observation at Lyme Regis on April 25, between 4h. and 4h. 30m. a.m. Similar observations are reported from Malta and Gibraltar, and, at the former, a tail about 1° in length, and inclined about 40° to the horizon, was seen.

In No. 16 of the *Comptes rendus* (p. 955, April 18) M. Giacobini reports having observed the comet, at the Paris Observatory, between 16h. and 18h. on April 17. He was surprised at the increase in brightness since March 7, when the magnitude was estimated as 9·5; at present he estimates it as 2·0 or 2·5. Taking the ephemeris values for the distances from the sun and earth, this means that on May 18, 19, and 20 the magnitude should be −1·3 to −1·8, as bright as, or brighter than, Sirius. To M. Giacobini the comet appeared as a circular nebulosity 30″ to 35″ in diameter, with a strong central condensation. No tail was distinguished except a small swelling of the circular nebulosity in position-angle 350°, but this measured scarcely one minute of arc in length.

Those observers who are generally unacquainted with celestial objects should note that Venus, as shown in Fig. 1 on p. 224 in last week's NATURE, is a conspicuous object near the comet's position at present; we have heard of a number of enthusiastic would-be observers who have evidently mistaken this planet for the comet, as many did in the case of comet 1910*a* in January last. Referring to Fig. 2, given last week, it should be noted that the position of Mars was inadvertently omitted from the diagram. On May 22 the comet will pass directly beneath Mars, which should be inserted about half-way between the top of the date (22) and the disc representing β Geminorum.

Mr. Denning writes:—"The meteors supposed to be connected with Halley's comet are due on the mornings of May 4–7, as the earth reaches her nearest relative position to the cometary orbit at that period. This meteoric shower is directed from the immediate region of the equator in about right ascension 338°, and was discovered by Colonel Tupman in 1870, and seen also in the following year. The radiant rises late on the night, so that the meteors can only be seen in the morning twilight. It is doubtful whether or not this meteoric shower is really connected with the celebrated comet of Halley, for the distance of the earth from the comet's orbit at its nearest approach is about 6,000,000 miles, but the computed orbits of the meteors and comet exhibit a significant resemblance. Should any rich display of meteors be presented at the period mentioned, the spectacle will be unique, for the parent comet will be visible at the same time."

COMET 1910*a*.—Observations by M. Pechüle on April 8 gave corrections of +3s. and +0·6′ to the ephemeris published by Dr. Kobold in No. 4393 of the *Astronomische Nachrichten*, and showed the magnitude of comet 1910*a* to be about 11·0. In No. 4404 of the same journal Herr Tscherny discusses the difficulties attending the calculation of the orbit of this comet, and gives three sets of parabolic elements, which he compares with ten other sets previously published by various calculators.

In No. 2 (1910) of the *Bull. de l'Acad. roy. de Belgique* Prof. Stroobant publishes an account of his observations of this comet, and shows that on January 31, at 6h. 20m., the tail extended to the middle of the Great Square of Pegasus, its length being about 36°.

OPENING OF THE NEW SCHOOL OF AGRICULTURE, CAMBRIDGE.

IN the presence of an assembly fully representative of agricultural interests, both scientific and practical, the new School of Agriculture at Cambridge was opened by the Duke of Devonshire on Tuesday, April 26.

The formal opening was preceded by a luncheon party given at Pembroke College Lodge by the Vice-Chancellor. In addition to the Duke of Devonshire, the heads of colleges, and the principal professors, the guests included the Master of the Drapers' Company, Lord Blyth, Sir George Fordham, Sir C. Dalton, Sir Thomas Elliott, Sir Richard Cooper, Prof. Somerville, Mr. A. D. Hall, and Mr. T. H. Middleton. Speeches were delivered by the Vice-Chancellor, the Duke of Devonshire, the Master of the Drapers' Company, and Prof. Wood.

In declaring the building open, the Duke of Devonshire emphasised the necessity for a close alliance between the scientific and the practical aspects in agricultural work, and promised to exert his influence with the Royal Agricultural Society to further that end. He also expressed the gratitude felt by all workers in the practical field to the University authorities for the extended facilities which it now gives to students of the agricultural sciences.

The new school is situated close to the Botany School. It was erected after the designs of Mr. Arnold Mitchell at a cost of 20,000*l*. The building consists of three floors, a basement, and attics. It contains three lecture rooms, two large elementary laboratories for chemistry and botany respectively, seven smaller rooms for private research, as well as a library and private rooms for the teaching staff. The accommodation is designed for one hundred students, and is already barely sufficient for the increased numbers coming forward.

Among the exhibits on view on Tuesday, the one which appealed most to practical men was a series illustrating the work of Profs. Wood and Biffen in connection with the improvement of English wheat. Prof. Punnett showed a number of interesting experiments illustrating Mendelian principles in connection with the inheritance of colour in poultry and rabbits. The forestry exhibits of Messrs. Henry and Burdon were also of extreme interest. Mr. Foreman showed the results of a laborious research on the constitution of the proteids found in linseed.

INTERNATIONAL CONGRESSES ON ORNITHOLOGY AND TROPICAL AGRICULTURE.

WE have received the announcement that the fifth International Ornithological Congress will meet in Berlin from May 30 to June 4 inclusive. Its success seems already ensured by the large number of distinguished ornithologists (representing twenty-three countries) who have intimated their intention of attending. According to the programme, the congress will assemble in the "Festsaal" of the Zoological Gardens, and its sectional meetings will be held in the Landwehroffizier-Kasino, close to the Zoological Gardens station of the State railway, where also will be installed on May 29 and following days the business bureau. The president designate is the distinguished professor of the Berlin Natural History Museum, Dr. Anton Reichenow, the subject of whose opening address is "Über die Fortschritte und den gegenwärtigen Stand der Ornithologie." In the ordinary course he would have been introduced by the retiring president, the late Dr. Bowdler Sharpe, and the absence of this genial personality, so familiar at these triennial congresses, cannot but cast a shadow over the meeting. The congress is divided into practically the same sections as at its last meeting:—systematic ornithology, anatomy, palæontology, geographical distribution; migration; biology and oology; bird protection; aviculture and acclimatisation; and economic ornithology. Many important papers are already announced by, among others, the president, Count v. Berlepsch, Herr Csörgey, Dr. Eckstein, Dr. Hartert, Dr. Helms, Herr Nehrkorn, Prof. Neumann, Hon. Walter Rothschild, Dr. Thienemann, and Prof. Virchow. Visits to the following places of interest have been arranged:—on Monday afternoon to the Havelsee, at the invitation of the German Ornithological Society; on Thursday morning to the Zoological Gardens, with lunch to follow; on Friday to the Natural History Museum, or a motor trip round Berlin for those who prefer it. On the evening of Tuesday there will be a kinematograph exhibition of bird pictures at the "Urania" Society's rooms. On Wednesday evening the city will entertain the members and their wives, and on Friday evening the customary banquet will take place in the Zoological Gardens. After the close of the congress excursions will be arranged, if sufficient members apply, to the observation station at Rossitten and to the experimental protection station at Seebach. The subscription for full membership is 20 marks, and for lady associates who do not desire the publications 10 marks. The secretary's address is 43 Invalidenstrasse, Berlin N. 4.

In order to facilitate the study of the problems of tropical agriculture, an International Association of Colonial Agriculture was founded in 1905 at the close of the first International Congress of Tropical Agriculture, held in Paris in that year. The association has arranged to hold a second International Congress at Brussels on May 20–23. A British committee has been formed to arrange for the contribution of papers by those concerned in tropical agriculture and colonial development. The president of this committee is Prof. W. R. Dunstan, F.R.S., and the secretary Dr. T. A. Henry, Scientific and Technical Department, Imperial Institute, S.W. As evidence of the interest taken in the work of the congress, it may be mentioned that the following papers have been promised already to the British committee:—W. L. Balls, (1) the application of Mendel's law to cotton breeding,

(2) some causes affecting the Egyptian cotton crop; G. C. Dudgeon, the cottons in indigenous cultivation in British West Africa; A. E. Humphries, wheat production in relation to the requirements of the United Kingdom; F. B. Guthrie, (1) work done in New South Wales in connection with the improvement and testing of wheats, (2) the work of the late W. J. Farrer on the improvement of wheat in New South Wales; I. B. Pole-Evans, problems connected with maize-growing in South Africa; J. B. Carruthers, (1) new methods of tapping Castilloa, (2) cover plants, as a substitute for weeding in rubber, cacao, and other cultivations; Dr. T. A. Henry and Dr. S. J. M. Auld, the burning quality of tobacco; G. M. Odlum, tobacco culture in South Africa; Mr. Easterby, cultivation and varieties of sugar-cane at the Sugar-cane Experiment Station, Mackay, Queensland; Prof. P. Carmody, (1) preparation of rubber, (2) preparation of paper from megass, (3) methods of manuring, suitable for natives, (4) influence of malarial diseases on labour supply, (5) breeding of stock suitable for the tropics; Mr. Benson, manuring of tropical fruits; Dr. S. S. Pickles, the aromatic grass oils; R. N. Lyne, causes contributing to the success of the Zanzibar clove industry; W. Macdonald, dry-farming and land settlement in South Africa; J. H. Barnes, the alkali lands of northern India; E. M. Jarvis, economic zoology in African colonies; W. Gill, the introduction of the remarkable pine (*Pinus insignis*) into South Australia, and its successful utilisation; F. W. Barwick, African wild silks; G. C. Dudgeon, some important insect pests in British West Africa; C. C. Gowdey, insects of economic importance in Uganda. The International Association of Colonial Agriculture has also arranged for the collection, in tropical countries, of information on a number of subjects of special interest, and general reports on these will be presented to the congress, as well as reports by experts in each country concerned. The inquiries already arranged for are on cotton cultivation, labour conditions in the colonies and tropical countries, acclimatisation of European cattle in tropical countries, and alcoholism in the tropics. All communications regarding the congress should be sent to the secretary of the British committee, Imperial Institute, London, S.W. Applications and subscriptions for membership should be sent to M. Vandervaeren, treasurer of the Belgian committee, at the Ministry of the Interior and of Agriculture, Brussels, Belgium.

ECONOMIC GEOLOGY IN CANADA.[1]

THE pamphlets mentioned below have been issued recently by the Department of Mines of Canada, mainly with the object of directing attention to the importance of the economic mineral products of the Dominion, and of assisting with trustworthy information those persons who are actually engaged, or may contemplate engaging, in the exploitation of its mineral wealth.

The first work on the list gives a concise but clear description of the general geological features of Canada and of the known valuable minerals that characterise the different areas. For the sake of convenience, the whole of the Dominion is divided into a number of regions, each of which has a more or less definite individual geological structure, and which accordingly produces a distinct series of economic minerals. The scope of the work is perhaps most readily explained by giving a list of the different regions into which the Dominion is here divided, these being as follows:—

(1) The Appalachian region, comprising the Maritime Provinces and that portion of the Province of Quebec which lies immediately to the north of them, consisting mainly of crystalline and Palæozoic rocks, the chief mineral products being coal, gold, and iron ores.

(2) The Lowlands of the St. Lawrence Valley, which consist mainly of Palæozoic strata, and have not, so far, shown any great mineralogical wealth, with the exception of petroleum; the principal Canadian oilfields, lying in the tongue of south-western Ontario that projects between Lakes Huron and Erie, occur in strata of Devonian age, which form a portion of this region.

(3) The Laurentian plateau, which comprises the greater portion of the Province of Ontario and of the North-western Territory; it consists mostly of pre-Cambrian—largely Laurentian—rocks, and though little more than the southern border of this vast track has been prospected, it is known to contain many valuable mineral products, such as the Sudbury copper-nickel deposits, the Cobalt silver deposits, gold, iron ores, corundum, apatite, mica, &c.

(4) The Arctic archipelago, which forms an imperfectly known area to the north of Hudson's Bay; it appears to consist mainly of pre-Cambrian and some Palæozoic strata, and so far is not known to contain minerals of any great economic importance.

(5) The Interior Continental plain, which comprises the western portion of Manitoba and the southern portion of Saskatchewan and Alberta, extending westwards to the Cordilleran mountain system, the strata being largely of Cretaceous age. The rocks contain very important beds of coal and lignite, also bitumen, indications of petroleum, and natural gas.

(6) The Cordilleran belt, which comprises the western portion of the Dominion. This is essentially a mountain region, showing a great variety of geological formations; it is noted for occurrences of the precious metals, gold and silver, whilst lead, copper, and zinc also occur; it is also very rich in coalfields, notably in British Columbia, where all varieties of coal from lignite to anthracite appear to occur.

This brief summary of a summary will serve to indicate the arrangement, the scope, and the objects of this little treatise; it should also be added that it is accompanied by two maps, one showing the broad geological features, and the other the distribution of the chief mineral products; the former is very satisfactory, but the latter is by no means so clear as might be desired. The maps serve, however, perfectly well their purpose of elucidating the text and of making the whole subject clear and readily comprehensible. Minute accuracy of detail is not to be expected in such a work as this, and is perhaps not even desirable, so that anything of the nature of criticism would be entirely out of place. It can only be said that the treatise admirably fulfils its objects, and should be of the greatest value to all who are in any way interested in the mineral wealth of the Dominion. The Geological Survey of Canada can only be congratulated upon the felicitous idea of publishing such a pamphlet and upon the excellent way in which that idea has been carried into execution.

In the second pamphlet of the above list Mr. D. B. Dowling has given an account of the coalfields of the Interior Continental Plateau, and is thus able to discuss more in detail than was possible in the general work the nature and mode of occurrence of these important deposits. The author commences with a historical and general review of the coalfields, and then describes them in some little detail. He points out that the coal of this region occurs at three main geological horizons, namely, at the base, about the middle, and close to the top of the Cretaceous formation; it should be noted that he ventures, on what can only be described as imperfect data, to attempt an estimate of the quantity of coal that exists in the region under discussion, which he gives as 143,490 millions of tons, the area of the coalfields being taken as 22,506 square miles. That the amount of development work yet done in these fields is of the scantiest possible description is evident from the fact that the output for the year 1907 was only 876,731 tons. After a detailed description of the coalfields, a large number of analyses of the various coals is tabulated. This list is an exceedingly useful one, and the author has done excellent service in collecting the records into a conveniently accessible form. Following this list is another of analyses of coals from other districts, apparently for the purposes of comparison: it is, however, not at all clear on what principle he has brought together this miscellaneous collection of analyses of coals from British Columbia, Yukon, Nova Scotia, Wales,

[1] Canada Department of Mines. (1) "A Descriptive Sketch of the Geology and Economic Minerals of Canada." By G. A. Young, with an introduction by R. W. Brock Pp. 151.
(2) "The Coal Fields of Manitoba, Saskatchewan, Alberta, and Eastern British Columbia." By D. B. Dowling. Pp. 111.
(3) "The Whitehorse Copper Belt, Yukon Territory." By R. G. McConnell. Pp. 63.
(4) "Report on the Iron Ore Deposits along the Ottawa (Quebec Side) and Gatineau Rivers." By Fritz Cirkel. Pp. 147.

Australasia, and the United States, still less why the whole of the coals of Great Britain should be considered to be adequately represented by analyses of some half a dozen Welsh coals. Such a comparative list should either be truly representative or else (and perhaps better) be omitted altogether. There appears to be no obvious reason why Mr. Dowling should want any new-fangled mode of classification in order to enable him satisfactorily to classify these coals. For most practical purposes the old classification of Gruner answers perfectly well, and if anything more precise is required, the fuel ratio (or the ratio of the fixed carbon to the volatile combustible matter) suffices for most purposes. The ratio suggested by the author, which he calls the "split volatile" ratio, appears to serve no particular purpose, and, on the other hand, would enable a coal to be put into almost any class at will by merely drying it more or less thoroughly before analysing it.

The two remaining treatises deal in more or less detail with ore deposits in definite regions, differing mainly in this respect that the copper deposits of the Whitehorse Belt have been opened up pretty extensively and are being actively worked to-day, whilst the iron ores of the Ottawa and Gatineau Rivers are not to-day of any economic importance.

The last treatise on the list is in some respects the least satisfactory. So long as the writer keeps to his proper subject, namely, a description of the ore deposits, their modes of occurrence, distribution and geology, there is little fault to be found, although the language is in places somewhat less clear than might be wished. It is, however, when the author ventures into metallurgical discussion that he seems to go widely astray. It is incomprehensible how anyone could write such a sentence as the following in discussing the metallurgy of iron (p. 104):—"By no known chemical or electro-thermic process can phosphorus be eliminated from the bath of any of the diverse metallurgical furnaces." The author seems to be exceedingly sanguine as to the future of the electrical production of pig-iron in the Dominion, an opinion which he seems to share with some other Canadian geologists. It is somewhat curious to note that it is the geologists who are urging on this metallurgical development, whilst manufacturers of iron appear to be more than doubtful as to its economic possibilities. Whether this is due to the well-recognised conservatism of the latter and the advanced scientific enterprise of the former, or whether it is a case of geologists rushing in where iron-masters fear to tread, is not for us to determine.

Henry Louis.

RECENT PAPERS ON BIRDS.

Mr. C. W. Beebe is to be congratulated on his attempt (*Zoologica*, No. 5) to explain the "racket-making" habit of the motmots. These birds, it is almost unnecessary to mention, are in the habit of removing the vanes of the middle pair of elongated tail-feathers for a certain distance, so as to give them a racket-like form very similar to that which occurs naturally in certain kingfishers and humming-birds. It is shown that the length of feather thus devaned is invariably constant, even when the adjacent pair of feathers, which might serve as a guide, has been removed. Further, the portion destined to be stripped has the vanes markedly narrower than in the rest of the feather, while the component barbs and barbules are much weaker and less coherent than elsewhere, so that their removal is a comparatively easy matter. Consequently, in the course of the preening to which these birds subject all their tail-feathers, the weak area in the vanes of the middle pair becomes stripped, with the production of the symmetrical pair of terminal rackets. The original cause of the narrowing and degeneration in the affected area is still unknown, but the author is of opinion that it is not a case of the inheritance of an acquired character.

In No. 2 of the same serial Mr. Beebe gives the results of his observations on the habits of that remarkable bird the hoazin, or hoatzin (*Opisthocomus cristatus*), made during a visit in March, 1908, to Venezuela, and a second in April of the following year to British Guiana. As young birds were not to be found, the notes relate only to the adult. Mr. Beebe commences his account by mentioning that the crop of the hoazin is unique on account of having assumed the structure and function of the gizzard of other birds, being much larger than ordinary, with the walls thick and muscular instead of thin and flabby. Despite this specialised feature, the primitive character of this bird is indicated by many points, the vestigial claw of the third digit of the wing linking it with Archæopteryx, while another claim to primitiveness is apparent in the quadrupedal habits of the young. Thickly wooded river-valleys form the haunts of the hoazin, of which Lower Amazonia may be considered the centre, the distributional area, according to our present information, being in several instances discontinuous. The bird has a peculiarly disagreeable odour of its own, which is, however, in Mr. Beebe's opinion, less powerful than commonly reputed, and, at all events, insufficient to render it immune to the attacks of parasites. In general character the nest and eggs are very similar to those of the Guiana green herons (Butorides), but are placed higher above the water. Both sexes assist in nest-building, and two eggs seem to be the usual number in a clutch. There is no foundation for the assertion that these birds are polygamous, or, of course, for the old legend as to their snake-eating habits.

The institution and celebration of the first "bird-day" in the Australian Commonwealth is recorded in the January number of the *Emu*. October 29, 1909, was the date selected in Victoria, when the celebration proved a thorough success, parents, teachers, and scholars joining in with enthusiasm, and visits being paid to noted bird-haunts in the different districts. Numerous nests were examined, but in no instance were either birds or eggs molested. A certain amount of preliminary work had to be done in teaching the children the names of many of the local birds, for which purpose special lists were prepared. In the same issue Mr. C. Barrett describes the nesting of the rock-parrakeet (*Neophema petrophila*) on Goat Island, Kellidic Bay. Here this appropriately named species rears its young in hundreds, the eggs being often laid deep down in burrows, although higher up on the cliffs they are frequently placed on the bare rock, in most cases under the protection of a raised stone.

In the March number of the *Zoologist* Mr. J. M. Dewar describes the manner in which the oyster-catcher breaks the shell of the purple whelk (*Purpura lapillus*) in order to be able to feed on its contents. As the soft-parts of this mollusc are much more difficult of access than those of mussels and limpets, the bird only occasionally attacks the whelk, and perhaps never does so at all in some localities. When a mollusc is to be operated upon, it is carried to some convenient spot, often a crack or hollow in the rock, or it may be a hard patch of sand, where it is laid with the mouth uppermost. The upper half of the beak is then introduced into the aperture, and an attempt made to punch out a small fragment from the opposite surface of the shell. If this is successfully accomplished, and the piece punched out is of small size, the beak is introduced into the new aperture, and the same process repeated higher up the shell, when, if it succeeds, the soft-parts can be scooped out. In cases where the first hole is larger, the latter operation can be accomplished by that aperture. Frequently the shell defies the bird's efforts.

The January number of the *Victorian Naturalist* contains the report of a paper, by Mr. A. H. E. Mattingley, on the breeding-habits of Australian cuckoos, in which it is stated that only an infinitesimal proportion of their eggs approximate in size, colour, markings, and shape to those among which they are laid. There are, moreover, numerous instances in which Australian cuckoos have laid in the nests of graminivorous birds, with the consequent starvation of the young. In other instances cuckoos lay in nests already containing eggs of their own species, while they also make use of nests too small to contain the young bird in comfort. It is concluded that, so far at least as Australian species are concerned, cuckoos, in place of possessing an instinct leading to the selection of suitable foster-parents, lay their eggs haphazard.

Ever since the year 1904 Dr. F. A. Forel has been endeavouring to ascertain the approximate number of individuals of the black-headed gull (*Larus ridibundus*) which resort to Lake Leman during certain months of the year, and likewise to explain the reason why many of these birds are to be seen on the lake at seasons when the majority of their kindred are in far distant lands. These observations and their results have been published in the *Bulletin de la Société Vandoise des Sci. Nat.* for 1905 and 1910. The gulls are most numerous from the end of July to the middle of October—during which period their numbers may reach as many as 3600—but the great bulk disappears during the breeding-season, and again in winter. For their breeding resorts in the north the birds take their departure towards the end of March, although a few hundreds remain on the Haut Lac throughout the season. Of these stay-at-home individuals only a small percentage nest on the lake, and it seems probable that the great majority are aged birds the breeding-days of which are over. On the other hand, a certain number of migrating gulls reappear on the lake at the beginning of July, several weeks before their fellows. Several explanations of this have been given, but it seems, on the whole, most probable that these early arrivals are birds which have completed their parental duties in the north at an unusually early date. It is well known that dark barrings on the tail are a sign of immaturity in this species, which generally disappear when the birds are about eighteen months old; on the other hand, the dark cap on the head is not assumed until the third year, while the birds do not lay until they are twenty-three months old. A certain number of birds are, however, met with in their second summer with the tail barred and the head dark, and these must probably be regarded as precocious individuals. Finally, the author has succeeded in demonstrating that the black-headed gull is not a diver.

The Land Agents' Society some time ago commissioned Mr. Walter E. Collinge to institute an inquiry into the feeding-habits of rooks, the results of which have been published in pamphlet form by Messrs. Laughton and Co., Ltd., Wellington Street, Strand. Observations made on more than 800 specimens from various parts of England indicate that (1) 67·5 per cent. of the food of these birds consists of grain, this, by the inclusion of roots and fruits, being raised to 71 per cent.; (2) the animal-food is 29 per cent., of which fully one-third is to be reckoned against the utility of the rook; (3) a grain-diet is certainly preferred; (4) the rook is not a particularly beneficial bird to the agriculturist, although its utility might be increased if its numbers were diminished.

In connection with the above, reference may be made to a paper by Dr. J. E. H. Kelso in the April number of the *Zoologist*, where it is shown that, in addition to doing considerable damage to fruit, the starling is nowadays an enemy to the farmer by devouring considerable quantities of wheat, such grain being presumably devoured for its own sake, and not on account of containing grubs. This wheat-eating propensity is considered to be a modern development.

In the same issue Mr. E. J. Stubbs makes out a strong claim, not only that the white egret (*Ardea garzetta*) should be added to the British list, but likewise that in the Middle Ages it was a common species in our islands. From various old works the author quotes passages indicating that a small white heron-like bird, without a crest, was commonly put on the table at state banquets in the north of England, where it was taken in the neighbouring marshes, and that this bird could have been nothing else than the egret, by which name it is indeed mentioned. The idea that the lapwing could have been intended is shown to be altogether untenable, and, indeed, the author adduces evidence to show that the present abundance of the latter bird is a modern feature.

LANGLEY'S CONTRIBUTIONS TO AERONAUTICS.[1]

THE award of the Langley medal to the Brothers Wilbur and Orville Wright emphasises the fact that we are living in an age of great achievements. The twentieth century had hardly dawned when the world was startled by the discovery of radium, which has opened up an entirely new field to science, and has led us to modify profoundly our conceptions regarding the constitution of matter. Another new field has been revealed to us through the development of wireless telegraphy and telephony, and we now utilise the vibrations of the ætherial medium of space for the transmission of thought.

Then, again, we may note the most revolutionary changes going on before our eyes relating to methods of transportation. The appearance of the hydroplane-boat probably foreshadows a revolution in marine architecture and propulsion. On land we see motor-cycles, automobiles, and electric cars displacing the horse. Petroleum and electricity have become powerful rivals of steam, and we seem to be on the eve of a revolution in our methods of railroad transportation through the application of the gyroscope to a mono-rail system; and now aërial transport has come, dispensing with rails and roads altogether. The air itself has become a highway, and dirigible balloons and flying machines are now realities.

How well the predictions of Langley have been fulfilled. We now recognise that he was right when he said, a few years ago (1897), that:—"The world, indeed, will be supine if it do not realise that a new possibility has come to it, and that the great universal highway overhead is now soon to be opened."

It has been opened; and who can foretell the consequences to man? One thing is certain, that the physical obstacles to travel have been overcome, and that there is no place on the surface of the globe that is inaccessible to civilised man through the air. Does this not point to the spread of civilisation all over the world, and the bringing of light to the dark continents of the earth?

The Pioneers of Aërial Flight.

Who are responsible for the great developments in aërodromics of the last few years? Not simply the men of the present, but also the men of the past.

To one man especially is honour due, our own Dr. S. P. Langley, late secretary of the Smithsonian Institution. When we trace backwards the course of history we come unfailingly to him as the great pioneer of aërial flight. We have honoured his name by the establishment of the Langley medal; and it may not be out of place on this, the first occasion of the presentation of the medal, to say a few words concerning Langley's work.

Langley's Work.

Langley devoted his attention to aërodromics at a time when the idea of a flying machine was a subject for ridicule and scorn. It was as much as a man's reputation was worth to be known to be at work upon the subject. He bravely faced the issue, and gave to the world his celebrated memoir entitled "Experiments in Aërodynamics." In this work he laid the foundations for a science and art of aërodromics, and raised the whole subject of aërial flight to a scientific plane.

The knowledge that this eminent man of science believed in the practicability of human flight gave a great stimulus to the activities of others, and started the modern movement in favour of aviation that is such a marked feature of to-day.

Everyone now recognises the influence exerted by Langley on the development of this art. The Wright Brothers, too, have laid their tribute at his feet.

"The knowledge," they say, "that the head of the most prominent scientific institution of America believed in the possibility of human flight was one of the influences that led us to undertake the preliminary investigations that preceded our active work. He recommended to us the books which enabled us to form sane ideas at the outset. It was a helping hand at a critical time, and we shall always be grateful."

Contributions to the Science of Aërodromics.

Langley's experiments in aërodynamics gave to physicists, perhaps for the first time, firm ground on which to stand as to the long-disputed questions of air resistances and reactions. Chanute says:—

(*a*) They established a more trustworthy coefficient for rectangular pressures than that of Smeaton.

(*b*) They proved that upon inclined planes the air pressures were really normal to the surface.

[1] Address delivered by Dr. Alexander Graham Bell at the presentation of the Langley medal of the Smithsonian Institution to the Wright Brothers on February 10.

(*c*) They disproved the "Newtonian law," that the normal pressure varied as the square of the angle of incidence on inclined planes.

(*d*) They showed that the empirical formula of Duchemin, proposed in 1836 and ignored for fifty years, was approximately correct.

(*e*) That the position of the centre of pressure varied with the angle of inclination, and that on planes its movements approximately followed the law formulated by Joessel.

(*f*) That oblong planes, presented with their longest dimension to the line of motion, were more effective for support than when presented with their narrower side.

(*g*) That planes might be superposed without loss of supporting power if spaced apart certain distances which varied with the speed; and

(*h*) That thin planes consumed less power for support at high speeds than at low speeds.

The paradoxical result obtained by Langley, that it takes less power to support a plane at high speed than at low, opens up enormous possibilities for the aërodrome of the future. It results, as Chanute has pointed out, from the fact that the higher the speed the less need be the angle of inclination to sustain a given weight, and the less, therefore, the horizontal component of the air pressure.

It is true only, however, of the plane itself, and not of the struts and framework that go to make up the rest of a flying machine. In order, therefore, to take full advantage of Langley's law, those portions of the machine that offer head resistance alone, without contributing anything to the support of the machine in the air, should be reduced to a minimum.

Contributions to the Art of Aërodromics.

After laying the foundations of a science of aërodromics Langley proceeded to reduce his theories to practice. Between 1891 and 1895 he built four aërodrome models, one driven by carbonic acid gas and three by steam engines. On May 6, 1896, his *Aërodrome No.* 5 was tried upon the Potomac River, near Quantico. I was myself a witness of this celebrated experiment, and secured photographs of the machine in the air, which have been widely published. This aërodrome carried a steam engine, and has a spread of wing of from 12 to 14 feet. It was shot into the air from the top of a house-boat anchored in a quiet bay near Quantico. It made a beautiful flight of about 3000 feet, considerably more than half a mile. It was indeed a most inspiring spectacle to see a steam engine in the air flying with wings like a bird. The equilibrium seemed to be perfect, although no man was on board to control and guide the machine.

I witnessed two flights of this aërodrome on the same day, and came to the conclusion that the possibility of aërial flight by heavier-than-air machines had been fully demonstrated. The world took the same view, and the progress of practical aërodromics was immensely stimulated by the experiments.

Langley afterwards constructed a number of other aërodrome models, which were flown with equal success, and he then felt that he had brought his researches to a conclusion, and desired to leave to others the task of bringing the experiments to the man-carrying stage.

Later, however, encouraged by the appreciation of the War Department, which recognised in the Langley aërodrome a possible new engine of war, and stimulated by an appropriation of 50,000 dollars, he constructed a full-sized aërodrome to carry a man. Two attempts were made, with Mr. Charles Manley on board as aviator, to shoot the machine into the air from the top of a house-boat, but on each occasion the machine caught on the launching ways and was precipitated into the water. The public, not knowing the nature of the defect which prevented the aërodrome from taking the air, received the impression that the machine itself was a failure and could not fly.

This conclusion was not warranted by the facts; and to me, and to others who have examined the apparatus, it seems to be a perfectly good flying machine, excellently constructed, and the fruit of years of labour. It was simply never launched into the air, and so has never had the opportunity of showing what it could do. Who can say what a third trial might have demonstrated? The general ridicule, however, with which the first two failures were received prevented any further appropriation of money to give it another trial.

Conclusion.

Langley never recovered from his disappointment. He was humiliated by the ridicule with which his efforts had been received, and had, shortly afterwards, a stroke of paralysis. Within a few months a second stroke came, and deprived him of life. He had some consolation, however, at the end. Upon his death-bed he received the resolution of the newly formed Aëro Club of America, conveying the sympathy of the members and their high appreciation of his work.

Langley's faith never wavered, but he never saw a man-carrying aërodrome in the air. His greatest achievements in practical aërodromics consisted in the successful construction of power-driven models which actually flew. With their construction he thought that he had finished his work, and in 1901, in announcing the supposed conclusion of his labours, he said:—

"I have brought to a close the portion of the work which seemed to be specially mine—the demonstration of the practicability of mechanical flight—and for the next stage, which is the commercial and practical development of the idea, it is probable that the world may look to others."

He was right, and the others have appeared. The aërodrome has reached the commercial and practical stage, and chief among those who are developing this field are the Brothers Wilbur and Orville Wright. They are eminently deserving of the highest honour from us for their great achievements.

I wish to express my admiration for their work, and believe that they have justly merited the award of the Langley medal by their magnificent demonstrations of mechanical flight.

INDUSTRIAL ENGLAND IN THE MIDDLE OF THE EIGHTEENTH CENTURY.

THE conditions of the chief industries of the country at the date (1754) when the Society of Arts was founded were surveyed by Sir Henry Trueman Wood in an elaborate paper read by him at a meeting of the society on April 20. In the middle of the eighteenth century England was not to any noteworthy extent a manufacturing country, the most important industry being agriculture and occupations relating to it. At the epoch to which the paper refers, however, an industrial revolution was beginning which transformed England from an agricultural country, with no manufactures beyond those required for the supply of its own population, into the workshop of the world. Sir H. T. Wood described the positions of industries concerned with wool, cotton, linen, silk, various metals, brewing, distilling, tanning, paper, printing, and many other arts. From the mass of historical material brought together in the paper a few extracts are subjoined upon subjects associated with science. The retrospective view which these extracts provide is of interest to students of the progress of science and industry.

Science.

Science, about the middle of the eighteenth century, was not in a condition of active progress either in England or abroad. The time was not, either for science or scientific men, a happy one. International intercourse was impeded by wars; national progress was hindered by political differences. The great days of Newton, Hooke, Boyle, and Halley were past. Those of the founders of modern science were yet to come. Cavendish had just left Peterhouse. Priestley had not yet turned his attention to natural philosophy—his scentific work began in 1758. Banks, who ruled the Royal Society for so many years, was in 1754 a boy of eleven. Gilbert White (b. 1720) commenced his "Garden Kalendar" in 1751, but he did not make Pennant's acquaintance until thirteen years later, when he started the famous correspondence which formed the groundwork of the immortal "Natural History of Selborne." Franklin had completed and made public his epoch-making experiments, and (in 1752) proposed to protect buildings by the lightning-rod. Black, the friend of Watt, and the enunciator of the principle of "latent heat," produced his first important work as a thesis for his M.D. degree in 1754.

In the earlier part of the century the power of mathematics in enabling us to grapple with the most abstruse problems of nature was first clearly demonstrated. In the latter part the foundations were laid on which the modern science of chemistry was built. The intervening years were not characterised by any marked progress in abstract science.

The Royal Society (to which a charter had been granted in 1662) was now firmly established at the head of British Science. Though it was still deemed a suitable object for the occasional shafts of humorists, and though it was sometimes attacked by quacks whose pretensions it declined to countenance, it was recognised and respected by all serious students of science at home and abroad. It had gathered to itself the best thought of the country, and was affording to what would otherwise have been the isolated efforts of scientific pioneers the advantage of coordination and cooperation.

Scientific attention was then principally, though by no means exclusively, directed to astronomy and to exploration. The transits of Venus of 1761 and 1769 had been predicted by Halley, and great importance was attached to their proper observation. An Act of 1743 offered a reward of 20,000*l.* for the discovery of a north-west passage, and later the discoveries of Captain Cook received full scientific recognition by the award of the Copley medal.

Perhaps no better indication of the state of scientific progress at any time in England could be found than is provided by the list of the Royal Society's Copley medallists. In 1731 and 1732 the medal was awarded to Stephen Gray,[1] the ingenious electrician who contrived a method of sending signals by means of frictional electricity, and who made, therefore, the first electric telegraph. It must, however, be added that the award seems to have been rather in the nature of acknowledgment of a skilful experiment than of appreciation of an important discovery. Bradley received the medal in 1748 for his discovery of the aberration of light, and Harrison in 1749 for his chronometer. In 1753 it was given to Franklin for the lightning-rod, and in 1758 to Dollond for his achromatic telescope.

The nature of these last three awards shows the tendency of the time towards practical rather than towards abstract science, and justifies the conclusion that the leaders of scientific thought of those days were working rather for practical results than for the advance of theoretical knowledge.

Iron.

The history of the origin and growth of the iron manufacture in England has been often told. The first step in its progress was the substitution of coal for wood charcoal in the process of reducing the metal from its ores. In the ironworks of Sussex and elsewhere the iron was made on open hearths, or small furnaces, by the help of bellows worked by hand or water. In early times the natural force of the wind was utilised, which, as an early writer says, "Saveth the charge of the bellowes and of a milne to make them blow."

In such furnaces, with their moderate temperatures, uncoked coal could not be used, and the sulphur and other components of the coal affected the product injuriously. Nevertheless, numerous efforts were made—more or less successfully—to use the cheaper and more abundant fuel, and but a very few years before the special date with which we are concerned, the new method may be said to have been placed on a commercial footing.

It was at Coalbrookdale,[2] in Shropshire, that Abraham Darby established the manufacture of iron by coal about 1730 or 1735. He treated the coal as the charcoal-burners treated wood, and found that in the resulting coke he had the fuel he required. In 1754 he had some seven furnaces (presumably small blast furnaces or reverberatory furnaces), and for blowing these he had five "fire engines" (steam or atmospheric engines), which pumped water to drive water-wheels which worked the bellows, the "rotative" engine not having then been invented. Such was the point that the manufacture of iron had reached at the time about which we are concerned. A few years later, in, or shortly after, 1760, Dr. Roebuck used blowing engines at the Carron Iron Works in Stirlingshire. These had four single-acting cylinders of cast-iron 4 feet 6 inches in diameter, and the pistons, of which the stroke was 4 feet 6 inches, were worked in alternation, so that a continuous and tolerably equal blast was maintained.[1] They were constructed by Smeaton.

It was the father of this Abraham Darby, Abraham the elder, who introduced into England about 1706 the art of casting iron vessels. The story, old and well known as it is, will bear re-telling. Early in the century John Darby brought over some Dutch brass-founders, and set up a foundry in Bristol. Here he tried to make iron pots instead of brass, but failed, until his Welsh apprentice, John Thomas, "thought he saw how they had missed it," tried the experiment, and, working secretly with Abraham Darby (the son of John), cast the same night an iron pot. "For more than 100 years after the night in which Thomas and his master made their successful experiment of producing an iron casting in a mould of fine sand, with its two wooden frames and its air-holes, the same process was practised and kept secret at Colebrook Dale, with plugged key-holes and barred doors."

It is about this date (1740, or a little later) that Huntsman perfected the process of making cast steel, which is still employed. Before this, "Steel was never melted and cast after its production." "By whatever method prepared, whether by the addition of carbon to malleable iron, or by the partial decarbonisation of pig iron . . . steel in mass was never obtained homogeneous." There is no need to describe the process, with its purely technical details. It may be sufficient to record the fact that the problem of producing ingots of steel of uniform composition was solved by Benjamin Huntsman, and that, as his secret method of working was stolen by a workman, it soon came to be generally employed in the Sheffield steel trade.

These early founders of the great British iron trade were soon followed by many others, chief of whom was Henry Cort with his invention of puddling (1783), and the manufacture, stimulated, in the later days of the century, to meet the rapidly growing demand for iron caused by the development of machinery and the steam engine, soon reached a most important place among the industries of the country.

Copper and Brass.

Without considerable research it might be difficult to give anything like a trustworthy account of the condition of metalliferous mining and metallurgy in the middle of the eighteenth century, and even if the labour were undertaken it would be difficult to ensure accuracy of result. Copper, tin, and lead have been mined and smelted in Great Britain from very early dates. Zinc, in the metallic state, was imported from China (or, at all events, from the East) in the early part of the seventeenth century,[2] but it does not seem to have been made in England until a century later.

Percy, while he professes himself unable to give a complete history of copper-smelting in England, tells us of early copper-mines in Cumberland and Northumberland, and thinks that the ores were smelted on the spot; but copper was imported from Hungary and Sweden, while calamine (zinc carbonate) was allowed to be exported as ballast. About the end of the seventeenth and the beginning of the eighteenth century copper-smelting was being carried on in Yorkshire and Lancashire, also a little later in Cornwall, in Gloucestershire, and at Bristol. The date of the establishment of copper works at Swansea (now the centre of the trade) is given as 1720, though Percy states that smelting was carried on in the Principality before that date. Brass (an alloy of copper and zinc), as distinct from bronze (copper and tin), was known

[1] Gray it was who first proposed the theory of positive and negative electricity.

[2] This is the usual spelling. Percy has Colebrook, and gives Coldbrook as the original name.

[1] Percy, "Iron and Steel," p. 889.

[2] Percy's "Metallurgy" (1851), p. 519.

"early in the Christian era, if not before its commencement"; but this was doubtless made, like early bronze, by mixing the ores before or in the process of smelting. By the middle of the century considerable progress had been made in its manufacture. Though brass, native and imported, was known in England long before, it is believed that it was not until the reign of Elizabeth that its manufacture was seriously undertaken. From that time forward a good deal of brass seems to have been made from British ores, and a goodly number of brass articles produced.

Tin.

Tin is certainly the most ancient of British exports. It was mined in this country before Britain was known to the Romans, and was brought by the Phœnicians from Cornwall and Devon, the Cassiterides (tin-lands), far beyond the Pillars of Hercules. For centuries England had what was almost a monopoly in supplying tin to the civilised world, the amount mined in Cornwall and the west of England growing steadily both in bulk and value until the discovery by the Dutch of large supplies of tin in Banka, Sumatra, whence it was first imported into Europe about 1787.

The most important application of tin is to the coating of iron-plate, to produce what is known as tin-plate or tinned plate, and is now popularly termed tin. Until the middle of the seventeenth century this manufacture was not known in England. English tin was exported to Saxony, where it was used to coat plates, which were sent to England. That ingenious projecter and author, Yarranton, found out the German methods, and established a factory in the Forest of Dean, where plates were made better, it is said, than the German productions. It seems likely that the secret lay in rolling out the iron, previous attempts having been made with hammered plates. From this date the manufacture of tin-plate, and the use of rolls for the purpose, appears to have been established in England.

Lead.

The reduction of lead from its ores is a comparatively simple process, and it might not be untrue to say that the process has been rather developed than radically changed from the time when Pliny referred to British lead as used for the manufacture of lead pipes in Rome. Down to some time in the seventeenth century wind was relied upon for feeding the Derbyshire furnaces, which (as in Pliny's time) were placed on high ground to catch the breezes. Later, bellows driven by water-wheels were employed. Cupola furnaces were introduced into Derbyshire from Wales about 1747. These are identical with those now used. Coal was employed for smelting lead in the seventeenth century, there being two patents (1678 and 1690) granted for this privilege.

Coal.

The use of coal for fuel is referred to in a grant of land to the Abbey of Peterborough in A.D. 853. Records referring to the existence of collieries in Scotland go back as far as the end of the twelfth century, and in the thirteenth there is evidence that coal was brought to London by sea from the north. Such coal, besides being used for domestic purposes, was at first used for lime burning, soon after in smiths' forges, and in later times for the smelting of copper and lead, in furnaces for the manufacture of pottery and glass, for drying malt, for making salt, by brewers, and for other industrial purposes.

Curiously enough, many of the earlier references to coal are due to its objectionable qualities. Its smoke and smell were disapproved of, and not without reason. In 1306 there was a Royal Proclamation against the use of coal in London, and there were many complaints about its smoke in later years. As its employment became more popular it became an article of commerce, and in 1563 an Act of Parliament prohibited its export, either in the form of ballast or otherwise. By the middle of the century it was, of course, worked on a large scale. As the shafts of the collieries grew deeper, in the effort to comply with the growing demand, fresh difficulties were encountered. The deepest shaft in 1754 appears to have been that at Whitehaven, which reached a depth of 130 fathoms (or about 800 feet), and this must have been quite exceptional, for probably hardly any coal was worked at a greater depth than 100 fathoms.[1]

Early in the eighteenth century fire-damp began to claim its victims. Its existence had been recognised long before, but very little was known about its nature. There were in the first half of the century several serious explosions with a considerable loss of life. The earliest effort to improve matters by ventilation was made about 1732, when the first attempt was made to produce a draught by means of furnaces. Between that date and 1754 considerable improvements were made in ventilation, and at that time, or a few years later, something like the modern system had been introduced by Spedding.

The great danger connected with fire-damp was, of course, the use of naked lights. From the earliest times lamps and candles were employed, and miners had got to be very expert in detecting the presence of fire-damp by the use of the latter.[2] When it was found that the use of naked lights was dangerous, attempts were made to provide a light which would not fire the inflammable gas. The best of these was the "steel mill," the date of which is probably somewhere between 1740 and 1750. This apparatus was introduced by Spedding in consequence of some experiments by Sir James Lowther, which seemed to show that fire-damp was not ignited by sparks from a flint and steel. It consisted of a steel disc rotated by hand, against which a flint was held. The result was a shower of sparks, which gave a very faint, dim light, and for long it was erroneously believed that the apparatus was not capable of firing the gas. Nothing better, however, was known until Dr. Clanny's lamp in 1812, the precursor of the safety lamps of Davy and Stephenson.

Another great difficulty—perhaps the greatest felt by the miner—was that of keeping the mines free from water. From the early part of the century Newcomen's steam, or rather atmospheric, engine had been successfully used for this purpose, all other attempts at pumping having been found quite unable to deal even with the short shafts then existing.

In the earliest coal mines the mineral had been raised to the surface by men climbing ladders, or in baskets worked by horse-gins; but the successful use of the steam engine for pumping suggested its application to haulage, and about 1753 attempts were being made to apply it to this purpose. In the earliest of these "a basket of coals was raised by the descent of a bucket of water, the steam engine being employed to re-pump the water to the surface."[3]

Later in the century the hardly less clumsy method was employed of pumping water to a height and causing it to work water-wheels, which served to wind the coal to the surface. This roundabout and costly device was coming largely into use, when the application of the crank to the steam engine enabled the necessary rotation of the winding drum to be obtained direct from the engine.

Glass.

From a very early date glass had been manufactured in many places in England, and on a considerable scale. Most of this early glass was inferior, greenish in colour, and principally used for windows, though drinking-vessels of tumbler shape were also produced of the same material.[4] At the date with which we are dealing large amounts of this same glass were being made in London, Newcastle, Birmingham, and elsewhere.

The materials employed were sand or "rock" (ground sandstone) and a crude alkali obtained from the ashes of plants. In this country the best alkali was obtained from burning kelp, and the collection and burning of that plant was a considerable industry on the coasts of Ireland and Scotland until the discoveries of Leblanc in 1792 enabled salt to be converted into carbonate of soda, and so put an end to the treatment of ashes for the potash and soda they contain. For making the commonest sort of green glass for glazing purposes the ashes of various plants were

[1] Wills' Cantor Lectures on "Explosions in Coal Mines" (1878), Journal of the Society of Arts, vol xxvi., p. 458. Galloway, "History of Coal-mining."

[2] Wills, Cantor Lecture, Journal, vol. xxvi., p. 474.

[3] Galloway, "History of Coal-mining."

[4] Hartshorne, "Old English Glasses" (1897).

employed, fern being one of the most common. The ashes of kelp were not only rich in alkali, but contained a large proportion of lime, which was a necessary ingredient.

The best alkali, known as barilla, soda of Alicante, &c., came from the East, and was produced by burning kali (hence, of course, the name of alkali) plants of the genus Salicornia, or glass wort. This Eastern alkali was certainly used in Venice, Bohemia, and France, and perhaps it may have been imported here also for the better sorts of glass. Saltpetre, either imported or obtained from accumulations of animal and vegetable refuse (nitre-heaps), was also occasionally used. The use of manganese for improving the colour of the glass was well known.

The most important feature, however, of the English glass manufacture in the middle of the century was certainly the production of what is still known as "flint" glass, and was at the time also commonly called "cristal" or "crystal." This was far whiter and more brilliant than any glass which could then be made by other methods. It was employed chiefly for making drinking-vessels, but also for mirrors. The name "flint" arose from crystal glass having originally been made from crushed flint, which provided a nearly pure form of silica. The so-called "flint" is really a lead glass. The best authorities seem to hold that the use of lead was first proposed in England some time in the seventeenth century, though neither the name of the inventor nor the precise date of the invention is known.[1]

Nesbitt thinks the glass-works established by Sir R. Mansell near Newcastle under his patent of 1614 owed their success to the use of lead, and it seems that England had for long a practical monopoly of the manufacture. Hartshorne quotes a French writer as his authority for the statement that in 1760 English flint-glass makers sent four-fifths of their output abroad, the whole of France being supplied with flint glass from England.

Watch-making.

During the eighteenth century the art of horology reached a high level in this country. Tompion, "the father of British watch-making," died in 1713, but his friend and successor, Graham, lived until 1751. Both were buried in Westminster Abbey. Graham invented the mercurial pendulum for compensating variations of temperature, and described it before the Royal Society in 1726. The lever compensation pendulum, acting by the different expansions of brass and steel, and commonly called the "gridiron pendulum," was invented by John Ellicott about 1735. In 1728 John Harrison showed his first chronometer to Arnold, who gave him the good advice that he should go back home into the country and perfect it. This he did, and in 1735 he brought it up to London again to enter it in competition for the reward offered by an Act of Parliament passed in 1714, which promised 10,000*l.* to the inventor of a chronometer capable of determining, within certain limits of accuracy, the longitude of ships at sea. The following year (1736) the Board of Longitude gave him 500*l.* after an experimental voyage, and in 1761 the chronometer was more completely tested by a voyage to Jamaica, when the Board awarded Harrison the full prize, though he did not get paid the whole of it until 1769. In 1749 he received the Royal Society's medal. Mudge (1715–94) and Arnold (1734–99) improved Harrison's chronometers, and practically brought them to their present form.[2]

Many of the clocks and watches made by these and other skilled mechanicians of the period are still keeping good time, and the work of these men, though sometimes a little lacking in finish, will bear comparison, not only with that of their contemporaries in other countries, but with that of any who have succeeded them.[3]

Salt.

In mediæval England salt was important rather as a food preservative than as a condiment, as it provided the only known means of keeping meat and fish in an edible condition. As Thorold Rogers points out,[1] for five or six months in the year the majority of people lived on salted provisions. They had to eat salted meat or go without meat at all. In Lent everybody had to live on salt fish—an unwholesome diet, which was a fruitful source of disease. The salt, which was always more or less impure, and often dirty, was originally obtained from sea-water all round the coast, evaporated first by solar heat and afterwards by fuel. The manufacture of salt was among the earliest applications of coal. The process was carried out sometimes in pans or ponds with clay bottoms, but in later years in metal evaporating pans heated by coal. Sussex, Devonshire, Shields, Bristol, Southampton, all had large salt works. From the southern coasts salt was exported to France, whence, centuries before, when the manufacture had depended on the heat of the sun, it had been imported.

The brine springs at Droitwich were certainly utilised before the early part of the eighteenth century. The salt-bearing strata at Northwich are said to have been discovered in 1670 in the course of boring for coal.

It is to be remembered that the idea of making soda from salt, the foundation of all modern chemical industry, had not yet been realised, though it was perhaps in the air. A little later Roebuck, the friend of Black and the associate of Watt, who was the founder of the great Carron works in Scotland and the first maker of sulphuric acid on a commercial scale, ruined himself by various speculations, amongst which was one for making soda from salt.[2]

Saltpetre.

Saltpetre or nitre (nitrate of potash) was a very important product, since it was a principal ingredient in the manufacture of gunpowder. It was also used in glass-making and for other purposes. It was first imported from the East, India and Persia. It was made in England and elsewhere in Europe, where it does not occur as a natural product, in "nitre heaps." These nitre heaps were composed of mixtures of animal excrement with wood ashes and lime. The process dates from the time of Elizabeth, when a German named Honrick discovered to the Queen for a sum of 300*l.* the secret of making "artificial saltpetre." The heap was watered with urine, and after a sufficient time the material was lixiviated, and the salt crystallised out. As time went on, native saltpetre was imported in considerable quantities, and the need for the strenuous search for saltpetre materials passed away, but much was obtained from the nitre heaps at the date with which we are concerned.

Gunpowder.

The earliest English gunpowder mills were those established at Long Ditton, in Surrey, by George Evelyn (John Evelyn's grandfather) about 1590. Another very important powder factory was that at Chilworth, established about 1654 by the East India Company, or leased by them about that time.[3] This changed hands several times, was flourishing in the middle of the eighteenth century, and is still at work. There were also mills at Dartford and at Battle, in Sussex. Defoe tells us that the best powder in the country was made at Battle. The materials, saltpetre, charcoal, and sulphur, in the same proportions as in modern black powder, were crushed in mills driven by water-power, pestles being used, and later stones. The Waltham Abbey mills, started early in the seventeenth century, were purchased by Government in 1787. The method of manufacture remained unchanged from a very early date until quite recent times, and until the introduction of modern powerful explosives.

Copperas.

Copperas (green vitriol, or sulphate of iron) was made at many places in England, and was a product of considerable importance. It was used in the manufacture of ink, in dyeing, and as a source of sulphuric acid (oil of vitriol). A certain amount of it was obtained in the manufacture of alum from shale, but the bulk of it was

[1] Nesbitt, "Glass Vessels in the South Kensington Museum" (1878); Hartshorne, "Old English Glasses"; "Encyclopædia Britannica," &c.

[2] F. J. Britten, "Former Clock and Watch-makers" (1894).

[3] The clock in the meeting room of the Royal Society of Arts was presented to the society in 1760 by Thomas Grignon (1740–84), a clockmaker of considerable reputation in his time. It is still an admirable time-keeper, and seems none the worse for its hundred and fifty years' service.

[1] "Six Centuries of Work and Wages," vol. ii., p. 95.

[2] Smiles, "Lives of Boulton and Watt," p. 152; "Industrial Biography p. 135; "Dict. Nat. Biog.," Roebuck.

[3] "Victoria County Histories (Surrey)," vol. ii., p. 318.

obtained from iron pyrites. The pyrites (sulphide of iron), or "gold stones," as it was termed, was stacked in heaps and allowed to weather. The drainings from the heap were boiled, with some iron added, and evaporated, the sulphate of iron crystallising out. There were important and old-established works at Deptford, Rotherhithe, and Whitstable. About 1754, works were established at Wigan.

Sulphuric Acid.

Sulphuric acid, known as "oil" or "spirit" of vitriol, was obtained by two processes, both invented by the alchemist Basil Valentine in the fifteenth century. In one of these crystals of sulphate of iron ("copperas") were distilled in earthen retorts, the resulting oil of vitriol being condensed in glass or earthenware receivers. The process is still employed at Nordhausen, in Saxony, and Nordhausen, or "fuming" acid, is still an article of commerce. It differs slightly in its chemical composition from the ordinary modern acid. The second process is the original form of the modern method. In it sulphur was burned under a bell-jar over water, and the acid liquor evaporated. Valentine also burnt a mixture of sulphur, nitre, and antimony sulphide in the same way, and this was an important improvement. About the middle of the eighteenth century a French chemist found that the antimony was not needed, and considerable amounts of the acid were then made.

Up to the middle of the eighteenth century all, or nearly all, the oil of vitriol made in England was made by the distillation of copperas, but in 1740 Ward introduced its manufacture by the method of burning sulphur and saltpetre. In 1749 he obtained a patent for the process. He set up works for making the acid, first at Twickenham and afterwards at Richmond. Dr. Roebuck improved on the process by substituting lead chambers for the glass receivers, and by this important modification the evolution of the modern method was practically completed. Roebuck and his partner, Garbett, first used their improved system in 1746 at Manchester, and in 1749 they set up work at Preston-Pans, near Edinburgh. This invention revolutionised the industry, greatly lowered the cost of production, and, among other applications, enabled the acid to be used for bleaching instead of the sour milk previously employed.

The method used at the present day for the manufacture of the vast quantities of sulphuric acid now required is really only a development of Roebuck's. The principle is the same, though it has been changed by chemical knowledge from an empirical manufacture to a highly scientific process. Iron pyrites (sulphide of iron) has generally replaced the sulphur first used, details have been improved, and the methods rendered more economical, but it remains in its essential features almost identical with that of a hundred and fifty years ago.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—An exhibition of 50*l.* a year, tenable for two years, is offered by the governing body of Emmanuel College to an advanced student commencing residence at Cambridge as a member of Emmanuel College in October. The exhibition will be awarded at the beginning of October. Applications, accompanied by two certificates of good character, should be sent to the Master of Emmanuel not later than October 1.

The chairman of the special board for biology and geology gives notice that applications to occupy the University's table in the Zoological Station at Naples, or that in the laboratory of the Marine Biological Association at Plymouth, should be addressed to him (Prof. Langley) on or before Thursday, May 26.

It is proposed to appoint a syndicate to consider the financial administration of the various scientific departments of the University and the financial relations between these departments and the museums and lecture rooms syndicate; that the syndicate confer with the financial board, the general board of studies, the museums and lecture rooms syndicate, the heads of the various scientific departments, and such other bodies or persons as they may think fit; and that they report to the Senate before the end of the Lent term, 1911.

At the Congregation to be held at 2 p.m. to-day, April 28, it is proposed to confer the degree of Doctor of Law, *honoris causa*, upon Colonel Theodore Roosevelt.

Prof. Senier delivered a lecture on March 9 last before the Royal Dublin Society on "The University and Technical Training," which has now been published by Mr. Edward Ponsonby, of 116 Grafton Street, Dublin. The lecture formed the subject of a note in our issue of March 24 last (vol. lxxxiii., p. 118).

Mr. Milton C. Whitaker, general superintendent of the Welsbach Company's works, has been appointed professor of industrial chemistry at Columbia University, to the vacancy caused by the retirement of Prof. Charles F. Chandler. Dr. Marston Taylor Bogert has been appointed to succeed Dr. Chandler as head of the department of chemistry.

The annual conference of the Association of Teachers in Technical Institutions will be held this year at Birmingham on May 16–17. Among the subjects for discussion are technical universities, relation of evening continuation schools to technical institutions, registration, superannuation of technical teachers, &c. An address will be given by Mr. Cyril Jackson, chairman of the Education Committee of the London County Council, on the extension of day technical work, and a paper will be read by Dr. T. Slater Price on the relation of technical institutions to universities.

The second International Conference on Elementary Education is to be held at the Sorbonne, Paris, on August 4–7. It is being organised by an International Bureau, consisting of representatives of the various associations of teachers throughout Europe. Among the subjects to be discussed by the conference may be mentioned the aim and object of elementary science teaching in primary schools; compulsory attendance; the professional training of teachers, inspectors, and educational administrators; and educational continuation work. Further information may be obtained from Mr. Ernest Gray, 67 Russell Square, London, W.C.

In connection with the appeal for 70,000*l.* for the purchase of a site and the erection of new chemical laboratories thereon at University College, London, to which we directed attention in the issue of Nature for February 17 (vol. lxxxii., p. 462), the Lord Mayor has arranged a meeting of city men to be held at the Mansion House on May 10, at 4 p.m. The chair will be taken by the Lord Mayor, and the following gentlemen will speak:—the Earl of Rosebery (Chancellor of the University), the Earl of Cromer, Lord Avebury, Sir Felix Schuster (treasurer of University College), Dr. Miers (principal of the University), Sir Henry Roscoe (chairman of the appeal committee), and Sir William Ramsay, K.C.B.

The attention of the Chancellor of the Exchequer was directed on April 22 in the House of Commons to the grave difficulty experienced by local education authorities in respect of the grant for secondary education based on the reduced amount of the "whisky money" for the present year. The amount received by local education authorities for higher education under the Local Taxation (Customs and Excise) Act has become greatly diminished, and many authorities have had to consider the question of reducing their work for next year, particularly in regard to evening classes. As was pointed out in the House by more than one speaker, it is highly unsatisfactory that the grant for higher education should depend upon the consumption of whisky in the country. The Chancellor admitted that something ought to be done in the course of this year to put the revenue of these local authorities on a more dependable basis. He said the loss owing to the decrease in the whisky revenue was 253,000*l.*, and he suggested, on behalf of the Government, that half the land taxes—which, it is expected, will be, in respect of last year, 490,000*l.*—shall be allocated for the purpose of making good the deficiency; and, secondly, that the

Government shall undertake, when it makes the financial arrangements for the year, to put on a more satisfactory and stable basis the whole question of the existing subvention from Imperial sources.

IN the House of Commons on April 20 a satisfactory and altogether sympathetic discussion on the care and education of adolescents indicated that the efforts of educationists during the past few years to instruct public opinion as to the need of a system of compulsory attendance at continuation schools have not been in vain. Mr. Whitehouse moved a resolution, which was subsequently agreed to, "That, in view of the relation of unemployment to adolescent and child labour, this House regards an improved educational system, with more adequate provision for the care and training of adolescents, as a matter of urgent necessity, and considers that the Imperial Exchequer should bear an increased share of the cost of this national service." The chief educational change which he advocated was a system of compulsory education at continuation schools from the time of leaving school until the age of seventeen or eighteen. Mr. S. H. Butcher, in seconding the resolution, pointed out that the great blot of our educational system is that with one hand we spend millions of money on elementary education, and with the other we throw away a large part of the results of that education. There is lavish expense on one side, sheer waste on the other. A system which can lead to such results is economically unsound and educationally ruinous. A change is needed in the curriculum, and that change ought to be in the direction of less insistence upon mere book work, more direct contact with nature, more manual training. The school age must be raised, whether it is to fifteen or to fourteen, and we must abolish, by degrees but ultimately altogether, half-time exemptions below thirteen. Mr. Trevelyan expressed sympathy with the resolution on behalf of the Board of Education. He pointed out that the present is a session in which the Board is not required to produce any legislation, but he said the Board is prepared to move in several directions if time, money, and public opinion are favourable. A drastic method of dealing with street trading, the abolition of the half-time system, the raising of the school leaving age, and the encouragement of attendance at continuation schools, were instanced as subjects on which the Board has been at work and is prepared to act.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 21.—Sir Archibald Geikie, K.C.B., president, in the chair.—Lord **Rayleigh**: The incidence of light upon a transparent sphere of dimensions comparable with a wave-length. The investigation is on the basis of the electromagnetic theory of light, the transparent sphere being supposed to have a dielectric constant different from that of the surrounding medium. The case of a very small sphere, or of an obstacle of any size and shape under the restriction of very small refractivity, was treated in 1881. In the numerical calculations of the present paper the refractive index is supposed to be 1·5, and the ratio of circumference to wave-length has the values 1, 1·5, 1·75, 2, and 2·25. When the ratio in question is small and the incident light is unpolarised, the scattered light is polarised in all directions except, of course, those parallel to the incident ray; and the polarisation is complete at right angles to the primary ray. As the ratio increases, this condition of things is departed from. The maximum polarisation is now to be found in an oblique direction, inclining backwards. A little later the polarisation in certain directions is reversed, such changes occurring very rapidly as the ratio alters. Experiments similar to those made in 1881 upon sulphur particles precipitated from a dilute and acidified solution of "hypo" are described, and it is shown that a passage from red to blue light may reverse the polarisation, although there is no change either in the liquid or in the direction of observation.—Prof. Karl **Pearson**: The improbability of a random distribution of the stars in space.—Dr. R. D. **Kleeman**: The total ionisation produced in different gases by the kathode rays ejected by X-rays. The results are given in the annexed table, in which are also placed the total ionisations obtained by Prof. Bragg with the α particle. It will be seen that the two sets of values relative to air are very nearly the same. The energy spent in making an ion thus seems not to depend in any marked degree on the nature of the ionising agent.

	Kathode Rays	α particle
Air	1·00 ...	1·00
Carbon dioxide (CO_2) ...	1·08 ...	1·08
Ethyl oxide ($C_4H_{10}O$) ...	1·23 ...	1·32
Pentane (C_5H_{12})	1·31 ...	1·35
Benzene (C_6H_6)	1·20 ...	1·29
Ethyl chloride (C_2H_5Cl) ...	1·33 ...	1·32
Chloroform ($CHCl_3$) ...	1·34 ...	1·29

—Prof. F. J. **Cole**: Tone perception in *Gammarus pulex*. The paper has reference to the occurrence of a definite and visible physiological response on the part of the freshwater amphipod *Gammarus pulex* to stimuli of an auditory character. Audition in the lower animals cannot be satisfactorily studied in most cases, since a stimulus produces no response that can be seen or measured. Gammarus, however, when confined in a microscope live box, responds in an energetic and striking manner by flexing its first pair of antennæ under its body. A response can be elicited after the second pair of antennæ have been removed, but not after the removal of the first pair. The instrument generally used to produce the stimulus was a tenor trombone, and the experiments were conducted either on the ordinary laboratory table or on a table specially constructed to filter off vibrations from the ground, and thus to ensure that the stimulus reached the animal through the air. It was found that Gammarus was most sensitive to the B flat below middle C, and that its range of tonal sense was so limited that it might almost be adduced as an example of absolute or physiological tonality, *i.e.* of an animal specially sensitive to one note. Only a small percentage of individuals, however, responded at all, and then, probably owing to fatigue, the power of response soon disappeared. One specimen responded to every note of the trombone. The experiments may be interpreted as either tactual or auditory reactions—if it can be held that these two senses have segregated out in such a simple and true aquatic species as *Gammarus pulex*, and do not merely form a part of an indefinite common sensibility.

Geological Society, April 13.—Prof. W. W. Watts, F.R.S., president, in the chair.—Dr. Tempest **Anderson**: The volcano of Matavanu in Savaii. Savaii is one of the German Samoan Islands. It is volcanic, formed of varieties of basic lavas, and for the most part fringed with coral reefs. The volcano of Matavanu was formed in 1905. The eruption was at first explosive, but since the first few weeks has been mainly effusive and accompanied by the discharge of fluid basic lava, which has run by a devious course of about ten miles to the sea, formed fields of both slaggy and cindery lava, filled up a valley to a depth in some places of probably 400 feet, and devastated the most fertile land in the island. The crater contains a lake, or rather river, of incandescent lava, so fluid that it beats in waves on the walls, rises in fountains of liquid basalt, and flows with the velocity of a cataract into a gulf or tunnel at one end of the crater. It then runs underground until it reaches the sea, into which it flows, and causes explosions attended with the discharge of showers of sand and fragments of hot lava, and the emission of clouds of steam. The resemblances to, and few differences from, the volcano of Kilauea are discussed.—Helen **Drew** and Ida L. **Slater**: Notes on the geology of the district around Llansawel (Carmarthenshire). The stratigraphy and geological structure of a small area some nine miles to the west of Llandovery, and to the north of Llandeilo, are dealt with. The rocks consist of a series of sediments, including a coarse conglomerate, grits, shales, and tough blue mudstones. The structure in the eastern part of the district is more complicated than in the west. The repeated outcrops of the conglomerate in the hilly region around Shon Nicholas give the clue to the structure. The paper concludes with a comparison of this district with those of Rhayader and Pont Erwyd.

FORTHCOMING CONGRESSES.

MAY 14-22.—International Botanical Congress. Brussels. General Secretary: Dr. E. de Wildeman, Jardin botanique, Bruxelles.

MAY 16-21.—International Congress of Americanists. Buenos Ayres. General Secretary: Dr. Lehmann-Nitsche, Calle Viamonte 430, Buenos Ayres, Argentine Republic.

MAY 20-23.—International Congress of Tropical Agriculture. Brussels. Secretary of British Committee: Dr. T. A. Henry, Scientific and Technical Department, Imperial Institute, S.W.

MAY 30 TO JUNE 4.—International Ornithological Congress. Berlin. President: Prof. A. Reichenow. Address for inquiries: Berlin N 4, Invalidenstr. 43.

JUNE.—International Congress of Mining, Metallurgy, Applied Mechanics and Practical Geology. Düsseldorf. General Secretaries: Dr. Schrödter and Mr. Löwenstein, Jacobi-strasse 3/5, Düsseldorf, Germany.

JULY 10-25.—International American Scientific Congress. Buenos Aires. Address for inquiries: President of the Executive Committee, c/o Argentine Scientific Society, 269 Calle Cevallos, Buenos Aires.

JULY 27-31.—International Congress on the Administrative Sciences. Brussels. Secretary of British Committee: Mr. G. Montague Harris, Caxton House, Westminster.

AUGUST 1-6.—International Congress of Entomology. Brussels. Chairman of Local Committee for Great Britain: Dr. G. B. Longstaff, Highlands, Putney Heath, S.W.

AUGUST 1-7.—French Association for the Advancement of Science. Toulouse. President: Prof. Gariel. Address of Secretary: 28 rue Serpente, Paris.

AUGUST.—International Congress of Photography. Brussels. Correspondent for United Kingdom: Mr. Chapman Jones, 11 Eaton Rise, Ealing, W.

AUGUST 2-7.—International Congress on School Hygiene. Paris. General Secretary: Dr. Dufestel, 10 Boulevard Magenta, Paris.

AUGUST 15-20.—International Zoological Congress. Graz (Austria). President: Prof. Ludwig von Graff. Address for inquiries: Präsidium des VIII. Internationalen Zoologen-Kongresses, Universitätsplatz 2, Graz (Österreich).

AUGUST 18-26.—International Geological Congress. Stockholm. General Secretary: Prof. J. G. Andersson, Stockholm 3.

AUGUST 29 TO SEPTEMBER 6.—International Union for Cooperation in Solar Research. Mount Wilson Solar Observatory. British Member of Executive Committee to whom inquiries should be addressed: Prof. A. Schuster, F.R.S., Victoria Park, Manchester.

AUGUST 31 TO SEPTEMBER 7.—British Association. Sheffield. President: Prof. T. G. Bonney, F.R.S. Address for inquiries: General Secretaries, Burlington House, W.

SEPTEMBER 6-8.—International Congress of Radiology and Electricity. Brussels. General Secretary: Dr. J. Daniel, 1 rue de la Prévôte, Brussels. Correspondents for United Kingdom: Prof. Rutherford and Dr. W. Makower, University of Manchester, and Dr. W. Deane Butcher, Holyrood, Ealing, W.

SEPTEMBER 18-24.—German Association of Naturalists and Physicians. Königsberg. Secretaries: Prof. Lichtheim and Prof. F. Meyer, Drummstr. 25-29, Königsberg.

SEPTEMBER 27-30.—International Physiological Congress. Vienna. President: Prof. S. Exner. General Secretary for United Kingdom: Prof. E. B. Starling, University College, London, W.C.

OCTOBER 6-12.—Congrès International du Froid. Vienna. Correspondent for United Kingdom: Mr. R. M. Leonard, 3 Oxford Court, Cannon Street, E.C.

DIARY OF SOCIETIES.

THURSDAY, APRIL 28.

ROYAL SOCIETY, at 4.30.—On the Rotatory Character of some Terrestrial Magnetic Disturbances at Greenwich, and on their Diurnal Distribution: R. B. Sangster.—The Liberation of Helium from Minerals by the Action of Heat: D. O. Wood.—The Chromophil Tissues and the Adrenal Medulla: Prof. Swale Vincent.

ROYAL INSTITUTION, at 3.—Blackfeet Indians in North America: Walter McClintock.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Earthed *versus* Insulated Neutrals in Colliery Installations: W. W. Wood.

MATHEMATICAL SOCIETY, at 5.30.—The Accuracy of Interpolation by Finite Differences: Dr. W. F. Sheppard.—Note on Maclaurin's Test for the Convergence of Series: G. H. Hardy.

FRIDAY, APRIL 29.

ROYAL INSTITUTION, at 9.—Matavanu: a New Volcano in Savaii (German Samoa): Dr. Tempest Anderson.

SATURDAY, APRIL 30.

ROYAL INSTITUTION, at 3.—The World of Plants before the Appearance of Flowers: Dr. D. H. Scott, F.R.S.

MONDAY, MAY 2.

ROYAL INSTITUTION, at 5.—Annual Meeting.

VICTORIA INSTITUTE, at 4.30.—Annual General Meeting.

ARISTOTELIAN SOCIETY, at 8.—The Emotional Experiences of some Higher Mystics: Rev. A. Caldecott.

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

SOCIETY OF ENGINEERS, at 7.30.—Up-to-date Roads: R. O. Wynne-Roberts.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Principles of Tanning: Dr. J. Gordon Parker.—The Crystalline Products of the Hydration of Portland Cement: E. F. Read.

TUESDAY, MAY 3.

ROYAL INSTITUTION, at 3.—The Mechanism of the Human Voice: Prof. F. W. Mott, F.R.S.

ROYAL SOCIETY OF ARTS, at 4.30.—Commercial Expansion within the Empire: P. J. Hannen.

ZOOLOGICAL SOCIETY, at 8.30.—(1) The Morphology and Life-history of *Eimeria* (*Coccidium*) *avium*: a Sporozoön causing a Fatal Disease among Young Grouse; (2) Observations on the Parasitic Protozoa of the Red Grouse (*Lagopus scoticus*); (3) Experimental Studies on Avian Coccidiosis, especially in Relation to Young Grouse, Fowls, and Pigeons; (4) Observations on the Blood of Grouse: Dr. H. B. Fantham.—Zoological Results of the Third Tanganyika Expedition, conducted by Dr. W. A. Cunnington, 1904-1905. Report on the Ostracoda: Prof. G. O. Sars.—On Tritylodon, and on the Relationships of the Multituberculata: Dr. R. Broom.

WEDNESDAY, MAY 4.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Composition of Milk; Note on Commercial Detergents: H. Droop Richmond.—Uses of Trichlorethylene in Chemical Analysis: L. Gowing Scopes.—A Convenient Fat Extraction Apparatus: W. Clacher.—An Extraction Apparatus: G. S. Walpole.

ROYAL SOCIETY OF ARTS, at 8.—Halley and his Comet: Prof. H. H. Turner, F.R.S.

ENTOMOLOGICAL SOCIETY, at 8.—Descriptions of Micro-Lepidoptera from Mauritius: E. Meyrick, F.R.S.

ROYAL GEOGRAPHICAL SOCIETY, at 8.45.—My Expedition to the North Pole: Commander R. G. Peary.

THURSDAY, MAY 5.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Development of Trypanosomes in Tsetse Flies: Col. Sir D. Bruce, C.B., F.R.S., Captains A. E. Hamerton and H. R. Bateman, R.A.M.C., and Captain F. P. Mackie, I.M.S.—On the Weight of Precipitate obtainable in Precipitin Interactions: Dr. H. G. Chapman.—The Absorption of Gases by Charcoal: Miss Homfray.

ROYAL INSTITUTION, at 3.—Blackfeet Indians in North America: Walter McClintock.

RÖNTGEN SOCIETY, at 8.15.—Quantitative Measurements of the Conversion of Kathode Rays into Röntgen Rays by Antikathodes of Different Metals: J. H. Gardiner.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—A Telephone Relay: S. G. Brown.

LINNEAN SOCIETY, at 8.—Eight Months' Entomological Collecting in the Seychelles Islands: Hugh Scott.—The Anatomy of *Tipula maxima*: J. M. Brown.

FRIDAY, MAY 6.

ROYAL INSTITUTION, at 9.—Auto-inoculation: Sir Almroth E. Wright, F.R.S.

GEOLOGISTS' ASSOCIATION, at 8.—The History of the Study of Fossils: Dr. A. Smith Woodward, F.R.S.

SATURDAY, MAY 7.

ROYAL INSTITUTION, at 3.—The World of Plants before the Appearance of Flowers: Dr. D. H. Scott, F.R.S.

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