THURSDAY, NOVEMBER 16, 1905.

"MATHEMATICS" APPLIED TO CHEMISTRY.

Researches on the Affinity of the Elements, and on the Causes of the Chemical Similarity or Dissimilarity of Elements and Compounds. By Geoffrey Martin. Pp. xii+287. (London: J. and A. Churchill, 1905.) Price 16*s.* net.

THE word "mathematics" has been placed in the title of this review in inverted commas, because, although the mathematical formulæ employed appear to be formally correct, the application of mathematical formulæ to the data collected in Mr. Martin's work appears to the reviewer to be unjustified. To demonstrate this a sketch of Mr. Martin's scheme is necessary.

Mr. Martin's endeavour is to find for each element, and, if desired, for each compound, a formula which will express its affinity for all other elements and compounds, so that it may be possible, in his own words, "to discover the law regulating the chemical attraction the elements mutually exert on each other"; and this is achieved, according to him, by "the construction of some geometrical figure which will quantitatively pourtray the chemical properties of the element."

The plan adopted is to arrange the elements into series and columns, as in the usual periodic diagram; the group numbers are plotted along a horizontal ordinate OX, and the series numbers along an ordinate at right angles to the former, OY. There are ten points along OX, filled in the second group by the elements Li, Be, B, C, N, O, F, and Ne, and there are eleven points along the ordinate OY, occupied in the first column by the elements H, Li, Na, K, Ca, Rb, Ag, Cs, ?, ?, and Au. This, it will be seen, gives one of the common forms of the periodic table. Next, for any one element, having one definite valency (one, it may be, of several valencies which it may possess), perpendiculars are erected on the point occupied by each of the known elements, expressing by its height the affinity of that element for each of the others. Thus, choosing the element chlorine, and regarding it as monovalent, vertical lines are to be erected, showing by their length that that erected on, say, the point occupied by cæsium, expresses a high degree of affinity or attraction; the vertical on the point occupied by arsenic, for example, viewed as triad, would show by its shorter length that the affinity of chlorine for arsenic is less than it is for cæsium; a repetition of this process for all known elements produces a number of points, 10×11, or 110 in number, if all spaces are considered, or a smaller number, the number of the actually known elements, in actual practice. Mr. Martin *imagined a curved surface to be drawn through these points,* and proceeds to develop equations which will represent that surface. He shows, so far as the reviewer can see, correctly, that for the complete characteristic equation for the supposed 110 elements, each of which is supposed capable of existing in 8 degrees of valency, there are $2{\cdot}3486 \times 10^{108}$ different possibilities of associating degrees of valency! However, by a device the author mercifully lowers this number to 8448, being 64 times 132; 132 represents the number of constants for the characteristic affinity-surface for each element existing with only one of its possible eight valencies exercised.

We have italicised the words "imagined a curved surface to be drawn through these points" because there lies the crux of Mr. Martin's attempt. What reason has he to join his points? Does he imagine that the interspaces are filled by an infinity of elements of all conceivable atomic weights between the known limits 1 and 240? If not, then the whole system is discontinuous, and the characteristic surface is non-existent.

But we will accept Mr. Martin's method for the moment, and inquire how he imagines affinity to be measured, so as to obtain the lengths of his vertical coordinates. The methods of estimating comparative affinity may be taken as three in number. First, he suggests that while the "energy of combination" should be measured by the heat generated by a reaction starting from the absolute zero, such measurements are impracticable, and, *faute de mieux,* the "heats of formation" at ordinary temperatures must suffice. This method may be better realised by a concrete example. One-third of the heat evolved when boron burns in chlorine amounts to 34·7 calories; one-quarter of that of the formation of silicon chloride is 39·4 calories. These numbers are approximately equal, hence the affinities of boron and of silicon for chlorine are nearly the same. But this is not always the case; for instance, as Mr. Martin points out, $\frac{1}{4}(Si,H_4)=8{\cdot}2$, whereas $\frac{1}{4}(C,H_4)=5{\cdot}2$; yet "undoubtedly of these two bodies, the H is attracted to the C in CH_4 with a greater intensity than it is attracted to the Si in SiH_4." He therefore guards himself by the statement that "it is only when the heat evolved in the formation of a compound is very great that it can be taken as measuring approximately the attractive forces." There may be a little in this, but the reviewer has read something like it before. Second, an estimate of the relative affinity of the elements in two similar compounds may be derived from a consideration of their temperatures of decomposition. Again, that suggestion is at least a century and a half old. Third, temperatures of reaction may be made a rough measure of affinity. For instance, lead oxide is reduced by hydrogen at a lower temperature than iron oxide, hence the affinity of lead for oxygen is less than that of iron. Estimates of such affinities, and their application to the formation of curved surfaces as described, fill 206 pages of the work. Three appendices treat respectively the causes of the absence of other compounds of elements than those which contain the element at a high or at a low grade of valency; the bearing on the phenomenon of life of the critical temperature of decomposition of chemical compounds; and lastly, "the possible significance of alcohol drinking," in which the glorious hope is held out to our remote de-

scendants of a world in which, owing to a decrease in temperature below the freezing point of water, that useful liquid will be replaced by alcohol!

There is a Scots proverb running thus:—"Mickle cry and little 'oo (wool)." The amount of "wool" in this work is surely insufficient for the "cry." Yet there are some suggestive passages, and the author has evidently spent much time over his problem.

A word in conclusion as to the "get-up" of the book. The reviewer, in reading it, felt that he must act as a proof-reader. There is hardly a page on which a misprint does not occur; and such lapses as "The only data available *is* the following:"; the words *uni-* and *tetra*-valent in one line; "to completly (*sic*) picture"; and the printing of almost every sentence as a paragraph, make the reader's task an ungrateful one.

Something, no doubt, may be accomplished in course of time when affinity constants have been numerically determined (and many are already known) to show that they, too, are periodic functions of the atomic weights; but Mr. Martin has not succeeded in pointing out the lines on which this goal is to be reached.

AN ORNITHOLOGIST'S JOURNALS.

Travels of a Naturalist in Northern Europe: Norway, 1871, Archangel, 1872, Petchora, 1875. By J. A. Harvie-Brown. 2 vols. Pp. xxii+541; with coloured plates and other illustrations and 4 maps. (London: T. Fisher Unwin, 1905.) Price 3*l.* 3*s.* net.

THE journals which compose the greater part of these two handsome volumes relate to three ornithological visits paid to Norway, Archangel, and Petchora about a quarter of a century ago, and the author good-humouredly anticipates their being regarded as "stale news" or "cauld kail het again." On this score, however, there was no need for an apology, for the author tells his story for the first time (apart from previous technical reports), and, besides, the interest of a naturalist's observations depends, not on their date (provided the date be given), but on their intrinsic worth.

As Mr. Harvie-Brown is an accomplished ornithologist, an enthusiastic faunist, and the author of some delightful and valuable books on the natural history of Scotland, it goes without saying that these journals contain some interesting scientific information and some picturesque narrative. But the trouble is that to discover these oases we have to traverse what seem to us dreary deserts of trivial and commonplace monotony, and we can hardly control our impatience by remembering that there had to be many trivial and commonplace days before the author found the nesting-ground of the little stint. What is published is just what was written down at the close of each day, and it follows that items which loomed large at the moment, such as the supper menu, appear of little importance to the callous reader, as doubtless to the journalist himself in retrospect at Dunipace. He got such a gorgeous "bag" of birds—1019 skins and 1021 eggs from the Petchora hunt alone—that we can sympathise with his wish to live his hunting days on the tundra over again; we only wish that his recapitulation had not been so terribly *in extenso*. We are much interested to read how Mr. Seebohm came in one evening, "and with a triumphant thump laid on the table, first a Grey Plover, then a Snow Bunting, and then a Curlew Sandpiper; lastly, and most triumphantly—hurrah!—five Little Stints, long looked for, found at last"; but we cannot get up much enthusiasm over the bulk of the narrative.

The tour in Norway was more or less of a novelty in 1871, and much is related that is now familiar. Much has changed, but more remains the same, and one unchanging feature of which the journal affords abundant illustration is the human appetite.

The Archangel region had been but little worked by ornithologists when Mr. Harvie-Brown and (the late) Mr. E. R. Alston explored there in 1872, and they were richly rewarded. The journal becomes more interesting, though our attention is still distracted by Ernst Craemers's toothache, by the size of the packing-case for the birds, by Alston's loss of his big knife ("one made by Wilkinson, of London"), by the number of bowls of milk drunk, and so forth.

The most adventurous journey was that which Mr. Harvie-Brown and Mr. Seebohm took in 1875 to the region of the Petchora, where they were the first to find the eggs of the little stint in Europe. The author shows his powers in the graphic description of the locality and in his story of the discovery. We quote the description of the nest:—

"Rather untidy, rather rough and uneven round its rim, very shallow, sparingly lined with dry grasses and a little leaf or two, which may have been plucked by the bird as she sat in her nest. Round it, deep, spongy, but not wet, yellow moss, the dark green leaves and empty calices of the Arctic Bramble, a tuft of round-stemmed green sedge with seed; a little further off, the now flowerless plants of the sweet-scented dwarf rhododendron, and bunches and patches of long white grass and plants of a small cotton-grass, and other plants and grasses, of which we shall bring home specimens for identification."

There is a fine plate of stint's eggs, and a careful comparison of the little stint and Temminck's stint. Another beautiful plate contrasts the eggs of grey plover and golden plover.

In the course of the Petchora journal we find some notes on habits which are interesting, *e.g.* those relating to the fact that birds which do not perch, or but rarely perch, in other countries, perch in Petchora. Thus, on one occasion, by patiently following up the "tick tjuck" of the common snipe, Mr. Harvie-Brown had the satisfaction of seeing this wader "perched on the tip-top of one of the gaunt branchless blasted larches, quite 70 feet from the ground." Curlews, gulls, snow-buntings, &c., were also seen perching.

"It is, we think, undoubtedly forced upon them by the great flooding of the country, and what was originally forced upon them has become a favourite habit."

The journal for July 7, 1875, gives an artificial table for distinguishing the downs of ten species of ducks, and that is the kind of minute detail more of which we would gladly have welcomed. It is also to the point to be told of the curious antics of the Arctic (Richardson's) skuas :—

"The birds often alighted within fifteen yards of me, raised the wings over the back—when they did this the white or dusky quills showed like a patch upon the raised wings—shammed lameness and sickness, and stood reeling from side to side as if mortally wounded. If I followed them, they continued to try and lead me off; but if I again approached the nest, they flew boldly towards me, and stooped repeatedly."

There are some vivid pictures of the tundra and its birds, there is an interesting account of the Samoyèdes, and there are some instructive notes on the habits both of birds and men, for all of which one is grateful, wishing only that there had been more of this wheat and less of the journalistic chaff.

PRACTICAL SEA-FISHING.

Practical Sea-Fishing. A Handbook for Sea Anglers. By P. L. Haslope. Pp. 274; illustrated. (London: Upcott Gill, 1905.) Price 3*s.* 6*d.*

SEA fishing is not a new form of sport, nor is it a subject which has been neglected by authors. We have several excellent works on it, such as "Sea Fishing" by "John Bickerdyke" in the Badminton Library series, and "Sea Fishing on the English Coasts" by Aflalo, so that a new book requires some justification for its production.

The work under review is perhaps worthy of a place in the sea fisherman's library, but it is, in our opinion, in no way fitter to occupy that position than either of the books already mentioned. It is obviously written by a practical sea-fisherman who has tested most, if not all, of the methods of rod and line fishing which he recommends; but it is as obviously written by a man whose experience has been mostly confined to the south coast, as south coast methods are much more often referred to than those of other parts of the country.

The author does not, however, appear to be so conversant with some of the methods of net-fishing which he discusses as he is with those of rod and line fishing. For instance, he considers the otter-trawl "a much more manageable net" for the amateur than the beam-trawl, a point we think open to doubt. It is true that the otter-trawl is more easily stowed away on board, but we think that its advantage over the beam-trawl for the amateur ends there, especially if the vessel is not a steamer. The difficulty of getting the otter-trawl to spread out and of getting it to fish properly is only known to those who have tried, and we should certainly recommend the amateur to use a beam-trawl, which, it is true, may capsize when being lowered, but otherwise will always fish when down.

When Mr. Haslope touches upon natural history or the habits of sea-fish he is clearly not so much at home as when he is discussing methods of capture. For instance, he refers to the angel fish, *Rhina squatina*, as a species of ray. He mixes up *Atherina presbyter*, the sand-smelt, and *Osmerus eperlanus*, the true smelt, and says "the Atherine, or sand-smelt, is the variety generally met with" (p. 100). In speaking of the sand-eel, he says :—"Any not required for bait should be fried and eaten, as they form a delicious article of food when in roe, but are not so good in winter" (p. 52). In our experience the sand-eel breeds in the winter; but perhaps Mr. Haslope means that after they have spawned they are not so good. He says of the grey mullet that "they feed chiefly on some kinds of sea-weed and decaying vegetable matter" (p. 95). It is true that algæ are occasionally, and perhaps often, found in the stomachs of grey mullet, but we should put down the staple food of the species as being animal. If we recollect rightly, in the aquarium at the Plymouth laboratory these fish are fed chiefly upon nereid worms. Day says that they are very destructive to molluscs and minute Crustacea, and that they also eat larvæ and ova ("Brit. Fishes," I., p. 234).

The English of the book is not all that can be desired, and badly arranged sentences are far too common. For instance, "In form this fish is very slender and its shape has some resemblance to that of a large sand-eel, which enables it to pursue its prey with great rapidity" (p. 50). "Great quantities of these crabs are taken in trammels and the shell on the back is so sharp and rough that it quickly cuts the twine, sometimes damaging the nets almost beyond repair. They are generally thrown away or used as manure for the gardens" (p. 60).

The directions as to skinning a ray are exceedingly involved :—

"To skin a Ray, remove a small portion with a sharp knife and grasp it with an old cloth in the left hand. This affords a firm hold, and by its means the whole skin can be readily stripped off. Meanwhile hold the fish firmly with the right hand, making with a knife a hole, or an incision, to enable the fingers to obtain a firm grip. Leave it upon the board in the open air with the flesh side upwards, and when dry it will have attained the consistency of horn, &c. . . ." (p. 68).

We prefer the old books on the subject of sea fishing, although, as we have said, the practical advice in the present work is thoroughly sound.

FRANK BALFOUR BROWNE.

MATTER AND FORCE.

(1) *Molecular Forces and Newtonian Laws.* By Alex. Clark. Pp. 237; illustrated. (Glasgow: W. and R. Holmes, 1905.) Price 3*s.* 6*d.* net.

(2) *Explication méchanique de la Matière, de l'Électricité et du Magnétisme.* By M. Despaux. Pp. 210. (Paris: Félix Alcan, 1905.)

(1) "BY deductions from the Newtonian Laws of Force and Motion the Author accounts for all the facts of Magnetism, Electricity and Chemical Affinity and proves their identity with gravitation" (extract from circular of publisher). We ourselves do not think that the author is successful in his attempt;

but this opinion of ours may possibly arise from the difficulty we have felt in fathoming his arguments. There is an originality of statement about them which often makes it impossible to decide hurriedly as to whether they are right or wrong. For example:—

"Electricity is not to be confounded with the electric spark—they are the direct opposites of each other. Electricity is a force of attraction which brings particles of matter into contact; the electric spark is the kinetic energy produced by the action of the electric force through the available distance, and has a dispellant effect upon the particles. By the conservation of energy the electric force ceases to act when the spark is produced. The potential is then converted into kinetic energy. This affords a conclusive reply to the theory, adopted by some eminent authorities, that electricity and light are identical. Light is a form of heat and has always a dispellant effect upon the particles of matter. It is therefore the direct opposite of electricity, which is a force of attraction."

This is certainly not all wrong. The question is how much of it is right? To those readers who are attracted by the above extract we recommend the two hundred and thirty-seven pages of this volume.

(2) Just as in the work reviewed above the dependence of forces upon position is made the universal law, so here the essential identity of all forces is sought for in a kinetic view of matter.

All phenomena of attraction are explained, and can be reproduced by the simple rotation of a screw or turbine in water and in air. The turbine is presented as the universal motor which gives rise to molecular attractive forces and the phenomena which accompany them. The author claims to assume nothing besides the propulsive motions produced by rotations of molecular turbines, and congratulates himself on the rare good fortune that everyone can understand the effects of such rotation.

A number of experiments with ventilating fans are described; the author then wanders off into a comparison of a magnet with a living being, and a consideration of the position of man in the universe.

It is a commonplace to suppose that scepticism is the beginning of belief; the author's creed is accompanied by the usual doubt as to the validity of many of the conclusions of modern science. The value of his criticisms can be measured by his objections to the recognition of the essential identity of light and Hertzian waves. He disposes of the argument which rests on the identity of velocity of the two phenomena by saying that all waves produced in the ether, of whatever nature they may be, must, in fact, have the same velocity, since the velocity of a wave depends, not on its form, but only on the elasticity and density of the medium of transmission, which in this case is the ether.

We cannot look upon this book as a serious contribution to scientific literature, but we readily admit that there are analogies between the effects of the motions which the author describes and other physical phenomena; and if these were systematically described a very interesting volume could be made. But there is so much here that is merely fanciful that we must advise anyone who reads it to read it with caution.

OUR BOOK SHELF.

A Descriptive Handbook of Architecture. By Martin A. Buckmaster. Pp. xvi+188. (London: George Routledge and Sons, Ltd., n.d.) Price 3*s.* 6*d.* net.

THIS is a little book which is intended to help those to whom architecture is a subject of ever-increasing interest. The author refers to a subject which Mr. Banister Fletcher has already brought forward prominently in the preface to "The History of Architecture" and in a paper read before the University Extension Guild, namely, the inclusion of the study of historical architecture in a liberal education. It certainly seems that, owing to the ease of travel, the use of photography and other causes, a knowledge of the elementary principles and forms of the various types of architecture might well be expounded to the senior forms of educational institutions, and this way of interesting the rising generation in matters which appertain to everyday life and observation would tend largely to increase interest in matters artistic and practical.

Concerning the book under notice, much cannot be expected for the low price at which it is published, and it would probably have been better had the author dealt with one period of architecture, and have done that thoroughly, rather than have taken up so large a field. It has resulted in an essay which is "scrappy," and from which we are afraid the attentive student will gather very little of much use to him.

One or two points call for revision. Why is "mediæval" architecture made to *end* at 1090 when most people hold that it *commences* about that time?

Plate iii*a*. is merely an enlargement of part of plate xviii., and might be omitted. Some of the illustrations are very poor; that on p. 20 would lead the student to believe that the Temple of Theseus and the Parthenon had suffered from an earthquake since we saw them last spring!

The ground range of the columns to the Colosseum is not Doric, dentils are wrongly spelt on pp. 25 and 27, and the Temple of Zeus, Athens, is given another name on p. 28. The giving of exact dates for each period, and the printing at the top of each page, are sure to mislead the student; for no style can be truly confined within a period of such exactitude as, say, 1377–1547, and the student should be warned against such an attempt.

The line illustrations are of an amateurish description, and plates viii. and xi. should be re-drawn.

Plate xliv. seems to be a copy of a plate in a well known history, though this is not acknowledged. The division of early Christian architecture into Roman and Byzantine is likely to confuse the student, as Roman is always considered historically as pagan architecture.

Proceedings of the London Mathematical Society. Vol. ii. Pp. xx+490. (London: Francis Hodgson, 1905.)

THE present volume of *Proceedings*, though the size of the page has been changed, and larger type is used, contains about the same amount of subject-matter as its predecessors. It affords evidence that the publication of researches in higher mathematics still receives the same care and attention which it has for many years past obtained at the hands of the small body of workers who mostly travel up on Thursdays by the 2.15 train from Cambridge to attend the meetings in Albemarle Street with their friends. It contains interesting obituary notices of Mr. Ronald Hudson and Dr. Pirie. Among the contributors we

note the well known names of Dixon, Glaisher, Hilton, Hobson, Jackson, Lamb, Love, MacMahon, Morley, Volterra, Rayleigh, Young, and many other mathematicians. An attempt to classify the papers by subject-matter would be difficult, but a general survey of the ground covered suggests that a not inconsiderable proportion, possibly as much as a half, of the work done comes under the heading of "analysis."

But while the reputation of English mathematical research is thus being maintained, it does seem a pity that there is no society which has undertaken the task of popularising the higher study of mathematics in our country in the way that has been undoubtedly done on the other side of the water by the American Mathematical Society, with its *Bulletin* containing full reports of meetings of mathematical societies, educational appointments, and courses of university lectures. The Mathematical Association has done much to render elementary mathematics more practical and interesting. The duty of impressing on the proper authorities the need of providing more fully for instruction in *advanced* mathematics in our *technical* colleges has not as yet been undertaken by any body of mathematicians, yet the matter is an urgent one as affecting national progress in the face of foreign competition. In connection with most of the papers before us, an enormous amount of work is generally done in refereeing previous to publication. Is it not possible that the energy thus expended might with advantage be diverted into some such directions as those above indicated?

Catalogue of the Collection of Birds' Eggs in the British Museum (Natural History). Vol. iv., Carinatæ (Passeriformes, continued). By E. W. Oates, assisted by Captain S. G. Reid. Pp. xviii + 350; 14 plates. (London, 1905.)

IN this volume the authors record the eggs of seventeen families of passerine birds contained in the national collection, thus carrying down the work to the family Certhiidæ (creepers), so that another volume ought, apparently, to bring their task to a conclusion. The total number of species catalogued in the volume before us is 620, which are represented by no less than 14,917 eggs—figures which give some idea of the heavy work the authors had to undertake. Fortunately, the Radcliffe Saunders and the C. B. Rickett collections were received in time to allow their quota to be added to the MS.

We had hoped that as the work progressed the authors would have seen their way to modify the style of the paragraphs recording the distinctive features of the various species catalogued. We regret to see that this is not so, and with the same dreary and wearisome iteration we find entry after entry commencing with the statement that the eggs of such-and-such a bird are of such-and-such form and colour. As a matter of fact, if the English names of the various species had been printed in the same lines as their scientific titles there would have been no occasion to mention the word "eggs" at all in the descriptive paragraphs, which should commence merely with a reference to their form and colouring. By this means not only would much valuable space have been saved (as might also be done in the mode of making the entries themselves), but the reader would have been spared that everlasting and utterly superfluous repetition which is so irritating to any person of literary tastes. We may also direct attention to the crude and schoolboy-like style of composition characterising almost the whole of the paragraphs in question. Reference may likewise be made to some imperfection in the method of recording localities. If, for instance, it is necessary to tell us on p. 16 that certain places are in the Nilgiri Hills, it was surely incumbent on the authors to give the same piece of information on p. 8, while to wait until p. 264 before stating that the Nilgiri Hills themselves are in southern India is a very remarkable proceeding. We are also surprised to learn (p. 162) that Dharmsala is in Kashmir.

The great feature of the volume is the beauty of the fourteen coloured plates of eggs, each containing a large number of figures, all of which have been drawn and coloured by Mr. H. Grönvold. These serve to illustrate very graphically the degree of constancy or variation which obtains in the egg-characters of the different family groups, and in addition to this show some very remarkable examples of individual variation or "sports."

Leather for Libraries. By E. Wyndham Hulme, J. Gordon Parker, A. Seymour-Jones, Cyril Davenport, and F. J. Williamson. Pp. 57. (London: Published for the Sound Leather Committee of the Library Association by the Library Supply Co., 1905.) Price 1*s.* 6*d.*

THIS interesting book, which may have a considerable influence on the improvement of book-binding, consists of five chapters, one by each of the authors whose names are on the title-page, three of whom are members of the Sound Leather Committee of the Library Association, and may therefore be considered as authorities on the subjects of which they write.

When light leather is tanned by bark and many other vegetable tanning substances the skin becomes coloured, and this colour cannot be removed without deterioration of the leather. In 1565 sumach tanning was introduced into England; this process leaves the skin white and in a suitable condition to receive the necessary dye. Experiments conducted by the Society of Arts Committee have shown that sumach tanning is the most suitable for binding leathers. Unfortunately this process is a slow one, and other tanning materials which act more rapidly have been employed; some of these, however, have a deleterious action on the leather, causing it to decay rapidly. Another cause of the short life of some modern leathers is the use of sulphuric acid at one stage of the process. This acid combines with the fibre and cannot be removed; it has a corrosive action on the organic matter, which action has often been attributed to the presence of sulphur in the coal gas used for lighting. In some libraries, however, which are not lighted by gas, the bindings have been found to perish in the course of a few years, and the presence of sulphuric acid in these leathers indicates the cause. Sulphuric acid is also used in connection with the aniline dyes frequently employed for colouring. Another source of weakness is the splitting of the leather in order to obtain smooth surfaces; this process necessarily cuts the network of fibres, and thus diminishes the strength of the material. The tanner should have regard to the sources of the skins, and if they are imported it is advisable to consider the treatment that they have undergone before coming into his hands.

It is impossible to do justice to this book in a short notice, but the attention that has recently been directed to the subject seems already to have borne fruit, for in the advertisements of leather-sellers and book-binders at the end of the book there are such notices as "dressed according to the recommendations of the Society of Arts Report" and "guaranteed free from mineral acids." H. M.

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.]*

British Mosses.

IN the review of Dr. Braithwaite's "British Mosses" which appeared in your number of August 31 (vol. lxxii. p. 425), I attributed the finding of *Catharinea tenella* to Lord Justice Stirling, and I did so on the authority of a passage relative to the plant in Dr. Braithwaite's supplement. The Lord Justice is, I find, desirous that it should be known that the entire merit of the discovery is due to Mr. E. S. Salmon. "I had the good fortune," says the learned judge, "to be his companion when the little plants were gathered, but his eye detected them in the field, and by his acuteness the true name of them was discovered." I am glad to second the Lord Justice in his desire that no mistake should be made in this matter, and I beg your courtesy to insert this short note. E. F.

November 8.

Border occasionally seen between Light and Dark Regions on Photographic Prints.

SINCE my recent brief note on a photographic appearance, Mr. Burke has informed me that the subject attracted the attention of Sir George Stokes, and was thought worthy of a communication from him to the Royal Society in May, 1882 (*Proc. Roy. Soc.*, vol. xxxiv. p. 63).

Had I been aware of that I should, of course, have referred to it. It seems to me now that there may be more than one explanation of such an appearance.

OLIVER LODGE.

Halation.

WHEN a photograph is taken of a dark object with a bright object or the sky some distance behind it, blurring occurs where the images of the objects meet.

That part of the bright object from which only a part of the lens is visible (the rest of the lens being cut off by the dark object) forms an image of varying brightness in the shape of a band which covers the edge between the images of the dark and light objects. If the bright object be at an infinite distance from the lens, the breadth of the band will bear approximately the same ratio to the diameter of the lens as that which the focal length of the lens bears to the distance of the lens from the near object.

It seems probable that many cases of halation are due to this cause. J. A. COBB.

108 Church Road, Richmond, Surrey, November 13.

The Engineer's Unit of Force.

I AM much indebted to "The Reviewer" for his courteous answer to my letter on the subject of the engineer's unit of force in your issue of November 2.

I readily admit that the engineer's unit of force may be so defined as to make it a constant quantity independent of locality; but does the engineer *in actual work-a-day practice* make use of this invariable unit? In problems involving the derived unit of work, does he not, as a matter of fact, estimate the work done or the potential energy, as the case may be, by multiplying together the distance factor and the weight (*i.e.* the force) factor *without making any allowance for the variation of the latter with latitude*?

The question at issue, it seems to me, narrows itself down to this:—is the title "engineer's unit of force" to be applied to the variable unit in actual use by the engineer, or is it to be restricted to the absolute gravitational unit, which may be defined, but which in nine cases out of ten is not actually applied in engineering practice? D. J. CARNEGIE.

Newton Abbot, November 6.

IT is quite true that in engineering practice a correction for latitude is seldom made in regard to the gravitational energy of a raised weight, the reason being that other and very much larger sources of error are usually present. But under sufficiently refined conditions this small correction is actually made. A Bourdon pressure gauge registers pounds per square inch in absolute measure the same everywhere. If Mr. Carnegie considers the pound force to vary with locality, what is his value, in foot pounds, for Joule's equivalent at the centre of the earth?

But surely even Mr. Carnegie himself must use the foot-pound unit, and hence the pound-force unit, in an absolute sense, when applied to such quantities as the kinetic energy of a rotating fly-wheel, the strain energy of a stretched spring, the work done on the piston of a steam or gas engine, the energy of motion or of position of a planetary body, &c.

The present case is an illustration of the apparent inability of academic writers to understand the engineer's position in this matter, and of the confusion which inevitably arises from the combination of two closely related systems of units. In any dynamical system the magnitude of unit mass is quite arbitrary, and the pound mass possesses no intrinsic merits over any other unit. Indeed, the choice of the pound unit has proved to be a most unfortunate one, for the conception of inertia or mass, coming as it does after that of force, finds the pound force already established and ingrained in the mind, forming an effective barrier against the practical adoption of the derived poundal, and being a fruitful source of error on account of the new and old meanings attached to the word pound. People do not, and never will, think in poundals, and so custom has compelled its advocates to incorporate into their system the pound force and the foot-pound unit of work, a tacit admission of its practical failure. Engineers contend that this duplex system with its overlapping terms is harmful and quite unnecessary. They advocate a single system which, so far as possible, shall adopt units in common use. The system used by them fulfils all requirements. It is an absolute dynamical system. Its terminology is not divorced from common thought and speech. It gives an exact and absolute meaning to the pound force and consequently to the foot-pound unit of work, and its unit of inertia has a distinct name of its own, never used in the sense of force, thus avoiding the conflicting nomenclature of the present mixed system. The engineer's and the C.G.S. systems are sufficient for all purposes, and it would be a great gain if the academic British system could be abandoned. THE REVIEWER.

THE EXPLORATION OF THE ATMOSPHERE OVER THE TROPICAL OCEANS.

THE study of the trade-wind region by the use of kites was first proposed by Mr. A. L. Rotch at the meeting of the British Association at Glasgow in 1901, after he and his assistant, Mr. Sweetland, had obtained a series of observations with them during a voyage across the North Atlantic. This method of investigation was later adopted by other meteorologists, notably by the French Scandinavian expedition to explore the atmosphere, which, under the direction of M. L. Teisserenc de Bort, flew kites in 1902 on the Baltic, and last year by Prof. Hergesell, who communicated to the Aëronautical Conference at St. Petersburg the interesting results of a cruise on the yacht of H.S.H. the Prince of Monaco in the vicinity of the Azores and Canaries. During this voyage fourteen kite-flights, some of which reached a great height, were made, and in a communication to the French Academy of Sciences on January 30 Prof. Hergesell said:—"Un courant de S.W., qui correspondrait au contre-alizé théorique, n'a jamais été trouvé par les cerfs-volants bien qu'ils aient plusieurs fois dépassé la hauteur du Pic de Ténériffe. Plusieurs constatations m'amènent à penser que les vents de S.W. observés au Pic par plusieurs observateurs sont d'origine locale et dûs à l'influence de l'île."

Thus Prof. Hergesell believes that the north-west wind which was found overlying the thin north-east stratum is a return current, or anti-trade, for he says:—"Der Luftersatz im Anti-passat erfolgte deshalb vorwiegend in der von uns durchforschten Gegend aus nordwestlichen Richtungen" (Aëronautical Conference, St. Petersburg, 1904, supplement vii., p. 91).

It appeared to the writers that these conclusions, which tended to invalidate the existence of the upper anti-trade, required further investigations, and by mutual consent we decided to have these carried on by two of our assistants, Mr. Clayton, meteorologist at Blue Hill, and M. Maurice, assistant at Trappes, aboard the *Otaria*, a large fish-carrying steamer, equipped with the electric kite-reel which M. Teisserenc de Bort had used for kite-flying at sea.

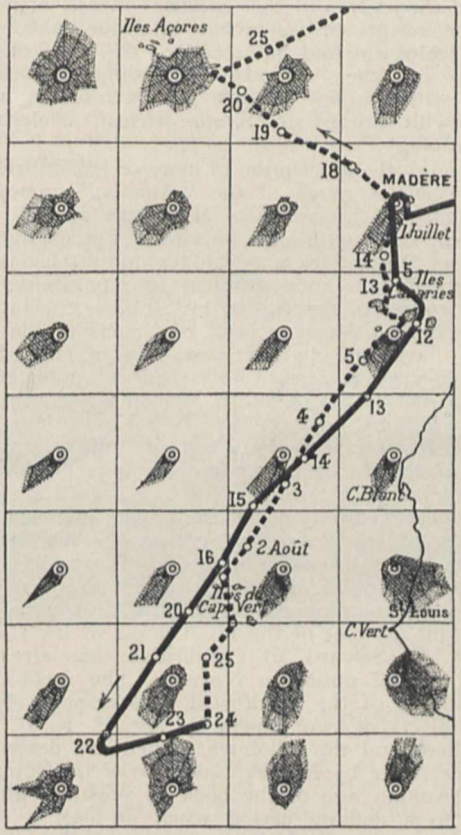

FIG. 1.—The route of the *Otaria*. The diagrams in centres of squares show the mean direction of surface winds in summer, by Captain L. Brault.

A study of the high barometric pressures at the Observatory of Trappes (see *Comptes rendus*, 1899) led to the conclusion that there exists, generally, at a moderate altitude, a zone of light winds which ordinarily the kites cannot penetrate. While it is true that at sea an artificial breeze may be created by steaming in a direction contrary to that of the wind, this method is inefficient in the trades, because, if, as is usually assumed, there is almost complete reversal in the directions of the upper and lower winds, the top kite arrives in the south-west current while the others are still in the north-east wind, and consequently the flight is stopped just where the change of regime commences. Therefore it is necessary to employ a single kite and a boat which is sufficiently fast to lift the kite regardless of the direction of the wind, but as these conditions cannot always be realised, in order to attain great heights on this expedition the paper pilot-balloons already tried at Trappes were used. Since these balloons were only intended to show the direction of the wind, they did not usually carry instruments, and their drift and height were determined by simultaneous angular measurements at the ends of a base-line on the shore, with the exception of one balloon which was observed from the boat. These soundings of the atmosphere, executed at various places, notably at Madeira, Teneriffe and Cape Verde Islands, and also over the open sea, gave the following results, to which are added observations of winds on two tropical mountains and during one of the kite-flights.

In the table on p. 56 the first column indicates the upper limit of the north-east trade, and the second column the limit of the associated north-west wind, these heights being expressed in metres. In the third column the figures in parenthesis show the maximum

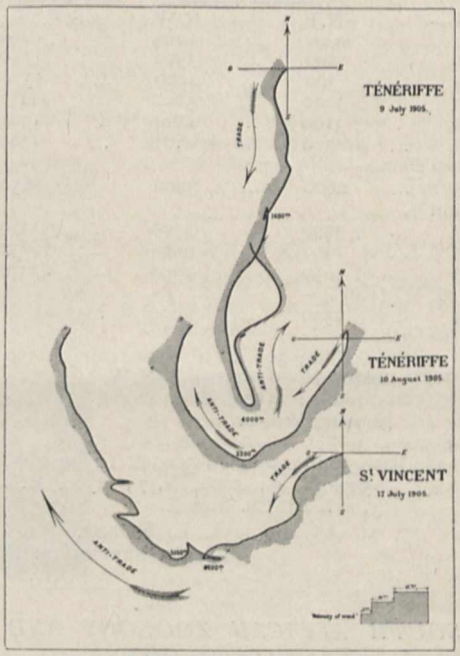

FIG. 2.—Direction of wind at great height, shown by the tracks of balloons.

heights at which the balloons were observed moving in the anti-trade, from south-east, south, or south-west.

There follow observations at different heights on the peaks of Teneriffe and Fogo, the figures after the direction of the wind being its velocity in metres per second. There is also noted the drift of the clouds passing above the peaks. The diagrams (Fig. 2) represent the direction and speed of the balloons which were sent up from Teneriffe on July 9 and from St. Vincent on July 17.

The tables and figures show that the winds blowing toward the equator have a direction varying between N.E. and N.W., these last being usually above the N.E. stratum, the thickness of this layer of the *trades* in the vicinity of Teneriffe being about 3000 metres or 5000 metres. Above it blow S.E., S., and S.W. currents which form the *anti-trades*, its thickness being probably very great, though its density is small. Thus, as was deduced from the observations of clouds and volcanic dust, the east wind in the vicinity of the thermal equator extends very high. At the Cape Verde Islands the south-east

wind was observed by a balloon up to a height of 11 kilometres.

As is seen, these results confirm the accepted theory of the *trades* and upper *anti-trade* in those parts of the Atlantic explored by the *Otaria* (see chart of route, Fig. 1), and prove that, contrary to the opinion of Prof. Hergesell, there exists a return current, or anti-trade, with a well defined southerly component.

We hope to give in a subsequent article the conclusions regarding temperature and humidity derived from the kite-flights made on the *Otaria*.

Winds above the Atlantic, between latitudes 11° and 37° N., longitudes 15° and 26° W., observed during the cruise of the S.Y. "Otaria" in 1905.

Punta Delgada—
August 22 ... ... 800 N.E. ... (4200) N.E.

Madeira—
Aug. 16, 1800 W.N.W.; 11,500 N.W. & S.W.[1]; (11,600) W.S.W.
,, 17, 2900 N.E.; 4,200 N.W. & N.E.; (12,500) W.S.W.

	Trade			Anti-Trade
Teneriffe—	N.E. metres		N.W. metres	S.E., S., S.W. metres
July 7 ...	400	...	3500	.. (7500)
,, 9 ...	300	...	4000	... (5760)
,, 10 ...	3000	...	5200	... (11,000)
Aug. 10 ...	3100	...	none	... (5900)
,, 11 ...	2300	...	,,	... (3900)
At sea near Palma—				
Aug. 13 ...	2600	...	3400	... (6500)
St. Vincent—				
July 17 ...	3200	...	3700	... (11,000)
,, 18 ...	1300	...	none	... (2360)
,, 29 ...	650	...	1900	... (11,000)
11° N., 26° W. (Kites)—				
July 24 ...	2500	...	(3000) E. ? strong	

Peak of Teneriffe—
Aug. 8 ... Base, E. 2; 500, E. 0; 1000, calm; 1500, N. 2; 2000, N. 2; 2500, N.N.W. 4; 3000, wind variable; 3500, S.; 4000?, Al.-Cu. clouds moving from S.

Peak of Fogo—
July 27-28. Base, wind variable; 500, E. 1; 1000, N.E. 13; 1500, N. 9; 2000, N. 7; 2500, E.N.E. 7; 3500?, Al.-Cu. from E.

A. L. ROTCH.
L. TEISSERENC DE BORT.

[1] Mixed stratum of N.W. and S.W. winds.

SOUTH AFRICAN ZOOLOGY AND PALÆONTOLOGY.

THE recent visit of the British Association to South Africa affords a favourable opportunity of directing attention to the zoological and palæontological work now being carried on by the museum at Cape Town under the able direction of Mr. W. L. Sclater, more especially as exemplified in that excellent serial publication entitled the "Annals of the South African Museum." Of this serial, which commenced in 1898, three volumes have been completed, and some seven parts of the fourth volume published up to the end of July of the current year, making a total of at least twenty-nine separate parts, each devoted to a special subject.

From the time that he took charge of the museum, Mr. Sclater appears, indeed, to have determined to devote all his energies towards increasing our knowledge of the fauna of South Africa. His mode of accomplishing this praiseworthy object seems to be threefold. In the first place, efforts have been made to increase the collections in the museum at Cape Town—both as regards the exhibition and the study series—by all possible means, and thus to afford as ample a basis as possible for the work of specialists, and at the same time to awaken increased interest on the part of the public in the museum itself. The second part of the programme consists in the publication of monographs of such portions of the South African fauna as are ripe for this mode of treatment. As examples of work of this nature may be cited the handsome volumes on the mammals and birds of the country, published some few years since, and duly noticed in our columns as they appeared.

Work of the above nature consists to a great extent in collating, revising, and adding to the labours of earlier naturalists; but, in addition to this, much of an altogether newer type has to be made known to the scientific world in such a rich, and in many respects little-worked, field as that presented by South Africa. And it is to work of this latter description that the "Annals of the South African Museum" are mainly devoted. Fortunately, the officers of the Geological Survey of Cape Colony have availed themselves of this excellent means of publishing the results of researches into the palæontology (both zoological and botanical) of this part of South Africa, and the "Annals" accordingly promise to afford within a few years a perfect mine of information with regard to South African zoology and palæontology.

Although the description of more or less entirely new work occupies much of the "Annals," monographs of groups, or revised lists of groups already monographed, come within its purview. For example, the moths of South Africa, which for many reasons could not probably be monographed in separate volumes, are in course of description by Sir George Hampson, of the British Museum, and two parts of his monograph have already appeared. Again, Mr. Sclater has taken advantage of this mode of publication to issue a revised list of South African birds, containing such additions and corrections as have been made since the issue of the volumes on this group in the series devoted to separate monographs of the South African fauna.

To mention by name all the papers included in the volumes of the "Annals" already published would be altogether beyond the limits of available space, and it must suffice, therefore, to refer to a few others. In the palæontological series, the first part of the important account of the fossil floras of the Cape, by Mr. A. C. Seward, of Cambridge, has already received special notice in NATURE. The molluscs and brachiopods of the Bokkeveld beds respectively form the subjects of two papers by Mr. F. R. C. Reed; and these and the trilobites, which are described in another paper by Mr. P. Lake, serve to demonstrate the Devonian age of the beds in question, and thus point to a definite period when at least a part of what is now South Africa was beneath the sea. The affinity of the trilobites to South American types is noteworthy. A fifth paper, by Mr. F. Chapman, is devoted to the foraminifera and ostracods from shallow water deposits of Lower Cretaceous age in East Pondoland. In the zoological series, in addition to those already mentioned, six papers by Mr. Peringuey, assistant director of the museum, form an important contribution to our knowledge of South African beetles; while in another part the Rev. O. Pickard-Cambridge has described a number of new spiders, including three new generic types; and there are many other papers of equal importance and interest.

In conclusion, we congratulate all those who have done so much good which this serial has been the means of communicating to the world, and trust that financial considerations will not be allowed to interfere with the continuation of such a valuable and important publication. R. L.

SCIENTIFIC RESEARCH IN THE PHILIPPINE ISLANDS.

THE valuable scientific work which is being carried out in the Government laboratories, Manila, has from time to time been noticed in these columns, and the record for the third year is stimulating reading and reflects the greatest credit on those by whom it has been done, and on the enlightened Government which has rendered it possible.

Dr. Paul Freer details in his report[1] the routine work of the laboratories and the nature of the investigations which have been carried out. In the chemical laboratory the analysis of foods and drugs, the standardisation of weights and measures, and the examination of the natural products of the country, vegetable and mineral, are some of the subjects dealt with. In the biological laboratory clinical investigations and pathological examinations are carried out, while valuable work is being done by the attached botanist and entomologist. The serum laboratory has been occupied in the preparation of an anti-rinderpest serum, which greatly mitigates the ravages of the disease, and of vaccine virus, while investigations have been made on plague and on the preparation of a cholera vaccine.

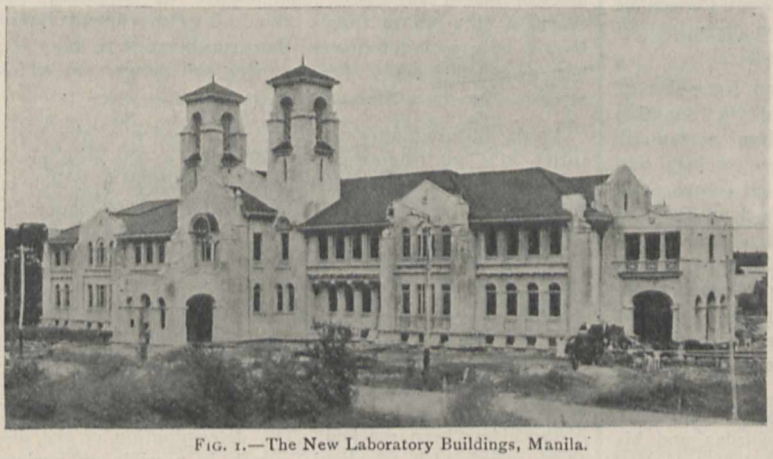

FIG. 1.—The New Laboratory Buildings, Manila.

While so much good work has been done in the past, we may expect considerable development in the future, as Dr. Freer is able to chronicle[2] the erection of new laboratories, the completeness of the arrangement and equipment of which will materially facilitate scientific investigation. The accompanying illustration shows the front elevation of the new buildings, which have the form of the letter "T," consist of two stories, and are erected on a site 23 acres in extent, on which an up-to-date hospital is also to be established, laboratory and clinical work thus being brought into proper contiguity.

The eastern half of the structure is devoted to biological work, and comprises rooms for the preparation of culture media, bacteriological and pathological laboratories and pathological museum, botanical room and herbarium, entomological room, and general biological laboratory, while the western half is devoted to chemical and physical work, and comprises laboratories for organic and physiological chemistry, a commercial laboratory with stills, baths, and machinery for carrying on commercial processes on a laboratory scale, rooms for photometry, adjustment of weights and measures, assaying and mineral analysis, organic combustions, agricultural work, food analysis, &c., together with balance rooms, laboratory for physical chemistry and physics, and a room for spectroscopes and instruments of precision. All the work tables are supplied with gas, electricity for light and power, steam, vacuum, and compressed air. There are in addition boiler and engine house, cold storage, cremating furnace, photographic laboratory, incubating chambers, animal house, serum laboratory, &c.; nothing, in fact, seems to have been forgotten.

Lastly, there is an excellent library of some 17,000 volumes, and the list of current periodicals on all subjects is very complete. Reference is made to the difficulties which have had to be overcome in preserving the books from the ravages of damp and of insects in this tropical climate. The legs of the book presses (which are of metal) stand in tins of petroleum, which effectually prevents the access of insects when the books are on the shelves, and varnishing the books with the following varnish has been found to be of service:—pure white shellac 50 grams, resin 20 grams, bichloride of mercury 1 gram, alcohol 1000 c.c. The constituents are mixed, and after twenty-four hours are filtered. The report and bulletin are illustrated with a number of plates, plans, and charts.

R. T. HEWLETT.

[1] Third Annual Report of the Superintendent of the Bureau of Government Laboratories, Manila, 1905.

[2] Bureau of Government Laboratories, *Bull.* No. 22, 1905. (1) Description of New Buildings, by Paul C. Freer, M.D., Ph.D. (2) A Catalogue of the Library, by Mary Polk, Librarian.

DR. WALTER F. WISLICENUS.

ASTRONOMERS have universally acknowledged the value, the accuracy, and the completeness of the "Astronomische Jahresbericht," which, appearing annually for the last six years, has presented an admirable history of the progress of the science. The systematic arrangement and organisation of its contents have made this compilation a necessity in every observatory, and the announcement of the death of its originator, Dr. Walter Wislicenus, at the early age of forty-six will have been received with profound regret by all who know this work. The deceased astronomer, who occupied the position of Professor extraordinary at Strassburg, began his career at Dresden, but the fame of Winnecke as a teacher, coupled with the advantages afforded by the efficient equipment of the new observatory at Strassburg, induced Dr. Wislicenus to migrate to that university, with which he remained connected until his early death.

Although Dr. Wislicenus will be best remembered for his literary work, and particularly for that already mentioned, his services to practical astronomy were by no means few or unimportant. In 1882, while still a student at Strassburg, he took part in the German expedition to Bahia Blanca to observe the transit of Venus, and for this task he was eminently fitted by the study he had made of the use of the heliometer. He not only continued to observe with this instrument after his return to Strassburg, but added a series of meridional observations of the zone $-2°$ to $-6°$, and some of the results of his work are incorporated into two papers, one on the determination of the period of rotation of Mars, and the other on the absolute personal error in meridian observations; but his most important services were rendered in the cause of astronomical literature.

Besides his articles in Valentiner's "Handwörter-

buch der Astronomie" on stellar photometry, spectroscopy, and chronology, he published a treatise on the determination of geographical positions for the use of travellers and explorers which was favourably received. His periodical compilation on the current history of astronomy has proved itself so useful and important that it is to be hoped it will be continued by some other hand. As a teacher of astronomy he is acknowledged to have been very successful. His presentation of the most recondite subjects was masterly and edifying, arresting and retaining the attention of his class.

NOTES.

THE list of honours conferred by the King on the occasion of His Majesty's birthday, November 9, includes the name of Prof. G. H. Darwin, F.R.S., who has been appointed a Knight Commander of the Order of the Bath (K.C.B.). Dr. W. Saunders, director of the experimental farms of the Canadian Department of Agriculture, and Dr. M. A. Ruffer, president of the Egyptian Sanitary Board, have been made Companions of the Order of St. Michael and St. George (C.M.G.). Sir Felix Semon has been appointed Knight Commander of the Royal Victorian Order, and the honour of knighthood has been conferred on Mr. Arthur Chance, president of the Royal College of Surgeons in Ireland, and Prof. McFadyean, principal of the Royal Veterinary College, Camden Town.

THE death of Prof. Albert von Kölliker on November 2, at eighty-eight years of age, has deprived the scientific world of one of the founders of modern systematic histology, and the eldest of the illustrious teachers and investigators in the realms of embryology and comparative anatomy. An outline of his scientific work was given in NATURE of May 5, 1898 (vol. lviii. p. 1), as a contribution to our series of Scientific Worthies; but his memoirs and other writings are so numerous that no adequate description of them can be contained within the limits of a short article. In the course of that appreciative notice, it was pointed out that von Kölliker was one of the first to realise that the complete justification of the cell-theory must be accomplished by a study of the whole history of animal tissues, from the fertilised egg onwards; and his papers on the development of Cephalopods (1844) and of Amphibia (1846–7) represent the first results of this conviction. Von Kölliker went to Würzburg in 1847 as professor of human anatomy, and almost immediately joined von Siebold in founding the *Zeitschrift für wissenschaftliche Zoologie*, to the early numbers of which he contributed a series of important papers. In the article already referred to mention was made of the considerable series of embryological and other papers, and of the masterly text-books, of which he was the author. In 1896, as a recognition of his brilliant scientific services, he was nominated a Knight of the order *pour le mérite*. He was elected a foreign member of the Royal Society in 1860, and received the Copley medal of the society.

DR. CHARLES WALDSTEIN has been created by the King of Denmark a Knight of the Royal Danish Order the Danebrog.

THE *Athenaeum* announces the death, in his seventy-fifth year, of Dr. Johann Meidinger, professor of physics at the Technical Institute in Karlsruhe, and author of a number of works dealing with the practical side of his subject.

THE superintendent of Commercial Agencies in Canada has expressed his conviction, says the *Journal of the Society of Arts*, that the establishment of a service of commercial agents to reside in British possessions for the purpose of reporting to the Commercial Intelligence Branch of the Board of Trade in London would be of immense benefit to the Empire at large. Such agents should report on all matters concerning the resources, growth, local enterprises, public contracts, openings for trade, and the investments for capital, as is done by His Majesty's consular officers and commercial *attachés* in regard to foreign countries. The superintendent adds that there is not in the whole of Canada a British official who can answer questions of the British exporter concerning Canada, while the Americans "have in the neighbourhood 190 officials."

AT a meeting of the Incorporated Society of Medical Officers of Health on November 10, Dr. Christopher Childs read a paper on a comparative study of the Lincoln, Maidstone, and Worthing epidemics of typhoid fever. After discussing the features presented by these epidemics, Dr. Childs advocated the retention of a staff of experts specially to investigate, at the earliest opportunity, similar outbreaks in the future, such a staff to consist of specially trained medical officers, bacteriologist, chemist, and sanitary inspectors, and organised by an epidemiologist of repute. Moreover, Dr. Childs advocated that in cases where water authorities refuse to listen to the repeated warnings of the medical officer of health with regard to the dangerous character of a water supply, the Local Government Board should take action to cause those authorities to take the best practicable means for removing the dangers to which attention has been directed.

AT the opening meeting of the new session of the Institution of Civil Engineers on November 9, the new president, Mr. John Gavey, C.B., gave an address in which he reviewed the progress of the telegraph and telephone industries during recent years. As illustrating the growth of telegraph and telephone accommodation provided by the Post Office, Mr. Gavey remarked that the telegraph wire mileage increased from 114,242 at March 31, 1880, to 338,120 at March 31, 1905. The telephone wire mileage rose during the same period from 40 to 253,521. There appears to be little prospect of serious competition between telephony and telegraphy after a certain critical distance has been reached. The determination of the distance over which telephonic speech is possible on various types of telephone circuit is a question of the greatest theoretical and practical interest. Telephone administrations have carefully considered what are the extreme limits of effective commercial speech, taking all the facts into consideration, and allowing a large margin of safety, and it is generally considered that from 42 to 46 miles of the English standard cable is the effective commercial limit. As to wireless telegraphy, the opinion was expressed that it is not likely to supplant, or even to compete seriously with, inland methods of communication; nor does it appear probable that it will, at least in the near future, actively compete with highly developed cable communication, although it may supplement that service. In submarine cable work the same progress may be noted as in other branches of telegraphy, the mileage of cable having increased from 87 nautical miles in 1852 to 212,894 miles in 1902, while it is still increasing. The problem of devising submarine cables for long-distance telephones has yet to be solved.

AN official guide to the Victoria Falls, compiled by Mr. F. W. Sykes, the conservator, has been published by the Argus Publishing Co., Ltd., of Bulawayo, at 1*s*. The guide has been compiled for the use of visitors, and is interesting throughout. On November 17, 1855, that is,

exactly fifty years ago, the falls were discovered by Livingstone. The native (Sekololo) name for the falls is "Mosioa-tunya," meaning "the smoke which sounds." Viewed from any of the surrounding hills, the rising columns of spray, more particularly on a dull day, bear an extraordinary resemblance to the smoke of a distant veldt fire. At sunrise, during the rainy season, a dense white column mounts upwards to a height of 1000 feet, which is visible at a distance of fifty miles from the falls. After a clear description of the places of interest in the neighbourhood of the falls, the book provides geological notes written by Mr. G. W. Lamplugh, F.R.S., botanical notes by Mr. C. E. F. Allen, ornithological notes by Mr. W. L. Sclater, and hints and cautions to visitors.

Two letters from Captain Amundsen, of the Norwegian vessel *Gjöa*, giving the earliest results of his expedition to the north magnetic pole, are published in Tuesday's *Times* (November 14). Captain Amundsen sailed in May, 1903, for Godhavn, on Disko Island, off the coast of Greenland. In the course of his first letter, dated November 24, 1904, he remarks:—February turned out the coldest month, with an average temperature of −40°·5 C. Commenced on March 1, 1904, putting down the stores for the coming spring voyage to the vicinity of the pole. Observed during this tour—in the interior of the country—our lowest temperature, −61°·7 C. Came back at the end of May. The summer I have spent in magnetic observations around the station. Wiik has put up the variation instruments—October, 1903—and has attended to them the whole time. Ristvedt is the meteorologist. Lieut. Hansen has to take care of the astronomical observations. Lund and Hansen have their hands full on board. The variation instruments will be kept in function until June 1, 1905. Besides the variation instruments, which have been in continual function, we also have made daily absolute observations. Along with the meteorological observations, we have also made observations of the aurora borealis. Besides we have ample collections of ornithological, ethnographical, and botanical matter, and some fossils. It is my intention to make my way out of the ice and go direct to San Francisco in the autumn of 1905. I will not omit to mention that the variation on the spot varies between N. 10° W. and N. 10° E. We have even found greater deviations. Most frequently it is about 5° W. The inclination is about 89° 20′. Captain Amundsen's second letter is dated May 22, 1905. In it he remarks:—This winter has not by far been so hard as the former. The sea-ice, which last year about this time measured about 380 cm., now is no more than about 170 cm. The lowest temperature we had in February, −45°. I commenced in February to circle the magnetic station, and have just finished this task. The magnetic variation house has been in uninterrupted activity. Absolute magnetic observations have been made daily, and at all temperatures. The meteorological registering instruments have been in function all the time. The zoological and ethnographical collections are constantly increasing. The magnetic variation house will be pulled down in the beginning of June, after nineteen months of uninterrupted activity.

In an article in the current number of the *Fortnightly Review* the Marchese Raffaele Cappelli sketches the growth of the ideas which led to the recent international conference on agriculture held, at the initiative of the King of Italy, at Rome. He enumerates also the advantages likely to accrue from the International Institute of Agriculture created on that occasion. At the close of the conference referred to, a protocol was signed by the representatives of all the Governments of the world—with the exception of some minor ones—favouring the establishment of the International Institute, and asking the respective Governments to adhere to the same. In the opinion of the writer of the article, the institute must aim at regularising, promoting, and generalising its internationalism. It must provide for the rapid and general diffusion of knowledge of technical improvements in the economics of production. The institute must further undertake the task of coordinating the efforts of many cooperatives scattered throughout the world, so that they may act in harmonious agreement. But most important of all will be the services which the international corporation will be able to render in the field of the economics of distribution. When once the institute is in full working order, it will be able to give an approximate idea of the stock in hand of each kind of produce, and so provide farmers with a trustworthy guide as to which crops they will be able to cultivate to the best advantage in a given year. The Marchese Raffaele Cappelli, in the course of his inaugural address as president of the International Congress of Agriculture held in Rome during 1903, adumbrated the present tendency towards international dealings in agriculture, and he is to be congratulated upon the successful inauguration of an institute which will realise the ends he has advocated.

We have received the second part of vol. lxi., and the first part of vol. lxii., of the *Verhandlungen* of the Natural History Society of Rhenish Prussia, Westphalia, and Osnabruck. Three papers, respectively by Dr. Krusch, G. Müller, and H. Westermann, are devoted to points connected with the coal-fields of Rhenish Westphalia and other districts coming within the purview of the society. Zoology is represented by a paper on the migrations of fresh-water planarian worms in the streams of the district, in which the author, Prof. W. Voight, distinguishes between the migrations of individuals and of species, and further subdivides the former class into accidental and periodical movements. In botany, Mr. F. Wirtgen descants on rare and disappearing plants of the Rhenish flora.

To the October number of the *Quarterly Journal of Microscopical Science* Dr. H. W. M. Tims contributes a suggestive paper on the development, structure, and morphology of the scales in certain bony fishes. Such a study, the author suggests, may not only throw light on the relationships of fishes, but it may also help to solve many problems in connection with the development of tooth-germs, for there seems little reason to doubt that scales and teeth are homologous. The question whether scales are ever replaced is raised in the course of the communication. Among the other contents of the same issue reference may be made to a paper by Mr. H. L. Kesteven on the developmental stages represented by the embryonic shell, or protoconch, of the gastropod molluscs.

In the October issue of the *Quarterly Journal of Microscopical Science* Messrs. Assheton and Stevens describe the minute structure of the placenta of an elephant belonging to Messrs. Sanger which in 1902 gave birth to a calf in the Zoological Society's Gardens. The duration of pregnancy appears to have been no less than twenty-eight months, although this is not absolutely certain. By an unfortunate error in Sir William Flower's article "Mammalia" in the ninth edition of the "Encyclopædia Britannica" (perpetuated in Flower and Lydekker's "Study of Mammals"), the proboscidean placenta is said to be non-deciduate. The deciduate character of the zonary

portion is, however, re-affirmed by the authors of the paper before us. On the other hand, the zonary placenta of the Sirenia is regarded as differentiated from the proboscidean type by being mainly, if not entirely, non-deciduate, although it is admitted that the two resemble one another in the long villi, which tend to remain in the walls of the uterus. Again, the resemblance of the proboscidean placenta to that of the Carnivora is deemed to be superficial, there being several important points of difference, the former having three areas of attachment in place of one. Another paper on development, by Dr. F. H. A. Marshall, deals with the mode of formation of the corpus luteum in various mammals.

In the *Proceedings of the Boston Society of Natural History* (vol. xxxiii., No. 7) Mr. A. H. Clarke gives a descriptive list of birds collected in the southern Lesser Antilles. Fishes collected in Tahiti form the subject of a paper by Messrs. Jordan and Snyder in the *Proceedings of the U.S. Nat. Museum* (No. 1422), a new species of Holocentrus being described and figured. In two other communications, Mr. C. H. Eigenmann discusses the phenomena of divergence and convergence in fishes (*Biol. Bulletin*, vol. viii., pp. 59 *et seq.*), and contributes a preliminary note on the fishes of Panama as considered from the standpoint of geographical distribution (*Science*, ser. ii., vol. xxii., pp. 18–20). As regards the first paper, the members of the American family Characinidæ present examples of both divergence and convergence, some forms being differentiated for carnivorous and others for herbivorous habits, while yet others approximate to fishes of quite different families. In the second paper it is concluded from the evidence of the fresh-water fishes that the Pacific slope fauna of tropical America was derived from that of the Atlantic slope subsequent to the shutting-off of a water-way between the Atlantic and Pacific Oceans.

In *Agricultural News* (September 23) reference is made to a memorandum written by Mr. M. Hesketh Bell, Officiating Governor of the Leeward Islands, on the occurrence of hurricanes in the West Indies. Mr. Bell points out that hurricanes do not occur in the West Indies so frequently as is generally believed, and that the accounts have in some instances exaggerated the amount of damage; further, he suggests that a scheme of insurance might be formulated which would offer great advantages to the landowners and at the same time prove acceptable to the underwriters.

The Bulletin of the Department of Agriculture, Jamaica, for September, contains an account of the discussion on cocoa cultivation which took place at the agricultural conference held in Trinidad, also notes on the fungoid and insect pests of cotton. The pests reported by the Hon. T. H. Sharp and Mr. S. Stricker include the cotton worm, which can be successfully treated when quite young with Paris green; cut worms, which attacked the roots, but also yielded to treatment with Paris green; and the cercospora fungus.

The report on the experimental agricultural work carried on in St. Kitts during the year 1903–4 has been published separately from the report on the botanic station. The superintendent, Mr. F. R. Shepherd, writes hopefully of the cotton industry and of the peculiar method generally adopted of growing the cotton as a catch crop on cane lands. Cotton seed was planted in May and June, and, after the first picking, the bushes were pulled up and sugar canes were planted. In the trials with varieties of sweet potatoes and yams, the very large differences between the yields of the better and poorer sorts furnish ample proof of the value of comparisons based on practical experiments to guide the cultivator in his choice of the best varieties.

Dr. E. B. Copeland has compiled a list of ferns belonging to the Polypodiaceæ recorded for the Philippine Islands, which is published in Publication No. 29 of the Bureau of Government Laboratories, Manila. The families are in accord with the "Pflanzenfamilien," but the subfamily Gymnogrammineæ is placed under the Asplenieæ. Of the sixty-two genera represented, naturally the largest is Polypodium, which is subdivided into six subgenera; a subgenus, Myrmecophila, is established for *Polypodium sinuosum* and *Polypodium lomarioides*, and this is followed by Drynariopsis, containing the species *P. heracleum* and *P. meyenianum*. Two species of the myrmecophilous genus Lecanopteris occur, and three species of Drynaria, a genus which is characterised by having pocket-leaves that collect detritus. In the same volume Dr. Copeland gives a selection of about twenty fungi for the islands, principally species of Coprinus, Phalliota, and Lepiota, which are said to be palatable and harmless.

We have received the first number of *Gas and Oil Power*, a new illustrated monthly review for factory owners and other power users. It contains an exhaustive article on the construction of internal combustion engines by Mr. R. E. Mathot, and a special table of the cost of power and light in the principal towns in England.

It has long been recognised that a wide field of profitable work has been opened for motors in connection with British railways. The earliest steam motor seen on a British railway began regular working in June, 1903, on the Fratton and Southsea line of the London and South Western Railway. It was designed by Mr. Dugald Drummond, and proved so successful that numerous other rail motor services have been introduced or sanctioned, for which an improved type of motor has been designed by Mr. Drummond. It seats eight first-class passengers and thirty-two third-class passengers. The total length of the car is 51 feet 2½ inches, and it may be driven from either end. When empty the vehicle weighs 31 tons 11 cwt.

The annual progress report of the Geological Survey of Western Australia shows that in 1904, under the able direction of Mr. A. Gibb Maitland, much valuable work has been done in investigating the mineral resources of the colony. An examination was made of the Pilbara, Mount Morgans, Southern Cross, and Norseman goldfields. The occurrence of telluride ore, petzite, at Mulgabble, and of precious opal at Coolgardie was reported upon favourably, and the reputed tin finds at Cuballing and of petroleum on the Warren and Donnelly rivers were investigated. Analyses were made of manganotantalite from the Pilbara district, of scheelite from the Nullagine district, and of cobaltiferous asbolite, of no commercial value, from Greenbushes.

Excellent work is being done by the mines branch of the Canadian Government under the direction of Mr. E. Haanel, the latest departure being the inauguration of a series of monographs on the economic minerals of Canada. The first of the series, which has just been received, has been written by Mr. F. Cirkel, and deals with the occurrence, exploitation, and uses of mica. It forms a handsome volume of 148 pages, and is accompanied by a coloured geological map of the mica region of Ontario. It contains a synopsis of all the available practical inform-

ation on mica, and should lead to the development of the large mica tracts now known only by name, and to a search for the mineral in other parts of the Dominion. At the present time only a small proportion of the Canadian deposits are worked, many promising deposits having been abandoned on account of lack of experience on the part of those who directed the operations. In 1902 the value of the world's production of mica, in dollars, was as follows:—India, 507,770; Canada, 242,310; United States, 98,859; Brazil and other countries, 55,200; total, 904,139.

IN the *Smithsonian Miscellaneous Collections*, vol. xlix., Dr. A. G. Maddren has published a report of his expedition to Alaska last year in search of remains of the mammoth and other extinct mammals. The report contains a valuable description of the surface deposits of the country which will interest students of glacial geology, and there is an appendix of extracts from the published writings of Kotzebue, Beechey, and later travellers who have visited Alaska for a similar purpose. Dr. Maddren appears to have failed to obtain any important fossil bones, but his geological observations justify a few interesting conclusions. He thinks that the climate of the Arctic and sub-Arctic regions was never colder than it is at present. He is also convinced that there are no deposits of ice in Alaska which date back to the Pleistocene period, except the large glaciers. He has not observed any ice-beds interstratified with undoubted Pleistocene formations.

THE well preserved fossil ganoid fishes from the black Triassic shales of New Jersey, U.S.A., have long attracted attention. They are sometimes found in numbers so great as to excite public interest. The State geologist of New Jersey, in his last annual report (for 1904), has accordingly published a short account of these fossils, illustrated by photographs, and preceded by some elementary remarks on the study of fossil fishes in general. The chapter was prepared by Dr. Charles R. Eastman, and contains a useful summary of our knowledge of American Triassic fishes up to date. Notwithstanding the abundance of individuals, only six genera are represented—a curious contrast in this respect to any fish-fauna now existing. The species are also remarkably few, and some of them are difficult to distinguish on account of the crushing and distortion to which the fishes have been subjected during burial and fossilisation. Dr. Eastman does not describe any new forms.

THE Philippine Islands experienced a very destructive cyclone on September 26; the accounts that have hitherto reached us are rather meagre, and are extracted from the Manila *Cablenews* of September 28, which states that the storm was the worst that has occurred in the last twenty years. Some hundreds of houses were unroofed in Manila, where the wind is said to have reached a velocity of 103 miles an hour; at the naval station at Cavite damage was done to the extent of at least 100,000 dollars, but, so far as is known, the loss of life has not been very great. The Manila Observatory did good service in giving timely notice of the approach of the storm, notwithstanding that it was mostly dependent upon its own observations, as the telegraph lines in south-east Luzon were destroyed. The direction taken by the storm seems to have been from E.S.E. to W.N.W., and the rate of advance was about 12 miles an hour. The barometer fell from about 29·850 inches to 29·213 inches between 9h. p.m. of September 25 and 2h. p.m. of September 26; compared with the fall in our own latitudes, the amount, of course, is not excessive. The rainfall in twenty-four hours amounted to 4¼ inches.

PROF. J. HANN has made a very valuable addition to our knowledge of the meteorological conditions prevailing over the tropical regions of the earth by his publication of "Der tägliche Gang der Temperature in der inneren Tropenzone," which has been reprinted from the seventy-eighth volume of the "Denkschriften der mathematisch-naturwissenschaftlichen Klasse der kaiserlichen Akademie der Wissenschaften" (Vienna, 1905). In his introduction he states that the mean temperatures of several stations in the tropics have been placed too high on account of inaccurate determinations of corrections which were applied to compute the true means. The object of the present investigation is therefore to determine the mean temperatures more exactly, making full use of the latest observations, and to employ a greater number of stations well distributed in longitude which were not previously available. Further, the two previous researches by Dove were published more than half a century ago, and no such complete work has since been published. In the present investigation the observations at thirty-five stations are utilised, and these are distributed over Africa, West Indies, Central and South America, south Asia and north Australia, and tropical oceans. To refer, even at the shortest length, to the method of reduction, the numerous tables, and the details given regarding each station utilised would considerably extend this note, but those interested in the investigation should make themselves acquainted with the volume itself.

A VALUABLE paper by Mr. S. R. Williams on the anatomy of *Boophilus annulatus* (Say), the tick which transmits the Texas fever of cattle, is published in the *Proceedings of the Boston Society of Natural History*, vol. xxxviii., No. 8, p. 313.

MR. WATKINS-PITCHFORD, bacteriologist and analyst to the Government of Natal, has published some observations on the germicidal action of copper salts and of bright copper. He concludes that in cupric sulphate, in the proportion of 1 part to 75,000 parts of water, we possess an agent which promises to be both efficient and safe.

Le Radium for October (2e année, No. 10) contains articles by Sir W. Ramsay, on a new element, radiothorium; by M. Bloch, on the electric conductivity of selenium; by M. Charbonneau, on the transformation of currents of high tension into static discharges; and by M. Fraenkel, on the application of the X-rays in the study of the distribution of the blood vessels; together with the usual summary of researches connected with radio-activity. It is altogether an excellent number.

WE have received the second number of vol. i. of the Memoirs of the College of Science and Engineering, Kyoto Imperial University, containing reports on original work carried out by members of the university. The present number contains accounts of research in pure and physical chemistry, geology, engineering, and electricity.

THE *Psychological Review* (n.s., vol. xii., No. 5) contains an account, by Mabel S. Nelson, of an investigation of the difference between men and women in the recognition of colour and the perception of sound. As a result of many observations, the conclusion is formed that men are clearly superior in the recognition of blue and women possibly superior in the recognition of yellow. Both men and women hear farther with the right than with the left ear, men hearing better than women.

RECENT American mathematical journals contain some interesting papers. In the *Transactions of the American Mathematical Society* for July 10 M. Poincaré gives a

characteristic discussion of the geodesic lines on convex surfaces, with the aim of illustrating by a comparatively simple case the difficult questions of dynamic stability and instability in the problem of three bodies. Prof. E. W. Brown investigates a general method for treating transmitted motions and indirect perturbations such as arise when the action of the earth on the moon is modified by the influence of a planet on the earth's motion. In a long paper on the relation of the principles of logic to the foundations of geometry, Prof. J. Royce directs attention to a former paper by Mr. Kempe, which seems to have been largely neglected, and proceeds to develop the logical consequences of a theory suggested by, but more general than, Kempe's theory. Prof. Bromwich gives the classification of quadrics in hyperbolic and elliptic space, Prof. J. E. Wright writes on differential invariants, and Prof. Pierpont on multiple integrals. The remaining papers, by Messrs. Neikirk, Miller, Dickson, and Wedderburn, are all short, and bear upon the theories of groups and numbers.—In the July number of the *Annals of Mathematics* Dr. E. V. Huntington begins a series of articles on the continuum as a type of order, being a systematic elementary account of the modern theory, put together for the sake, not only of the mathematical student, but of non-mathematical students of scientific method; and Prof. Dickson proves a theorem in the theory of groups and applies it to the discussion of the real elements of certain classes of geometrical configurations.—The *Bulletin of the American Mathematical Society* gives in full a translation of M. Darboux's survey of the development of geometrical methods, the address delivered by him at the St. Louis International Congress of Arts and Sciences. In a short note Dr. Morehead proves that $F_n=2^{2n}+1$ is not a prime when $n=7$, and states that he is in possession of a method for testing other similar cases. The only cases known to be primes are the first four, proved to be so by Fermat.

In a paper published in the *Sitzungsberichte* of the Vienna Academy of Sciences (vol. cxiv. p. 553), F. von Lerch describes an experimental investigation of the electrochemical behaviour of thorium X, particularly as regards the manner in which it differs from the "induced activity" of thorium. When thorium X is dissolved in hydrochloric acid, and different metals are immersed in the slightly acid solution, the active substance which separates on the metal is not thorium X, but the induced activity; the same holds true of the product separated from the acid solution by electrolysis. On the other hand, from a solution of thorium X made alkaline with caustic potash or ammonia, thorium X is usually deposited either by a metal or under the influence of an electric current; but in certain cases, for example with amalgamated zinc, the induced activity is also thrown down. The production of thorium A and thorium B, and the relation existing between them, is also discussed.

In vol. ix., p. 441, of the *Journal of Physical Chemistry* Messrs. E. S. Shepherd and G. R. Upton discuss the tensile strength of copper-tin alloys in relation to their chemical and physical structure. The test pieces made use of were heated for a prolonged period at different temperatures in order fully to attain the crystalline structure normal to those temperatures, the heating being followed by fixation of the properties by control of the rate of cooling. Among other results, it was found that prolonged annealing tends to coarsen the crystalline structure, to decrease the tensile strength, and to increase the ductility. In a second paper Mr. E. S. Shepherd gives an account of investigations of aluminium-zinc alloys, from which it is concluded that these series of alloys present no so-called definite compounds. There are, however, two series of solid solutions, that of zinc in aluminium and that of aluminium in zinc.

We have received the annual address of the retiring president of the Society of Public Analysts, reprinted from the *Analyst* of April of this year. In the course of his address, Mr. Fairley referred particularly to the necessity that exists for a properly constituted authority to supervise the standard for drugs. In "Notes on the History of Distilled Spirits," published in the *Analyst* for September, Mr. Fairley includes an interesting collection of illustrations of ancient forms of stills used in several countries. The manufacture of whiskey was a matter of common knowledge amongst the people of Ireland when their country was invaded by the English in 1170–2, its Celtic name being "uisque beatha," meaning water of life. The distillation of brandy began to take form in France as a manufacturing industry early in the fourteenth century. Originally known as brandwine, brandewine, or brandywine, the term brandy came into use about 1657.

We have received the first part of a "Natural History of the British Butterflies, their World-wide Variation and Geographical Distribution," by Mr. J. W. Tutt. The work is being published by Mr. Elliot Stock at 1*s.* net per part.

Mr. R. W. Robinson has prepared a revised edition of "The Photographic Studio and what to do in it" by his father, the late Mr. H. P. Robinson (London: Iliffe and Sons, Ltd., price 2*s.* 6*d.* net). Few changes have been made, but references to some matters now out of date have been omitted. Amateur as well as professional photographers who wish to know something of the poses and practice of good portraiture will find Mr. Robinson's book a useful guide.

A second edition of "Thermodynamique," by M. G. Lippmann, has been published in Paris by M. A. Hermann. The edition has been edited by MM. A. Mathias and A. Renault. The author endeavours first to elucidate the principles of thermodynamics in such a way that they may be applied intelligently. The facts upon which the principles rest are then explained. The general method of treatment adopted will enable the student to apply the principles of thermodynamics to particular cases, and thus render it unnecessary to search in a book for the right equation to use.

Five parts of a work on the fauna of New England, to be included in the occasional papers of the Boston Society of Natural History, have been received. The society is able to print this work by the aid of the proceeds of the Gordon Saltonstall fund. The first part is a list of the Reptilia, by Mr. Samuel Henshaw; the second of the Batrachia, by the same authority; the third is by Mr. Glover M. Allen, and deals with the Mammalia; the fourth, by Mr. Hubert L. Clark, is concerned with the Echinodermata; and the fifth is a list of the Crustacea, by Miss (or Mrs.) Mary J. Rathbun. When the series of lists is complete we hope to review them in these columns. Parts are to be published at irregular intervals, and though the details of the several lists will vary somewhat in the different groups, each list is to include, first, the accepted name (scientific and vernacular); second, reference to the original description, with record of locality; third, reference to an authentic description and illustration; and fourth, habitat and occurrence.

American palæontologists are becoming more and more strongly convinced of the decisive character of the evidence afforded by extinct faunas of a comparatively recent con-

nection between South America, South Africa, and Australia. A short time ago, Dr. W. B. Scott, in the report of the results of the Princeton Expedition to Patagonia, announced his opinion that the fossil Santa Cruz insectivore Necrolestes is closely allied to the South African Chrysochloris, and that this relationship indicated a connection between South Africa and South America. Now Mr. W. J. Sinclair, of Princeton, in a paper published in the *Proceedings of the American Philosophical Society*, states unequivocally that Prothylacinus and the other marsupial-like carnivores of the Santa Cruz beds are true marsupials closely related to the Australian thylacine. He is, moreover, of opinion that the living South American marsupial Cœnolestes and its extinct relatives are annectant forms between diprotodonts and polyprotodonts, and are also not far removed from the ancestral stock which gave rise to the Australian phalangers. The existence of primitive opossums which cannot be regarded as ancestral to the modern South American forms is also an important determination. In view of the aforesaid relations, coupled with the evidence afforded by the invertebrate faunas, Mr. Sinclair considers himself justified in stating that "considerable evidence is now available to show that a land connection between Patagonia and the Australian region existed not later than the close of the Cretaceous or the beginning of the Tertiary, and it is possible that at this time the interchange of marsupials between the two continents was effected."

THE Carnegie Institution of Washington has published the first part of vol. i. of a "Bibliographical Index of North American Fungi," by Prof. William G. Farlow, professor of cryptogamic botany in Harvard University. This part extends from Abrothallus to Badhamia. The index owes its origin to the fact that in 1874 Prof. Farlow found it impossible to ascertain what species of fungi were known to occur in the United States, and he determined to bring together all references to North American species in the form of a card index. At the same time an authors' catalogue was started to include the titles of all works used in forming the catalogue of species. The latter catalogue was printed in 1887, and was followed by a supplemental list in 1888. A new edition with additions up to 1905 is in preparation. It was found impossible to obtain means of publication for the index until the Carnegie Institution offered to provide the funds. It is expected that the appearance of the present index will save many American institutions much time and money involved in the duplication of work. The index does not pretend to be a summary of all references to North American fungi, but is limited to those which concern the systematic mycologist, and does not include references to papers on fungicides and other technical subjects. We hope to review the index when its publication has been completed.

THE eleventh volume of the new series of the *Reliquary and Illustrated Archaeologist*, containing the four quarterly numbers published in 1905, is now available. Among contributions which will appeal to men of science are Mr. George Clinch's papers on the Neolithic dwelling and on Neolithic burial, Mr. John Patrick's essays on the sculptured caves of East Wemyss, and Mr. W. Heneage Legge's paper on glimpses of ancient agriculture and its survivals to-day. The journal makes a successful appeal to all who are interested in antiquities, architecture, the arts and industries of man in past ages, and in kindred subjects.

THE eighth volume of the *Transactions of the Rochdale Literary and Scientific Society*, dealing with the years 1903–5, has now been published. Among papers read before the society and printed in the volume the following may be mentioned:—Mr. T. Stenhouse, on the radio-activity of radium and other compounds; Mr. W. A. Parker, on the remains of fossil fishes found near Rochdale; Mr. W. H. Sutcliffe, on the bullion mine of the Upper Carboniferous rocks; Mr. C. W. R. Royds, on life in Antarctica; Mr. W. Baldwin, on the palæontology of Sparth Bottoms, Rochdale; and Mr. W. H. Pennington, on some ancient colouring matters. The latest report contained in the volume shows that the total number of members at the end of 1904 was 249, and that the society had a balance of about 66*l.* in hand. The society is to be congratulated upon its continued activity and upon the way in which, by lectures, field excursions, and other methods, it is disseminating an interest in scientific subjects.

OUR ASTRONOMICAL COLUMN.

A SUGGESTION FOR THE NEXT INTERNATIONAL SCHEME.—As the work on the international chart of the heavens is now nearing completion, Mr. W. E. Cooke, of the Perth (W. Australia) Observatory, suggests that astronomers should now begin to consider the next essential astronomical problem which should be attacked internationally. He suggests that the coordination of meridian observations is desirable, and outlines the plans on which such work might be commenced. These include the observation of fundamental stars, of about the sixth magnitude, in every part of the sky, and the formation of a main catalogue comprising, say, three stars to each square degree of the sky, that is, about 120,000 stars altogether. The accomplishment of this work would not only provide the necessary reference stars for future observations, but would give definite meridian work to a number of observatories which at present are performing it in a casual manner and often overlap each other's programmes (*Monthly Notices R.A.S.*, No. 9, vol. lxv.).

PHŒBE, THE NINTH SATELLITE OF SATURN.—Further details concerning the discovery and recognition of Saturn's ninth satellite are published by Prof. W. H. Pickering in No. 5, vol. liii., of the *Harvard College Observatory Annals*.

Prof. Pickering describes the taking and the reduction of each of the numerous plates on which the position of Phœbe has been measured. Up to the commencement of the present year 105 plates of Saturn had been secured with the Bruce telescope, and Phœbe had been recognised on 72 of these, the image on 69 of them being sufficiently well defined to be accurately measured.

On comparing these plates with others which were taken by Prof. Perrine with the Crossley reflector, it is seen that with plates having had equal exposures, and on which Phœbe is seen equally well, those taken with the reflector show stars of about one magnitude fainter than any to be found on the Bruce refractor plates.

Recent observations give the period of Phœbe as about 547·5 days, and the comparison of the observational results with the different sets of elements shows that with the revised elements the deviations are much smaller.

In No. 6 of the same volume Dr. F. E. Ross shows, in detail, the procedure followed in calculating the elements of Phœbe, and compares the three sets of elements which have been computed with the observational results. The discussion shows that slight changes in the previously determined eccentricity and period will bring the plates secured during 1898 into line with the more recent observations.

GRAPHICAL METHOD OF DETERMINING ALTITUDES AND AZIMUTHS.—A simple method of finding the altitude and azimuth of an observed body, the latitude of the observer and the declination and hour-angle of the object being known, has been devised by Mr. Littlehales, of the U.S. Hydrographic Office, and is briefly described in No. 6, vol. xxxiii., of the *Monthly Weather Review* of the U.S. Department of Agriculture.

The plan of solution employs a stereographic projection of the celestial sphere on the *plane of the observer's*

meridian, and by laying off the predetermined data on this projection—which is illustrated in the description—the observer may quickly find the required quantities.

The editor of the *Review*, Prof. Cleveland Abbe, commends Mr. Littlehales's method to the attention of all who have occasion to solve spherical triangles to the nearest minute of arc, whether in geodesy, navigation, astronomy, or general mathematical work.

THE METEORS OF BIELA'S COMET.—In No. 363 of the *Observatory* Mr. Denning directs attention to the probability of a strong shower of Andromedids this year. By quoting the observational results obtained during recent years, he shows that the shower has apparently developed into an important annual phenomenon, and he expects that the maximum display will take place on November 18, although a watch should be kept from November 17 to November 23. The position of the radiant is about R.A. = 25°, dec. = +43°, *i.e.* near to γ Andromedæ.

THE MAGNITUDE OF η ARGÛS.—From a series of observations made at Johannesburg during May and June, Mr. R. T. A. Innes found the magnitude of η Argûs for 1905·5 to be 7·67, and its colour, on Chandler's scale, to be $7\frac{1}{2}$. On comparing these with the observations made in 1896, he finds that the change, if any, since that date is quite insignificant (*Monthly Notices R.A.S.*, No. 9, vol. lxv.).

ENGINEERING AT THE BRITISH ASSOCIATION.

BEFORE dealing with the actual work of the section, it is desirable to put on record the fact that several of the special lectures arranged by the council were exclusively engineering in their character, namely, the lectures delivered at Johannesburg by Prof. Ayrton on the distribution of power, and by Prof. Arnold on steel as an igneous rock, and the address given at Kimberley by Prof. Porter on the bearing of engineering on mining. In judging, therefore, the work done by Section G during the South African meeting, the effect produced by these lectures, delivered in all cases to large audiences, must be kept in mind.

At Cape Town the first paper read was by Mr. C. H. Smith, on colonial Dutch architecture. In this paper Mr. Smith gave a brief account of the history and development of the early architecture of Cape Colony. He pointed out that building materials were exceedingly difficult to obtain, but in spite of all difficulties the early Dutch settlers, who were men of excellent taste and education, commenced their labours on true lines. Although drawing upon the well known principles of Dutch and Batavian architecture, they adapted their buildings to the new country, and developed a style distinctly their own. It was to Governor Simon van der Stel that many of the most picturesque houses in the Cape Peninsula were due. He and his son, who succeeded him, were great builders of houses and planters of trees. The author showed a number of slides illustrating some of the quaint old houses in the Cape Peninsula and its neighbourhood, in particular at Stellenbosch, famous for its beautiful situation and surroundings. This paper proved a great attraction, and drew a large audience.

The paper by Prof. Biles, on steam turbines as applied to ocean liners, was the next dealt with. When this paper was first promised, the author hoped that detailed results of the running of the only two completed turbine ocean steamers would have been available for his paper; unfortunately this was not the case, though Prof. Biles stated that the results so far obtained had completely justified the adoption of the turbine on ocean steamers. He pointed out that such a great revolution as a change from reciprocating engines to turbine engines had never before taken place in such a short time. The author gave figures dealing with the gain in economy from an engineering point of view; in the case of the turbine steamers the *Londonderry* and the *Manxman*, as compared with the *Antrim* and the *Donegal*, designed at the same time, and having reciprocating engines, the *Londonderry* showed a total economy of 2·4 per cent. and the *Manxman* of 7·7 per cent. Prof. Biles, in summing up the work which had been done so far, stated that he was of opinion that there was every indication that in the largest installations on ocean liners there was an economy of power and cost in the use of turbines as well assured as in the case of channel steamers, and that there was little doubt that the turbine would completely displace the reciprocating engine in all moderate and high-speed liners.

Mr. How, in his paper on roller bearings, which was read in his absence by the Recorder of the section, gave some results of recent tests on line shafting when fitted with roller bearings, and on tramway and railway vehicles. In the Birmingham electric tramways it was stated that a saving of 24·3 per cent. of tractive power per ton of load was obtained, and that the net saving per car per annum would amount to 38*l.* 16*s.* 3*d.* Several railway companies had experimented with roller bearings, and in all cases a considerable economy in coal consumption had resulted. On the Liverpool overhead railway, tests proved that the reduction per ton mile of coal consumption was equal to 9 per cent., and that longer trains could be employed.

A very interesting paper was that on motor-cars in South Africa, by Mr. A. T. Hennessey. The chief object of the author was to make clear the special points in car design and construction to which attention should be paid if the motor-car is to be a success in South Africa. So far, of course, all the cars in use there are imported cars, and are built for conditions which prevail in Europe and America, and not for the conditions which prevail in South Africa. In comparing steam cars with petrol cars, Mr. Hennessey came to the conclusion that the latter were the more suitable for South African conditions; in fact, he was of opinion that the shortcomings and disabilities of the steam car were greatly accentuated by the climatic and road conditions of South Africa. The question of the cooling of the cylinders in a semi-tropical country, with roads carried up very steep hills, is most important, and very few imported cars have anything like enough water-cooling capacity. As regards springs, also, there has been great difficulty, and motorists at home have very little idea as to the strain placed upon the springs by the ordinary South African roads. In a motor-car excursion, arranged for the visiting members of the association on the Saturday of the Cape meeting, along the beautiful coast road which runs from Cape Town to Hout Bay, owing to a landslip on the mountain-side, caused by the heavy rains of July and August, the visitors had an ample opportunity of testing the kind of strain to which motor-cars are subjected in South Africa; the cars had to charge through a mass of liquid mud and stones, probably 12 inches in depth, and extending for some 100 yards along the road. In many country districts the author pointed out that it is a common occurrence for the centre of the track to be from 6 inches to 12 inches higher than the sides, which would render it impossible for a car with only a 5-inch under-clearance, which is the maximum clearance of many cars, to travel over these country roads. This paper provoked a very interesting discussion, in which the claims of the steam car were strongly upheld by one or two of the speakers.

The most important paper read before the section in Cape Town was Mr. Tippett's, on Cape Government railways. The author is one of the leading engineers in the Cape Government Railway Service, and the Government gave him every facility in the preparation of his paper. The paper formed practically a complete record of the growth of the railway industry in Cape Colony, and of the methods adopted in surveying, in constructing, and in working the railways. It bristled with statistics and figures, and there were a number of excellent diagrams and reproductions of photographs to illustrate the paper. It will form a most valuable paper for reference purposes to anyone engaged in studying the conditions of railway construction and working in our South African colonies. It is obviously impossible to give anything but a very faint notion of the contents of a paper of such length and importance in a brief summary, such as this is, of the proceedings of the section. One or two salient points to which the author devoted much attention may, however, be briefly dealt with. The one is the question of gauge. He pointed out that the original line from Cape Town to Wellington, now part of the main western system, which was constructed by a private com-

pany, was built on the 4 feet 8½ inch gauge, but when the Government took over this line, and decided to take in its own hands the construction of the railways, acting on the advice of a strong commission, it decided to adopt 3 feet 6 inches as the standard gauge. That gauge has been adhered to throughout South Africa with the exception of one or two short branch lines, which are on the 2-feet gauge, and at the present time a 2-feet gauge line is in process of construction between Port Elizabeth and Avontuur, a coast line, which will probably be eventually extended to Cape Town. The wisdom of constructing a line such as this on a 2-feet gauge seems rather doubtful, but the large bridges on it have been put up of such a strength and of such dimensions as would enable a 3 feet 6 inches gauge to be adopted later on. Another point on which the author laid great emphasis was the system of surveying which it was necessary to adopt in a country where Ordnance maps are at present unavailable. The colonial-trained surveyors are able to carry out work with rapidity and with accuracy by the use of the tacheometer only, which would be impossible in the hands of surveyors trained only in our home methods. If a country like South Africa is to be developed by railways, it is obvious that the cost of construction must be kept down to the lowest possible figure, and, therefore, tunnels, heavy cuttings, and heavy banks must be avoided. All the members of the visiting party who travelled over the main lines in all the colonies during the visit of the association were struck with the extraordinary surface character and curvilinear meanderings of the railway lines, although by this system of construction the actual length of the lines has been in many cases increased, and the possible speed at which trains can be worked has been lessened; nevertheless, when one compares travelling, both as regards time and cost, on these lines with that in the old days with ox or mule waggons, there is no doubt that the wisest plan was to sacrifice, for the time being, possible speed for economy in construction. The Cape lines, and in fact all the lines which serve the Transvaal, suffer from the same disability as the steamer lines which ply between Europe and the Cape—heavy goods traffic is all in one direction. No less than 80 per cent. of the goods traffic on the Cape Government railways is in the shape of up-country traffic; this means necessarily a large number of empty waggons returning to the coast, and must inevitably increase freight charges.

The section opened its proceedings at Johannesburg with the president's address, which was devoted to irrigation. The subject is one of such paramount importance to South Africa that no happier choice could have been made of a president for Section G than that of Sir Colin Scott-Moncrieff. Naturally the examples selected by the president for illustration of the problem of irrigation for agricultural purposes were India and Egypt, although he had also a good deal to say with regard to the system in force in the United States and in Italy. It is to be hoped that the information placed at the disposal of South African engineers by this address will not fail to influence the trend of legislation on this question in our South African colonies.

Sir William Preece gave an interesting account of the present condition of wireless telegraphy, and his paper, bringing all the information on this question up to the most recent date, was a welcome contribution to the transactions of the section. Sir William Preece has on previous occasions contributed papers on this question to the section, and has kept the section well informed of the gradual progress in the evolution of wireless telegraphy as a practical mode of communication.

Prof. Perry's paper on the accidental breakage of winding ropes in mines concluded the first day's work at Johannesburg. In this paper certain examples were worked out in full, and in an appendix to the paper the whole of the mathematical treatment of the problem was given by the author.

The second day's proceedings were opened by Mr. Hammond with a paper on electrical power distribution for the Rand. After alluding briefly to the present tendency at home, and at such situations as the Niagara Falls, to construct large central supply stations, the author referred to the fact that he was surprised to find that this problem had not yet been taken up on the Witwatersrand. Two points were, therefore, discussed in the paper—one was whether the working of the mines could not be cheapened by the extended application of electrical power, and the second, as a corollary, whether such electrical power could not be more economically produced by a central station rather than by each mine, or group of mines, laying down its own plant. In colliery work in Great Britain there is, and has been for the last year or two, a steady growth in the application of electricity to haulage and other work in the coal mines, and the author advocated the adoption of electrical winding for the Rand mines. He also pointed out that a considerable increase of efficiency would be obtained by the abolition of the surface compressed-air plant, and by the introduction of electrically driven compressors, placed underground near the actual workings. Mr. Hammond showed that the total requirements of the Rand mines worked out at a very high figure of horse-power hours (400,000,000), and he proved by further figures that a central power station would thus have a very favourable load factor. Assuming a diversity factor of 60 per cent., and a 20 per cent. loss in distribution and transformation, he estimated the plant capacity at the central station would be 60,000 kilowatts. Basing his further calculations on these figures, the author then proceeded to work out fully the costs of generation and distribution, the revenue which could be expected, and the corresponding financial results. In concluding his communication, which was one of great value, Mr. Hammond referred to the case of the well known central power station at Newcastle-upon-Tyne, and expressed the opinion that if on the river Tyne, where coal was available in large quantities at very low rates, it paid to displace steam power by electric power, still more so would it pay on the Rand.

Mr. Dew read a short paper on water-power plants, Pilgrim's Rest, Transvaal. In this paper the author gave a list of plants in actual operation with the horse-power developed, the type of prime mover, quantity of water, and head, and dealt with a number of points of special interest in the running of such plants.

On the Friday, the last day the section met, the first paper was by Mr. C. W. Methven, on South African harbours. This paper was one of great importance, and must have involved an immense amount of work in its preparation. Practically a complete history of the harbours which have been built up round the South African coast was given. As the author pointed out, there is a remarkable absence of deep-water indentations forming natural harbours between Cape Town and Delagoa Bay, and therefore all the harbours have had to be artificially created. After giving a brief account of the Table Bay works, and the extensions now being carried out by Mr. Hammersley Heenan, the author referred to the Algoa Bay works, and the remarkable stride which had been made within the last few years in the commercial prosperity of this harbour, in spite of the difficulties due to its exposed condition and the heavy seas which frequently make approach almost impossible. Mr. Methven then discussed very fully the formation and treatment of sand-bars at the mouths of the rivers and lagoons on the south-east African coast, which render the construction of harbours and their maintenance such a difficult engineering problem.

Another valuable paper taken at this sitting was one by Mr. C. D. H. Braine, on irrigation in South Africa, dealing with the important question of the duty of water used for irrigation purposes. The author stated that there was very little information on the subject as regards South African practice, and that therefore irrigation engineers in South Africa had to be guided to a great extent by experience in other countries, such as America, Spain, India, &c. He pointed out how unskilled irrigation frequently means a waste of from 25 per cent. to 50 per cent. of water, and that many crops were actually impaired by excessive irrigation. For South Africa he was of opinion that the duty actually used on the land could be safely taken at the rate of 285 acres per cubic foot of water per second, and he quoted statistics from other countries to show that this was a reasonable allowance. To show the value of irrigation in South Africa, the author gave figures as to increase in land values;

land valued in the dry, unirrigated state at anything from 10*s*. to 30*s*. per acre was valued at rates of from 25*l*. to 100*l*. per acre when properly irrigated.

The concluding paper, by Mr. J. H. Ronaldson, dealt with the copper deposits of Little Namaqualand. The author pointed out that from the very early days it had been known that this district in the extreme west of Cape Colony, lying just south of the Orange River, and bounded on the west by the Atlantic Ocean, was a copper-producing one. As early as 1685 one of the Dutch governors dispatched a party to explore the country, but it was not until 1855 that successful work was begun. The district in which the copper mines are situated lies in the hilly ground about 50 miles from the coast, and is connected with Port Nolloth by a 2 feet 6 inches narrow-gauge railway, the property of the Cape Copper Co. During the year 1904 about 85,000 tons of ore were raised, the percentage of copper ranging from 26 per cent. to as low as 3·6 per cent. T. H. B.

ANTHROPOLOGY AT THE BRITISH ASSOCIATION.

THE South African meeting will long be memorable to members who are especially associated with Section H, not so much on account of the high quality and interest of the papers read (though, as will be seen, these were often of considerable importance) as because it afforded an opportunity of examining, measuring, and photographing specimens of the native races, and (what was still more valuable) of visiting Bantu kraals, seeing the native in his ordinary surroundings, and witnessing some of his ceremonial rejoicings. These visits and investigations were outside the strictly sectional work, and can hardly be detailed here; but they cannot fail of permanent results in an increased comprehension of the conditions of native life and of the great problems, scientific, social, and political, connected with the native peoples of South Africa, by all who were privileged to take part in them.

Dr. Haddon's presidential address, delivered on August 16 at Cape Town, has already been printed in full in NATURE (September 7, p. 471), and need not be further referred to here than to point out its exceptionally comprehensive and useful character as a summary of our present information as to the process by which South Africa was peopled, and a sane, earnest, and timely appeal for scientific study on the spot of peoples, some of which are actually vanishing before our eyes, and the others of which are undergoing at the hands of the white race a process of so-called civilisation which will issue in a few years in the total destruction of their ancient institutions and beliefs.

The first paper read was by Mr. E. Sidney Hartland on the totemism of the Bantu. He pointed out that to the French Protestant missionary Casalis belongs the honour of being the first to note the similarity between the totemic practices and belief of the North American Indians and those of the Bantu peoples. The object of the paper was to examine the latter practices and belief, so far as they have been recorded, with the view of ascertaining how far they extend and what evidence there is of their former existence where they are no longer preserved; whether there is any essential difference between the practices and belief of the Bantu and what is generally understood by totemism elsewhere; and lastly, the process of decay. The conclusions arrived at were that, though there is little in what is recorded of the Bantu on the western side of the continent down to the southern boundary of Angola which points directly to totemism, there is sufficient to suggest that it once generally prevailed there, and that its disappearance is due to contact with the Negro; that with regard to the eastern and northern Bantu there can be no doubt about the prevalence of totemism which, though now in decay, corresponded in all essential particulars to that of other races, such as the North American Indians and the Australians; and that its decay was due to the change in the reckoning of kinship from reckoning through the mother only to reckoning through the father only, and to the ancestor-worship which had arisen upon the new social basis thereby laid.

Mr. L. Peringuey, curator of the South African Museum, followed with an address on the Stone age in South Africa. The substance of this address has been published in the volume entitled "Science in South Africa." It was illustrated by a carefully selected series of specimens from the museum, which were examined with interest in the course of an indecisive discussion which followed.

The session on Thursday, August 17, was opened by Mr. Henry Balfour with a paper on the musical instruments of South Africa. Mr. Balfour is already known as an authority on the evolution of the musical bow. In the bow of the Damaras, which is upon occasion temporarily converted into a musical instrument, he recognised an example of the earliest stage of development of a long series of instruments culminating in various forms of the harp. Other types of musical instruments were discussed, of which the most interesting, as well as the most enigmatical, was the *goura* of the Bushmen, an instrument substantially identical with the *iseba* (or *lesiba*) of the Basuto and some other Bantu tribes. On this instrument the writer had little to add to what he had previously published in the *Journal of the Anthropological Institute*. Generally as to the development of musical instruments, stress was laid on the importance of exact information with the view of determining the geographical distribution and evolution of the various types.

Miss B. Bullen-Burry read a paper discussing the social and political questions raised in the United States by the existence of the Negro in the midst of a white population. This paper dealt with an aspect of ethnology rarely brought before the section; but the state of things described by the writer and the problems involved are so similar to those even more critical in character now engaging the attention of politicians in South Africa, and on the satisfactory solution of which depends the future of the country, that it is much to be regretted that the writer had so small an audience.

On Friday, August 18, Prof. von Luschan read a paper on artificial deformation in Africa, abundantly illustrated by lantern slides. He traced all deformations of the human body to a foreign source, except possibly the tattooing in relief and the deformations of the lips.

The Rev. Canon Crisp presented a paper (which was read by the Rev. J. S. Moffat) on the mental characteristics of the Bechuana. He dwelt on the peculiarities of Sechuana grammar and construction, illustrating them by various examples. The Bantu languages will express any idea, however esoteric, and will do it with extraordinary precision and often with great felicity. A foreigner who has acquired one of them will often leave his own language to use a Bantu word, because it conveys his thought more aptly and tersely. Bantu proverbs and metaphors are often most incisive, emphasising with much power and delicacy what it is intended to say. The Bechuana are accustomed to use their proverbs without any introduction, their rapidity of thought enabling both speaker and hearers at once to locate the idea to be conveyed. They are masters in the art of destructive criticism, and their native shrewdness, observation, and wit render them dangerous disputants. Instances of the facility with which Bantu acquire European learning and adapt themselves to European thought were given. This paper aroused much interest on the part of the over-sea members who heard it, and numerous questions on details were addressed to Canon Crisp, though of discussion strictly speaking there was none.

A short paper by Mr. William Grant was read giving an account of a visit in March, 1894, to Magato, the then chief of the Mawenda in the Transvaal. The business of the Cape Town meeting was then closed by the president with a few appropriate words of appreciation of the assistance rendered by Mr. Peringuey, who had kindly acted as local secretary, and of the kindness with which the visitors from the Mother Country had been received.

The session at Johannesburg was opened on Tuesday, August 29, with a paper by Dr. S. Schönland, on arts and crafts among the natives of South Africa, containing a summary of present knowledge on the subject.

A paper followed by Mr. W. A. Squire on the art of the Bushmen. It was illustrated by the exhibition of copies of a number of Bushman drawings, on which the author

commented. The methods by which the artist achieved such wonderfully spirited and life-like results were simple indeed. Coloured earth, pounded stones, charcoal, blood, and bird-fat constituted his pigments. A flat stone was his primitive palette. His brushes were perhaps made of the coarse hair of the male wildebeeste or buffalo. Elsewhere he scratched on the walls of his rock-shelter with a stone a little harder than the surface to be adorned. Much interest is obviously shown in the details. Obscenity, as such, is rare. By way of illustration of the technique of these drawings, a copy of a Bushman battle picture from the Natal side of the Drakensberg Range, near Bushman's Pass, and an unpublished drawing by a member of the Kamilaroi tribe of eastern Australia were exhibited, and compared to the disadvantage of the latter in strength, vividness, and accuracy of portrayal. Finally, the object and meaning of the drawings were touched upon, but not discussed, by the author, possibly because too little is known as yet; perhaps too little ever will be known to give rise to more than conjecture. It may be observed, however, that the late Mr. G. W. Stow, the author of a book recently published on the natives of South Africa, formed a large collection of copies of Bushman drawings. These were examined by the president and several members of the section after the meeting was over, and a strong desire was expressed that they should be published. If this could be done, a careful collation might result in some conclusions as to the motives which prompted and the circumstances which developed these remarkable exhibitions of artistic power by a people usually accounted so low in the scale of humanity—conclusions which might, moreover, throw unexpected light on the similar memorials left by the palæolithic people of central France.

A descriptive summary of recent discoveries of stone implements in South Africa was presented by Mr. J. P. Johnson.

Mr. A. E. Mabille read a paper on the Basuto. As a grandson of the famous missionary Casalis, who had lived (except for a few years when he was completing his education at Paris) his whole life in touch with the people, the author was specially fitted to deal with the subject; and the paper was valuable for the statistics it contained and the picture it offered of the present condition and customs of the Basuto under the British protectorate. In the discussion which followed some exception was taken to the use of the word *Modimo* for *God*, but the author defended its use on the ground that it was the word long ago adopted by the missionaries, and, whether rightly or wrongly adopted at that time, its use was now fully understood and accepted among the Basuto themselves.

On Wednesday, August 30, Prof. von Luschan read a paper on the racial affinities of the Hottentots, in which he contended, mainly on the evidence of the Hottentot language, that the Hottentot were a Hamitic people which had come into contact with the Bushmen and absorbed Bushman characteristics. Apart from a few roots and clicks, he declared the Hottentot language to be strictly Hamitic. On the physical side, the loss of their original high stature and the acquisition of steatopygia and of the spiral curled hair of the Bushman have been the penalties of intermarriage with the pigmy people.

Mr. Randall MacIver exhibited and described a number of lantern slides of the Rhodesian ruins. His report on his recent examination of the ruins was read in greater detail at an evening meeting at Bulawayo. It may here be said, however, that he has with some probability established by his researches the native origin of the ruins, and shown that most of them are of no great antiquity, in no case going back to more than 600 or 700 years. They are essentially Bantu kraals in stone. Great Zimbabwe he identified with the capital of Monomotapa, as described by the earlier Portuguese travellers. All the problems connected with the ruins are not yet solved. We are still ignorant what gave the artistic and military impulses to the erection of these structures, against what enemy they were planned, and what led to their ruin and abandonment. These matters can only be determined, if at all, by accurate scientific exploration, and not by mere speculation like much of that which has been hitherto wasted upon these mysterious remains.

Not the least important day in this section was Friday, September 1. Besides papers by the well known missionary M. Junod on the Thonga tribe (illustrated by an interesting exhibition of native music, both vocal and instrumental), and by Mr. J. W. Shepstone, C.M.G., giving a general sketch of the native tribes, two striking communications were read, the one by the Rev. E. Gottschling on the Bawenda, and the other by the Rev. W. C. Willoughby on the totemism of the Bechuana. Mr. Gottschling's paper was partly historical, partly descriptive, and gave a number of particulars hitherto unpublished relating to the Bawenda, a tribe of Bantu in the north-east of the Transvaal, and their customs and beliefs. Some of the details were of quite extraordinary interest. Mr. Willoughby's paper was a discussion of a number of points connected with the totemic practices and of the relation to them of various ceremonies not usually regarded as totemic in origin, in which oxen and certain vegetables play an important part. The writer's conclusions were open to much debate, for which little time was found. The paper, however, as a whole was so suggestive, directing attention to aspects of the Bantu religious ceremonies other than those from which they are usually regarded, that it will be a great pity if this paper, as well as that of Mr. Gottschling, be not published in some form accessible to anthropologists.

The business of the section was wound up with graceful words of thanks by the president to the local committee, and in particular to Mr. A. von Dessauer, the local sectional secretary, to whose energy, forethought, and organising ability the success of the Johannesburg meeting was so largely due.

THE SOLAR OBSERVATORY ON MOUNT WILSON, CALIFORNIA.[1]

IN a report entitled "A Study of the Conditions for Solar Research at Mt. Wilson, California," an outline was given of the circumstances that have resulted in the establishment of a solar observatory on Mount Wilson by the Carnegie Institution of Washington. At the recent annual meeting of the board of trustees, a grant of 150,000 dollars was authorised, for use during 1905. It is expected that the first equipment will cost about twice this sum, and that important additions will result in the future from the operation of a large and well appointed instrument and optical shop.

In April, 1904, a grant of 10,000 dollars was made by the executive committee of the Carnegie Institution for the purpose of bringing the Snow telescope to Mount Wilson from the Yerkes Observatory. An expedition for solar research was accordingly organised under the joint auspices of the University of Chicago and the Carnegie Institution, with the understanding that the funds granted by the Carnegie Institution would be used for the construction of piers and buildings, and for other expenses incidental to the work, while the University of Chicago would furnish the instrumental equipment and pay the salaries of some of the members of the party.

It is a fortunate circumstance that the construction and use of a great reflecting telescope, with a five-foot mirror, is in the general plan of research laid down for the Solar Observatory. In "Year Book" No. 2 (p. 49) of the Carnegie Institution may be found a report on this subject, prepared at the request of Profs. Boss and Campbell, my colleagues on the committee, and improved in many particulars as the result of their criticisms. The prime object of the Solar Observatory is to apply new instruments and methods of research in a study of the physical elements of the problem of stellar evolution. Since the sun is the only star near enough the earth to permit its phenomena to be studied in detail, special attention will be devoted to solar physics. It is hoped that the knowledge of solar phenomena thus gained will assist to explain certain stellar phenomena. Conversely, the knowledge of nebular and stellar conditions to be obtained through spectroscopic and photographic investigations with the

[1] Abridged from No. 2 of "Contributions from the Solar Observatory of the Carnegie Institution of Washington," by Prof. G. E. Hale, director of the Observatory

five-foot reflector should throw light on the past and future condition of the sun. All the principal researches will thus be made to converge on the problem of stellar development. The name "Solar Observatory" is regarded as appropriate, since the spectroscopic study of stars and nebulæ, to be carried on in connection with the solar work, are essential elements in any attempt to determine the mode of origin, the development, and the decay of the sun as a typical star.

How, then, shall we attack in an effective manner the complex problem of stellar evolution? It goes without saying that I can offer no general answer to this question; I can only point out the three principal lines of attack which we hope to pursue at the Solar Observatory. These involve:—

(1) The more complete realisation of laboratory conditions in astrophysical research, through the employment of fixed telescopes of the cœlostat type, and through the adoption of a *coudé* mounting for the five-foot reflector. This should permit (*a*) the use of mirrors or objectives of great focal length, thus providing a large image of the sun for study with spectroscopes and spectroheliographs; (*b*) the use of long focus grating spectroscopes, mounted in a fixed position in constant temperature laboratories, for the photography of stellar spectra requiring very long exposures; (*c*) the use of various laboratory instruments, such as the radiometer, which cannot be employed in conjunction with moving telescopes.

(2) The development of the spectroheliograph in the various directions suggested by recent work at the Yerkes Observatory, including the photography of the entire solar disc with dark lines of hydrogen, iron, and other elements; further application of the method of photographing sections of flocculi corresponding to different levels; special studies of sun-spots, &c.; and daily routine records of calcium and hydrogen flocculi and prominences.

(3) The construction of a five-foot equatorial reflector, with *coudé* mounting, and its use in the photography of nebulæ, the study of stellar and nebular spectra, and the measurement of the heat radiation of the brighter stars.

It was originally intended that a prolonged series of determinations of the solar constant, extending over at least one sun-spot period, should be made an important feature of the observatory's work. The plans outlined in "Year Book" No. 2 accordingly included an equipment at Mount Wilson for this purpose, and suggested, in harmony with Dr. Langley's view, that provision be made for two additional stations, one near the summit of a high mountain, at an elevation of about 12,000 feet, the other at a much lower level on the same mountain. The principal purpose of these two stations was to measure the atmospheric absorption, in order to eliminate it from the solar constant determinations. The recent developments of Dr. Langley's researches at Washington have led Mr. Abbot, who is associated with Dr. Langley in the work, to the conclusion that entirely satisfactory results can be obtained there by the method employed. The poor atmospheric conditions with which the Washington observers have so successfully contended, and the disturbances arising from ground tremors in the heart of a large city, would be largely eliminated at Mount Wilson. For this reason it seems probable that results of higher precision could be obtained at this site.

In addition to the above mentioned observations, provision will be made at Mount Wilson for various laboratory investigations necessary in conjunction with solar research. In view of the importance of securing a complete record of solar phenomena when magnetic storms are in progress, suitable magnetic apparatus, recommended by Dr. L. A. Bauer, in charge of the department of terrestrial magnetism of the Carnegie Institution, will be installed at a sufficient distance from the electrical machinery.

As no description of the Snow telescope has been published, the present brief account may be prefaced by a statement regarding the construction of the telescope.

In 1900, after Prof. Ritchey had succeeded Prof. Wadsworth as superintendent of instrument construction at the Yerkes Observatory, a cœlostat with mirror of 15 inches (38 cm.) aperture was made, from Prof. Ritchey's designs, for the total solar eclipse of that year. This gave such satisfactory results that the plan of constructing a large cœlostat was again taken up. Unfortunately, however, no funds were available for this purpose. In 1901, during a visit to the observatory of Prof. Cross, chairman of the Rumford committee, I showed him the details of the instrument, as worked out by Prof. Ritchey. The design called for a cœlostat of 30 inches (76 cm.) aperture, with second plane mirror of 24 inches (61 cm.) aperture, the latter mounted so as to slide north-east and south-west on rails lying east of the cœlostat. The concave mirror, to which the light was reflected from the second plane mirror, had a focal length of 61 feet, and a second concave mirror, of 165 feet (50·3 m.) focal length, was also to be used.

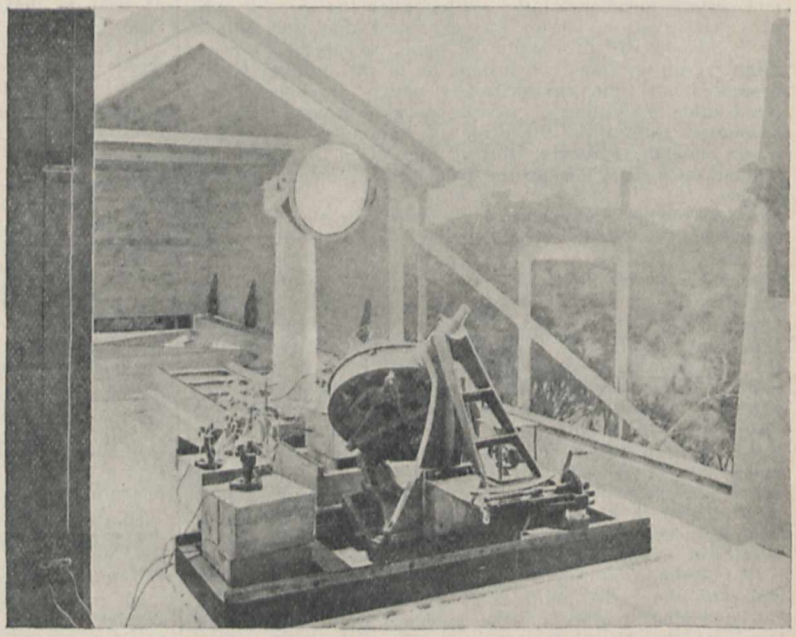

FIG. 1.—The Snow Telescope when mounted at the Yerkes Observatory.

At the kind suggestion of Prof. Cross, a grant of 500 dollars was made by the Rumford committee in aid of an investigation to be undertaken with this telescope. Subsequently, through the kindness of Prof. Pickering, chairman of the Draper committee, two other grants, of 500 dollars each, became available. With these funds, helped out by small amounts obtained from other sources, the work was begun.

A gift of 10,000 dollars from Miss Helen Snow, of Chicago, in memory of her father, the late George W. Snow, provided sufficient funds to complete the telescope and to instal it in a suitable house. The cœlostat was mounted on a brick pier, at a height of 15 feet (4·57 m.) above the ground. In Prof. Ritchey's design of the previous instrument the rays were reflected in a north-easterly direction from the cœlostat mirror to a second plane mirror, which sent them toward the south-west to one or the other of the concave mirrors. In designing the Snow telescope, a new arrangement of the second mirror was adopted by Prof. Ritchey, at the suggestion of Mr. C. G. Abbot. As Fig. 1 indicates, the light is reflected upward and to the south from the cœlostat mirror to a

second plane mirror, mounted in a fork at the upper extremity of an iron column, on a carriage which can be moved along heavy iron rails. The position of this carriage on the rails depends upon the declination of the observed object; with a low sun the second mirror stands close to the cœlostat, but with a high sun it must be moved away in order to intercept the reflected beam. The cœlostat itself may be moved east or west on its own rails, so that a low object near the meridian may not be hidden by the second mirror or its support.

With the exception of the solar and stellar spectroscopes, for which suitable gratings could not be obtained, the Snow telescope was practically completed in the autumn of 1903. On October 3 of that year it was formally presented to the University of Chicago by Miss Snow, in the presence of a number of guests.

In designing the new cœlostat house on Mount Wilson I was influenced by two principal considerations:—(1) The importance of placing the cœlostat as far as possible above the ground, which had been indicated by observations made with a telescope in a tree at elevations ranging from 20 feet to 70 feet; (2) the importance of constructing the house in such a way as to reduce to a minimum the heating and the radiation of the floor, walls, and ceiling, with the purpose of keeping the air within the house at the same temperature as the outer air.

The cœlostat, and the supports for the plane mirror and the 60-feet concave mirror, are now in place on the piers, but heavy storms have prevented the mirrors from being mounted. The concave grating stellar spectrograph is nearly ready to be set up, and work is well advanced on the smaller of the two spectroheliographs. The ultra-violet glass prisms and lenses for the stellar spectrograph have been completed by the Carl Zeiss Company, and orders have been placed for the optical parts of the 30-feet spectroheliograph and the Littrow spectrograph. Through the courtesy of the president and trustees of the University of Chicago, the Snow telescope and some of its accessories will be used by the Solar Observatory for some time. It will subsequently be replaced by a similar telescope constructed in our own instrument shop.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The following examiners have been appointed in the science schools:—in physics, Mr. W. C. D. Whetham; in anatomy, Mr. A. H. Young; in physiology, Mr. Leonard Hill; in pathology, Dr. E. W. Ainley Walker; in forensic medicine, Dr. A. L. Ormerod; in medicine, Dr. J. R. Bradford; in surgery, Mr. H. J. Stiles; in obstetrics, Sir Arthur V. Macan; in preliminary physics, Mr. C. E. Haselfoot; in preliminary chemistry, Mr. A. Angel; in preliminary botany, Prof. J. Reynolds Green.

The Burdett-Coutts scholarship for 1905 has been awarded to Mr. James A. Douglas, Keble College.

The Junior Scientific Club held its 276th meeting in the museum on November 8. Prof. Gotch exhibited the Gotch ophthalmic spinthariscope, and Dr. H. M. Vernon read a paper on the chemical constitution of protoplasm.

CAMBRIDGE.—The election of the well known scholar Mr. F. C. Burkitt, of Trinity College, to the Norrisian chair of divinity has a certain interest outside theological circles. It is, we believe, the first time that a layman has been elected to a chair of theology in the University of Cambridge. The Norrisian chair is open to laymen, but until this year has invariably been held by clergymen. That the heads of houses, who form the electing body, should have made this departure is perhaps a sign of the times.

Mr. C. T. R. Wilson, Sidney Sussex College, has been re-appointed demonstrator of experimental physics for a period of five years from Michaelmas, 1905.

On Monday, November 6, the following were elected to vacant fellowships at St. John's College:—Mr. J. W. H. Atkins, lecturer in English at the Victoria University, Manchester, and Mr. Frank Horton, for research in physics, 1903, Allen student, 1904; D.Sc. London and Mackinnon student of the Royal Society. Mr. Horton joined the university as an advanced student.

IN connection with Sir Donald Currie's offer of 20,000*l.* to Queen's College, Belfast, on condition that a similar sum is raised by those interested in the welfare of the college, President Hamilton announced on November 11 that subscriptions forthcoming to that date amount to nearly 16,000*l.* The remainder of the sum must be subscribed, according to Sir Donald Currie's conditions, before Christmas.

WE learn from *Science* that Mr. Andrew Carnegie has offered 20,000*l.* to Union College, for an engineering building, on condition that the institution raises a like amount for this purpose. Mr. Carnegie has also offered to give Smith College one-half of 25,000*l.* required for a biological laboratory. It is worthy of note that the first of the initial group of seven structures that form the new Carnegie Technical Schools, in Pittsburg, Pennsylvania, has been opened with a class of 120 students, selected from more than 600 applicants.

THE Department of Agriculture and Technical Instruction for Ireland will award in July, 1906, not more than ten open scholarships and ten limited scholarships to assist students of domestic economy to undertake the full course of instruction at the Irish Training School of Domestic Economy, Dublin. Scholarships will entitle the holders to free admission to the full course of training. The school is not residential, and no subsistence allowance is given. The scholarships will be awarded as the result of a competitive examination. Forms of application may be obtained from the secretary of the department after January 1, 1906.

A *Times* correspondent reports that the trustees of the Witwatersrand Council of Education have decided to dispose of a sum of 115,000*l.*, raised in 1899 to provide elementary education for the Uitlander community, in the following manner. The Transvaal Technical Institute is to receive 60,000*l.*, and 30,000*l.* is to be used to found a public school at Frankenwald on the lines of an English public school. The remaining 25,000*l.* will probably be divided between Jeppestown High School and Johannesburg College, but is held over until the publication of the report of the Government Commission on Secondary Education.

IT is announced that a school for post-graduate medical study, to be named "The London School of Clinical Medicine," is to be established by the Seamen's Hospital Society at the *Dreadnought* Seamen's Hospital, Greenwich. The hospital contains 250 beds, and by the addition of eminent members of the medical profession to the present staff, and by an affiliation for teaching purposes with other special hospitals south of the Thames, it is hoped that a complete curriculum for post-graduate study may be arranged. The new school will be complemental to the same society's School of Tropical Medicine at the Albert Dock, which has proved such a success.

AT the session of council of University College, London, on November 6, the following resolution was adopted and ordered to be communicated to Mr. Bawden and Mr. Speyer:—"That the most grateful thanks of the council be offered to Mr. E. G. Bawden and Mr. Edgar Speyer for providing and allotting the sum of 16,000*l.*—to be known as 'the Bawden Fund'—to the fund for advanced university education and research, thereby making up the balance of the sum of 200,000*l.* necessary to complete the financial arrangements for the incorporation of the college in the university. The council are of opinion that by promoting the incorporation of the college in the university they can most effectually realise the purposes for which the college was founded and can best advance the cause of learning and science. They therefore feel that they can congratulate Mr. Bawden and Mr. Speyer on helping to complete an arrangement that is likely to have a far-reaching influence in the furtherance of advanced education and research in London."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, July 20.—"The Influence of Phase Changes on the Tenacity of Ductile Metals at the Ordinary Temperature and at the Boiling Point of Liquid Air." By G. T. **Beilby** and H. N. **Beilby**, B.Sc. Communicated by Prof. J. Larmor, Sec.R.S.

The observations recorded in this paper are intended to prepare the way for a more direct attack on the problems of molecular cohesion by the establishment of clearer views as to the influence of changes of phase on the tenacity of ductile metals at various temperatures.

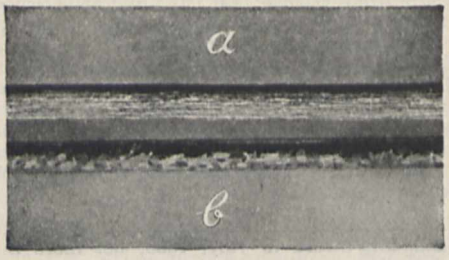

FIG. 1.

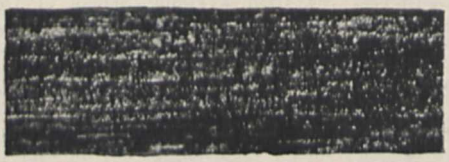

FIG. 2.

FIG. 3.

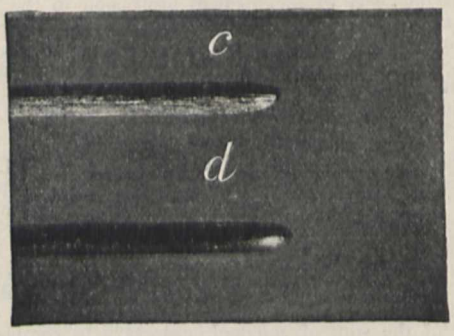

FIG. 4.

According to the phase theory of the hard and soft states in metals which was first developed by one of the authors more than a year ago, the changes of state from hard to soft and from soft to hard were shown to be due to the changes of phase brought about, in the one case by heat, and in the other by mechanical deformation or flow. In the ductile metals the crystalline is the mechanically unstable phase, while the amorphous only becomes thermally unstable when a definite temperature is reached.

The comparative mechanical instability of the two phases is well illustrated in the stretching of wires under tension. Annealed wires, which are in the **C** phase, stretch when they are stressed beyond the yield point; hardened wires, which are partly in the **A** phase, do not stretch—they break without extension when their limit of tenacity is reached.

The homogeneous **C** phase in ductile metals has no true breaking point—it yields and stretches when stressed beyond the elastic limit, and in so doing it passes partly into the **A** phase, and rupture occurs at the breaking point *of the mixed structure*. The tenacity of the mixed structure approaches, but never quite reaches, that of the homogeneous **A** phase. For the purpose the authors had in view it was necessary to obtain the metals as nearly as possible in this homogeneous condition.

Wire drawing was the means employed for the breaking down of the **C** phase. After a wire had been stretched to four or five times its original length by drawing it through the holes of a wire plate, all the ordinary traces of crystalline structure disappeared, but it still consisted of minute granules of the **C** phase embedded in a matrix of the **A** phase. Further drawing at the same temperature alters the mixed structure only slightly; for each temperature there appears to be a certain mechanical equilibrium between the phases. By lowering the temperature of drawing, the **C** phase is further broken down into still smaller granules, and the mixture approaches more nearly to the homogeneous **A** state.

(*a*) Fig. 1 is a photograph of a gold wire which has been etched after drawing The flow lines near the surface consist of rows of granules. (*b*) On the same photograph, shows the effect of heating another piece of the same wire to about 400°. Removal of the surface by etching now discloses the fully developed crystalline grains with their differently oriented lamellæ. The thermal transformation from **A** to **C** has taken place, and the wire is restored to the soft condition. Figs. 2 and 3 are photomicrographs at higher magnifications, which show the details of structure more fully. Fig. 2 is the granular structure by oblique light at a magnification of 250, and Fig. 3 is the crystalline structure by normal light at a magnification of 700.

The observations were made on wires which had been as completely as possible converted into the **A** phase by wire drawing at the ordinary temperature, and in every case the tenacity observed was higher than any which had been recorded by previous observers for equally pure metals.

	Tons per square inch
Gold. Purity—9,997 per 10,000	
Tenacity at 288° absolute (15° C.)	15·6
,, 53° ,, (−180° C.) ...	22·4
Silver. Purity—10,000 per 10,000	
Tenacity at 288° absolute (15° C.)	25·7
,, 53° ,, (−180° C.) ...	34·4
Copper. Purity—9,996 per 10,000	
Tenacity at 288° absolute (15° C.)	28·4
,, 53° ,, (−180° C.) ...	36·0

The wires broken at the ordinary temperature showed no general stretching. There was a slight extension of from ½ per cent. to 1 per cent., due entirely to a sharp reduction of diameter at the actual point of rupture. At the boiling point of liquid air all the wires stretched from 11 per cent. to 12 per cent. This stretching was uniform over the whole length between the grips. This was confirmed by exact measurements of the diameter at a number of points.

The appearance of the fractured ends revealed several points of interest. In every case the copper wires showed the cupped formation at the extreme end. This formation is evidently due to the lower tenacity of the central core, due to the presence of gas bubbles which have been drawn out into long tubes or cells. The silver wires occasionally showed a slight cupped formation, but in this case the gas bubbles to which it was due were globular, as if they had been evolved at the moment of fracture. The gold wires were practically free from sponginess, and the fractures were almost perfectly viscous (Fig. 4).

By drawing wires at the lowest possible temperatures the authors hope to obtain the ductile metals in their condition of maximum tenacity, and from the figures then

available to be able to calculate the molecular cohesion at the absolute zero.

July 29.—"Studies on Enzyme Action. VIII.—The Mechanism of Fermentation." By E. Frankland **Armstrong.** Communicated by Prof. H. E. Armstrong.

The experiments described, which were begun in the Carlsberg Laboratory, Copenhagen, were undertaken to ascertain, if possible, the manner in which the activity of the various organisms giving rise to alcoholic fermentation is dependent on, or influenced by, the enzymes which they contain. The action of twenty selected yeasts on each of the four hexose sugars glucose, fructose, mannose and galactose, and on the disaccharides cane sugar, maltose and milk sugar, was investigated. All the yeasts tested were able to ferment glucose, mannose and fructose, but quite a number were unable to ferment galactose. It is shown that inability to ferment galactose has nothing to do with the absence from the yeast of any one of the sucroclastic enzymes, since yeasts are to be found which are without action on galactose; in fact, the fermentation of glucose and galactose is brought about by different mechanisms.

The results further indicate that the power of a yeast to ferment mannose, glucose or fructose is clearly in no way conditioned by the presence of a particular sucroclastic enzyme; indeed, it would seem that the occurrence of alcoholic fermentation is altogether independent of the presence of an enzyme—whether free or fixed—able to induce the hydrolysis either of maltose or of sucrose.

The fact that the three hexoses which behave alike have one common enolic form is of utmost significance as an indication that the formation of the enol is the initial stage in the fermentation of the hexose, and that the breakdown of the molecule commences at the terminal carbon atom.

Chemical Society, November 2.—Prof. R. Meldola, F.R.S., president, in the chair.—Molecular conductivity of water: P. **Blackman.**—The stereoisomerism of substituted ammonium compounds: H. O. **Jones.** Wedekind's supposed β-phenylbenzylmethylallylammonium iodide is proved to be in reality *phenylbenzyldimethylammonium iodide.* At present optical activity is the only evidence of stereoisomerism of quinquevalent nitrogen compounds of the type N*abcd*,X, and the hypothesis suggested by the author (*Trans. Chem. Soc.*, 1903, lxxxiii., 1403), slightly developed, is adequate to explain all the known facts.—Note on the fluorides of selenium and tellurium: E. B. R. **Prideaux.** The fluorides of selenium and tellurium are gaseous substances, easily condensable by cold, forming white, snow-like solids. They have the formulæ SeF_6 and TeF_6.—The constitution of glutaconic acid: J. F. **Thorpe.**—Some alkyl derivatives of glutaconic acid and of 2 : 6-dioxypyridine: H. **Rogerson** and J. F. **Thorpe.**—Note on the formation of β-methylglutaconic acid and of αβ-dimethylglutaconic acid: F. V. **Darbishire** and J. F. **Thorpe.**—The influence of water and alcohols on the boiling point of esters. A modification of Markownikoff's method of preparation: J. **Wade.** The Markownikoff interaction proves on investigation to proceed in most cases readily at 100°, and in presence of any strong acid; it may be modified to afford a general and practically automatic method of preparing the lower alkyl esters of such acids as formic, acetic, propionic, and butyric.—Note on bromine fluoride: E. B. R. **Prideaux.** Fluorine when passed over bromine combines with it to form a pale yellow liquid, which freezes to a white solid, melting at −2°, and which probably has the formula BrF_3.—Solution and pseudo-solution: E. **Linder** and H. **Picton.** The authors discuss (1) the physical and chemical properties of colloidal arsenious sulphide; (2) the physical and chemical properties of colloidal ferric hydroxide; (3) dyeing, a phase of coagulation.—The influence of very strong electromagnetic fields on the spark spectra of ruthenium, rhodium, and palladium: J. E. **Purvis.** The general results showed that (1) most of the lines are divided into triplets, and that there is a periodic or rhythmic change in the direction of the vibrations of the constituents of the triplets; (2) some lines become quadruplets, and within certain definite regions of the spectrum their constituents also change the directions of their vibrations; (3) other lines become doublets; (4) the inner member of the triplets is usually the strongest; (5) the strongest spectral lines are not the most widely separated when vibrating in the field; and (6) the decrease in the width of the triplets does not proceed *pari passu* from the less to the more refrangible end of the spectrum.—A volumetric method of estimating the cinchona alkaloids by means of their double thiocyanates: P. W. **Robertson.** Notwithstanding the complexity of double salts of this type, the determination of the amount of thiocyanate removed from solution by the alkaloids forms an accurate and speedy volumetric method of estimating quinine in the commercial drugs and in the assay of the crude cinchona bark.—The osmotic pressure of sugar solutions in mixtures of alcohol and water: P. S. **Barlow.**

Mathematical Society, November 9.—Prof. A. R. Forsyth, president, in the chair.—The De Morgan medal was presented to Dr. H. F. Baker.—On improper double integrals and On the arithmetic continuum: Dr. **Hobson.** In the first of these papers necessary and sufficient conditions are obtained in order that a double integral, of which the integrand becomes infinite at an infinite number of points within the domain of integration, can be transformed into a repeated integral, so as to be capable of being evaluated by successive integrations with respect to two variables. The second paper deals with some criticisms by J. König levelled against the fundamental notions of the theory of sets of points and with the possibility of a general construction of all irrational numbers. It is shown how a general definition of all numbers rational or irrational can be obtained, and that the set of numbers constructed by means of the definition has the essential properties of the continuum, that is to say, it is at once "perfect" and "connected."—On the arithmetical nature of the coefficients in a group of linear substitutions of finite order (second paper): Prof. W. **Burnside.** An irreducible group of linear substitutions being given in any one of its possible forms, it may be possible to choose new variables so that, when expressed in terms of them, the coefficients of the substitutions belong to an assigned domain of rationality. The simplest domain of rationality for which this could be possible is that defined by the characteristics of the group. It is shown that, in general, apart from certain exceptional cases, it is possible to exhibit the group so that the coefficients belong to the domain of rationality defined by the characteristics. The result is obtained without introducing the theory of the reduction of the group when regarded as a permutation-group.—The continuum and the second number-class: G. H. **Hardy.** The paper is a reply to a criticism by Dr. Hobson of a construction for certain transfinite numbers given by the author in the *Quarterly Journal of Mathematics,* vol. xxxv.—On the asymptotic value of a type of finite series: J. W. **Nicholson.**—On an extension of Dirichlet's integral: Prof. T. J. I'A. **Bromwich.**

PARIS.

Academy of Sciences, November 6.—M. Troost in the chair.—On the mixed derivatives of dextrorotatory camphoric acid and on β-campholide: A. **Haller** and G. **Blanc.** The esterification of camphoric acid by methyl alcohol and hydrochloric acid gives poor yields, the acid ester being produced in considerable quantity. By treatment with phosphorus trichloride, the latter forms the corresponding chloride, from which the neutral ester can be quantitatively obtained by treatment with methyl alcohol. The compounds obtained by the action of ammonia and phenylhydrazine upon the chloride are also described, and the preparation of the β-campholide by the reduction of the neutral methyl ester with sodium. The yields of the latter ester are poor, and the attempt to prepare from it an isomeric cyanocampholic acid was not successful.—The evolution of the Tertiary mammals: the importance of migrations: Ch. **Depéret.** The author emphasises the importance of an exact study of the migrations of mammals at different periods in order to explain the appearance of a given group in strata not containing their immediate predecessors, and gives details for the Eocene fauna.—On recurrent convergent relations: Pierre **Boutroux.**—On a certain category of functions: H. **Padé.**—On the impossibility of negative impulse waves in gases: Győző **Zemplén.** An impulse wave is a surface propagated in a

gas the density and velocity of which undergo abrupt variations. Such a wave is not purely adiabatic, even when the gas is isolated from all sources of external heat. In the case of a positive wave the gas itself is a source of heat, and the entropy of the system increases; the inverse case is not possible.—Remarks on the preceding note: M. **Hadamard.**—Researches on gravitation: V. **Crémieu.** It is shown that it is possible to repeat the Cavendish experiment in liquids under conditions equal, if not superior, to those realised in air.—On the electrical conductivity of selenium: Maurice **Coste.** The selenium in these experiments was placed between gold plates 1 mm. apart. The gold has the advantage over other metals of not forming a selenide, the conductivity of which might interfere with the accuracy of the results. If the selenium is rapidly cooled, the resistance is above 50 megohms, but after annealing it falls to some thousand ohms. It has been found that to obtain a selenium that is very sensitive to the action of light it is necessary to have it in the metallic state in a form as compact as possible.—The determination of calorific conductivity: J. **Thovert.**—The ultra-violet spectra of the purins: Ch. **Dhéré.** Thirteen photographs were made on the same plate, the first being the comparison spectrum, the others the absorption spectra of the aqueous solution of the purin considered with progressively increasing thickness. Results are given for 6-oxypurin, xanthin, and uric acid.—On the reduction of oxides and on a new method of preparation of the compound $SiMn_2$ by means of aluminium: Em. **Vigouroux.**—Molecular transpositions and the migration of carboxyl in the dehydration of certain acid-alcohols: E. E. **Blaise** and A. **Courtot.** The ethyl ester of $\beta\beta$-dimethyl-β-phenylhydracrylic acid, under the influence of phosphoric anhydride, gives dimethylatropic acid. The removal of water in this reaction must have been preceded by the migration of the carboxyl group, and furnishes the first example of such a migration.—On the crystallography of a double compound of ammonium chloride and nickel bromide: Fréd. **Wallerant.**—Rheotropism of some hydroids: Paul **Hallez.**—Experiments on the toxicity of eggs: Gustave **Loisel.** The yolks of the eggs of the chicken, duck, and tortoise contain substances which, when injected into the veins, under the skin, or in the general cavity of the body, determine promptly the death of the injected animals.—Contribution to the study of Corti's organ: M. **Marage.**—On the nature of the pigments of the blood: MM. **Piettre** and **Vila.** The author has repeated Nencki's work on the composition of Teichmann's crystals, and obtains analytical results for the substance which vary with varying conditions of preparation, and hence concludes that the formula attributed to the substance is illusory.—Researches on the fatty acids. Experimental lesions: Jean **Camus** and Ph. **Pagniez.**—On the age of the Vire granite: A. **Bigot.**—On the parallelism of the Upper Eocene strata of Biarritz and Vincentin: Jean **Boussac.**—On the storm of July 4 in the district of Orleans: M. **Maillard.**

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 16.

ROYAL SOCIETY, at 4.30.—The Physical and Chemical Properties of Iron Carbonyl: Sir James Dewar, F.R.S., and H. O. Jones.—The Transit of Ions in the Electric Arc: A. A. Campbell Swinton.—First Photographs of the Canals of Mars: Prof. Percival Lowell.—On the Laws of Radiation: Prof. J. H. Jeans.—The Pressure of Explosions. Experiments on Solid and Gaseous Explosives: J. E. Petavel.—The Accurate Measurement of Ionic Velocities: Dr. R. B. Denison and Dr. B. D. Steele.—On Newton's Rings formed by Metallic Reflection: Prof. R. C. Maclaurin.—The Electrical Conductivity of Dilute Solutions of Sulphuric Acid: W. C. D. Whetham, F.R.S.

CHEMICAL SOCIETY, at 8.30.—Silicon Researches, Part ix., Bromination of Silicophenyl Imide and Amide, and Formation of a Compound including (SiN): J. E. Reynolds.—Condensation of Ketones with Mercury Cyanide: J. E. Marsh and R. de J. F. Struthers.—Application of the Microscopic Method of Molecular Weight Determination to High Boiling Solvents: G. Barger and A. J. Ewins.—Green Compounds of Cobalt produced by Oxidising Agents: R. G. Durrant.—Synthesis of Tertiary Menthol and of Inactive Menthene: W. H. Perkin, jun.—Optically Active Reduced Naphthoic Acids, Part i., Dextro-$\Delta^{(2 \text{ or } 3)}$-dihydro-1-naphthoic Acid: R. H. Pickard and A. Neville.

LINNEAN SOCIETY, at 8.—Contributions to the Embryology of the Amentiferæ: Dr. Margaret Benson, Elizabeth Sanday and Emily Berridge.—On the Ears of certain Sharks: Prof. Chas. Stewart, F.R.S.

FRIDAY, NOVEMBER 17.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Seventh Report to the Alloys Research Committee; On the Properties of a Series of Iron Nickel-Manganese-Carbon Alloys: Dr. H. C. H. Carpenter, R. A. Hadfield, and P. Longmuir.

MONDAY, NOVEMBER 20.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—First Exploration of the Hoh-Lumba and Sobson Glaciers (Himalaya): Mrs. F. B. Workman.

SOCIOLOGICAL SOCIETY, at 8.—The Origin and Function of Religion: A. E. Crawley.

TUESDAY, NOVEMBER 21.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—Exhibition of Photographs of North American Indians: J. S. Chase.—Boomerangs: N. W. Thomas.

INSTITUTION OF CIVIL ENGINEERS, at 8.—On Waterways in Great Britain (*Discussion*): J. A. Saner.

WEDNESDAY, NOVEMBER 22.

GEOLOGICAL SOCIETY, at 8.—On a New Specimen of the Chimæroid Fish *Myriacanthus paradoxus*, Ag., from the Lower Lias of Lyme Regis: Dr. A. Smith Woodward, F.R.S.—The Rocks of the Cataracts of the River Madeira, and the adjoining Portions of the Beni and Mamoré: Dr. J. W. Evans.—The Doncaster Earthquake of April 23, 1905: Dr. C. Davison.

SOCIETY OF ARTS, at 8.—The Cinematograph and its Applications: F. Martin-Duncan.

THURSDAY, NOVEMBER 23.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* On the Nature of the Galvanotropic Irritability of Roots: Dr. A. J. Ewart and Miss Bayliss.—Some Observations on *Welwitschia mirabilis*, Hooker-f.: Prof. H. H. W. Pearson.—On the Effects of Alkalies and Acids, and of Alkaline and Acid Salts, upon Growth and Cell Division in the Fertilised Eggs of *Echinus esculentus*; a Study in Relationship to the Causation of Malignant Disease: Prof. B. Moore, Dr. H. E. Roaf, and E. Whitley.—A Note on the Effect of Acid, Alkali, and Certain Indicators in Arresting or Otherwise Influencing the Development of the Eggs of *Pleuronectes platessa* and *Echinus esculentus*: E. Whitley.—On Certain Physical and Chemical Properties of Solutions of Chloroform and other Anæsthetics. A Contribution to the Chemistry of Anæsthesia. (Second Communication): Prof. B. Moore and Dr. H. E. Roaf.—(1) On the Possibility of Determining the Presence or Absence of Tubercular Infection by the Examination of a Patient's Blood or Tissue Fluids: (2) On Spontaneous Phagocytosis and on the Phagocytosis which is obtained with the Heated Serum of Patients who have responded to Tubercular Infection, or as the Case may be to the Inoculation of a Tubercle Vaccine: Dr. A. E. Wright and Staff-Surgeon S. T. Reid, R.N.—On the Occurrence of the Heterotypical Mitosis in Cancer: Dr. E. F. Bashford and J. A. Murray.

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