THURSDAY, AUGUST 13, 1903.

THE UNIVERSITY IN THE MODERN STATE.

V.

SINCE the earlier articles under the above heading appeared, the views we have attempted to express touching the importance of universities in the lives of States and even of Empires from a national or political, as well as from an academic point of view, have been strengthened in a remarkable manner by the inauguration of a new movement in relation to the universities of the British Empire.

The important departure to which we refer is due to the initiative of Sir Gilbert Parker, and was recently discussed at a conference in London, at which official representatives, specially approved by every one of the governing bodies of degree-conferring universities throughout the Empire, including Canada, Australia, New Zealand, and the Cape of Good Hope, as well as the home institutions, were present. By the kindness of one of the delegates we were enabled to give an account of what took place at the time. The publication of a full account of the proceedings, which has now appeared in the *Empire Review*, enables us to enter into some details.

One of the most important and interesting announcements made during the meeting, showing how much may spring from a closer union of university with other national aims, was made by Sir John Buchanan, the Vice-Chancellor and delegate of the Cape of Good Hope University, who reported that the first step to the union of the different States of South Africa had been accomplished by the Cape University, which this year, for the first time, had conducted its examinations in each of the five States of South Africa at the request of the Governments of the several States.

Now that this conference has taken place, we are in a position to gauge its importance. There is no question that a movement has been begun which is bound to go on from strength to strength; which, if the committee appointed does its work thoroughly, will bring all information bearing upon our university organisation together, and so enable a levelling up process to go on. Nothing is more distressful in English history than the way in which, since the introduction of scientific processes into modern civilisation, our schools and universities, for want of proper endowment for the new learning, have failed to provide the scientific spirit and the brain power which are now recognised as the most important weapons in a nation's armoury, and with which, to our detriment, the competing nations are now so fully equipped.

The Prime Minister in his admirable speech at the inevitable dinner left no doubt as to the origin of our present backwardness. While properly pointing out that the collective effect of our public and secondary schools upon British character cannot be overrated, he frankly acknowledged that the boys of seventeen or eighteen who have to be educated "do not care a farthing about the world they live in except in so far as it concerns the cricket-field or the football-field or the river." On this ground they are not to be taught science, and hence, when they proceed to the university, their curriculum is limited to subjects which were better taught before the modern world existed, or Galileo was born.

The first great result of the conference was the distinct recognition of the importance of arrangements for the mutual benefit of all the academic bodies in the Empire, and this complete agreement is all the more satisfactory at a time when the question of fiscal arrangements is dividing the country into two hostile camps. Again, the absence of such academic arrangements at present was shown to be detrimental. Unlike the fiscal problem, therefore, on the proper discussion of which much time may be spent, the university problem may be tackled at once, and we need not delay to profit by any benefits it may bring.

The resolutions passed at the conference were as follows:—(1) In the opinion of this conference it is desirable that such relations between the principal teaching universities of the Empire should be established as will secure that special or local advantages for study, and in particular for post-graduate study and research, should be made as accessible as possible to students from all parts of the Empire. (2) That a council consisting in part of representatives of British and colonial universities be appointed to promote the objects set out in the previous resolution, and that the following persons be appointed a committee to arrange for the constitution of the council:—Lord Kelvin, Lord Strathcona, Mr. Bryce, M.P., Mr. Haldane, M.P., Sir William Huggins, Sir Michael Foster, M.P., Sir Oliver Lodge, Sir A. Rücker, the Rev. Dr. Mahaffy, the president of Magdalen College, Oxford, the president of Queens' College, Cambridge, the Hon. W. P. Reeves, and Sir Gilbert Parker, M.P.

One of the most important matters raised in connection with the first resolution was the value of the education imparted in the British universities in relation to those of other countries. Sir John Buchanan told the conference that they were endeavouring at the Cape to send their best graduates abroad for further training, "and it was much to be regretted that at present those students could not always get what they sought for in the mother country."

In the United States, where the university system is more complete and far better endowed than with us, the students who wish to go afield for further study do not come to Britain, they go to Germany or France, and before we can expect colonial students to come to the mother country exclusively, our university system will require to be brought up to date, which can only happen when many millions are available for proper endowments, in other words, when the principle of State endowment already accepted has been effectively acted upon.

If one effect of the conference is to bring this home to the minds of those who have to deal with such matters, it will have already accomplished an important work when as great freedom and facility for study and research can be obtained within the King's dominions as are available elsewhere.

That the facilities referred to by the colonial university authorities included ample means for the prosecution of original research was made perfectly

clear, and to this part of the inquiry Prof. Ewing contributed a most important statement as to the educational value of research as demonstrated by his experience at Cambridge. We may hope that at least after thirty years' debate this matter can be considered settled. In the language of our correspondent, "Since Germany has given to our disadvantage a definite experimental proof of the success of research as an instrument of education, the delegates probably felt that the matter had gone beyond the range of academic discussion."

When once this idea of the proper function of universities is re-established and in full operation, not only at Oxford and Cambridge, but in many other British universities, it may happen that not everybody will agree with Mr. Balfour's comparisons between the old and the new seats of learning.

"I daresay that many of us have looked back with a certain regret, and a certain feeling of shame, to the medieval passion for learning without fee and without reward—with no desire to make the universities stepping-stones to good places or to successful mercantile or industrial undertakings—but with an ideal which made thousands of students from every country in Europe undergo hardships which would be regarded in these softer days as absolutely intolerable, for the sole purpose of seeking, and it might be finding, the great secret of knowledge. We despise, and we perhaps rightly despise, their methods. We know that they were not in touch with the actual realities of the world in which they lived. Yet, after all, we have something to learn from them; and if we in these days could imitate their disinterested passion for knowing and for extending the bounds of knowledge, surely we, with our better methods, and our clearer appreciation of what we can know and what we cannot know, might accomplish things as yet undreamed of. Now, what did they do? They moved from university to university, from Oxford to Paris, from Paris to Padua, from country to country, in order that they might sit at the feet of some great master of learning, some great teacher who might lead their thoughts into undreamed of paths. I hope that in the universities of the future every great teacher will attract to himself from other universities students who may catch his spirit—young men who may be guided by him in the paths of scientific fame; men who may come to him from north or from south."

We agree as to the facts as to the past, but it is not the carelessness and greed of the modern student that are in question, but rather the decadence of our universities, which are no longer seats of learning in the old sense, that is, they do not supply the knowledge most useful to those who attend them in relation to the needs of the time. They are chiefly conducted as playgrounds for the sons of the rich, learning is too little endowed, and great teachers are too little encouraged, especially in the matters in which the modern world is concerned.

If only students of science found at our universities of to-day what students of theology, law, medicine, and *les trois langues*, found in the old time at all universities, that is, perfect teaching, and the endowment of research at the university itself, things might be righted, and, as of old, many fitted for the battle of life would go out into the world to apply their knowledge as did their forerunners, and show neither more nor less "disinterested passion" than the well paid ecclesiastics, lawyers, and doctors of the past.

It is because the universities of Germany, France, and the United States, aided by wisdom and endowments, conform to the old ideal, while our ancient ones remain as *hauts lycées*, as Matthew Arnold called them, and our modern ones are crippled for want of funds, that the students of both Britain and Greater Britain find an advantage in going abroad to build up their brain power.

It is to be hoped that as a result of the conference the educational federation of the Empire will some day be brought about. It must not be forgotten that the first step in this direction was taken when the Royal Commissioners for the Exhibition of 1851 founded its research scholarships, in which every university in the Empire has a share—a share which it has fully used, and with the best effects. That other similar scholarships should be founded by the different Governments and private individuals may be one of the results of the conference.

Our plea for better brain power for the nation was not lost sight of in the deliberations, and we may fitly conclude by the following quotation from a speech by Mr. Haldane, which brought the discussion to a close.

"To-day we are a step further on towards doing that which, as a people, as the great English-speaking people, we need more than anything else. We have got the splendid energy of our race, we have got the power which is ours, in a unique degree, of adapting ourselves to new conditions, of overcoming difficulties which to others might even seem to be insurmountable, and yet we have been deficient in the capacity of organisation. What we have lacked in this country, somehow, has been the thinking faculty, and it is the work of education to develop the thinking faculty in a nation. And never before was the thinking faculty so much needed as to-day when the weapons which science places in the hands of those who engage in great rivalries of commerce leave those who are without them, however brave, as badly off as were the dervishes of Omdurman against the Maxims of Lord Kitchener."

THE SPECTROSCOPE IN ASTRONOMY.

Problems in Astrophysics. By Agnes M. Clerke. Pp. xvi+567. (London: A. and C. Black, 1903.) Price 20*s.* net.

THE triple alliance of astronomy, physics and chemistry has extended the boundaries of each in unexpected directions. Astronomy is no longer a dependency of mathematics, but an independent power having a high place in the hierarchy of the physical sciences; instruments of research in physics have been turned from earth to sky, and chemistry now looks to the stars for evidence as to the distribution and ultimate structure of the elements.

The spectroscope is the chief means by which these new territories have been gained for science and explored, and the photographic plate has not only been its faithful scribe, but has also gained distinction as an astronomical artist. Individually and jointly, the prism and the camera have increased our knowledge of the nature and number of all classes of celestial

objects. The general study of the solar spectrum has given way to investigations of the sun in detail; and spectrum analysis now not only reveals the constitution of the stars, but measures their movements with an exactitude impossible by any other means. The light of nebulæ has been shown to be but the manifestation of molar activity having a vastly greater sphere of influence than that suggested by the visible limits; and nebulæ themselves, from being regarded as a peculiar class of celestial bodies, have been linked to stars and shown to be the amœbæ in a scheme of inorganic evolution.

The story of this development is related by Miss Clerke in the exuberant style with which all readers of astronomical literature are familiar. The first part of her book, occupying about one-third of the whole, is devoted to the sun, and the remainder to sidereal physics. Among the subjects of chapters in the former part are peculiarities of the solar spectrum, the reversing layer, the spectrum of sun-spots, the chromospheric spectrum, the sun's rotation, and the solar cycle. The forty-one chapters of the second part deal with many varieties and characteristics of stars and nebulæ, the subjects including helium stars, carbon stars, the spectra of double stars, rotation of the stars, spectroscopic binaries, dark stars, star clusters, nebulous stars, variable nebulæ, the nature of nebulæ, and the physics of the Milky Way.

For the collection and analysis of contributions to the study of these and other problems in astrophysics, Miss Clerke merits the thanks of astronomers. As is the case with every branch of science in its youth, questions arise much faster than they can be answered, and it requires a fine critical faculty to separate results of transient value from those of significance to scientific progress. The historian has to decide what things matter and what may be neglected when considered from the point of view of their influence upon development; and success is achieved when this power of discernment is combined with insight which enables the relationship to be seen between cause and consequence.

With the best desire in the world to give Miss Clerke credit for her work, we must confess to a feeling that it is not altogether satisfactory. In the first place, the net which she has used in her explorations of astronomical literature is of too fine a mesh, so that she has gathered in results and ideas which ought to have been discarded as being of little value, or immature. Next, as we shall show later, she has not understood the real nature of some of the material collected; and finally, she passes judgment and gives advice on matters which can only be rightly understood by investigators actively engaged in spectroscopic work.

A man who has had a scientific training can quickly grasp the essential points of progress in any branch of natural knowledge if they are brought before his notice, but he will rarely venture on criticism of results, or lay down the lines of further research unless he has a personal and practical acquaintance with the subject. Miss Clerke does not always exercise the same caution, with the result that she sometimes labours the obvious. Her function as an historian is to assimilate and describe, and when she is exercising her talents in this direction she is at her best. She surveys the work from the point of view of the spectator, and should describe fairly and clearly what she sees, without irritating the men who are doing the work by expressing her opinion upon it or suggesting what course they ought to take next. In other words, she should remember that "Passengers are respectfully requested not to speak to the man at the wheel."

In preparing a statement of the position of fact and theory in any branch of science, great care must be exercised, and not a single assertion should be made without substantial reason for it. A cynic has said that it is a characteristic of women to make rash assertions, and in the absence of contradiction to accept them as true. Miss Clerke is apparently not free from this weakness of her sex. Referring to the line 1474 K she says (p. 117):—"Eclipse-spectrographs do not include it, while they have afforded some other quite unexpected results." An examination of spectrum photographs of the eclipses of 1893, 1896, and 1898 would have shown Miss Clerke that 1474 K is included in all of them. There are other instances in which statements of an *ex cathedra* character are made without a full appreciation of the facts. Thus, the identification of a "dozen and upwards" chromospheric lines in the spectra of krypton and xenon (p. 120) is doubtful, to say the least; and the Stonyhurst origins referred to on p. 187 in connection with the spectrum of γ Cassiopeiæ are in the same case. Again, in the table of nebular lines on p. 477, the line at λ 4122 has a note of interrogation placed after the word helium indicating its origin, though there is practically no doubt that the line is helium λ 4121. Moreover, the line λ 4715, said to be of origin "unknown," is really the helium line λ 4713·3.

It is in such matters as these that Miss Clerke shows she is not a working spectroscopist possessing an intimate acquaintance with the subjects she describes. The result is that she is led to pass unsound judgments, and to be satisfied with an imperfect record of the facts available. Thus, on p. 48, in considering the relation of the chemistry of the chromosphere to the depth she quotes a paper by Mr. S. A. Mitchell, but makes no reference to the Royal Society report on the 1893 eclipse, where a full discussion of the conditions is given. Again, for evidence of the existence of more than one gas in the solar corona reference is made (p. 131) to a paper by Mr. S. J. Brown, but a note on the discussion of the photographs of the 1898 eclipse, presented to the Royal Society and published in the *Proceedings* (vol. lxvi. p. 189), is not mentioned, though it shows that three groups of lines, indicating three gases, are recognisable in the corona spectrum.

Miss Clerke demurs to the late Prof. Rowland's conclusion that there is no fundamental difference between solar and terrestrial chemistry. "*Quantitative*, if not *qualitative*, dissimilarity must," she believes, "be recognised"; and she instances titanium among other elements which are clearly represented in the solar spectrum, and yet are scarce here. Titanium is more widely distributed than Miss Clerke supposes, but, even if it were extremely rare, her

suggestion as to the relative amounts of this and other elements existing in the sun and earth is misleading. Remembering that nothing is known of the chemical constitution of the earth a few miles below the surface, it is possible that rare elements in the crust may be abundant nearer the centre. The differences between solar chemistry as manifested by the solar spectrum, and terrestrial chemistry as represented by mineralogical knowledge, are therefore only apparent, and Rowland was justified in his remark, "were the whole earth heated to the temperature of the sun, its spectrum would probably resemble that of the sun very closely."

The distinction between spark and arc spectra is not sufficiently recognised, with the result that unsound judgments are sometimes reached. A case of this kind occurs in connection with the discussion of the chromospheric spectrum. The green line of the chromosphere is coincident with one of the members —due to iron—of the triplet known as Kirchhoff 1474 in the Fraunhofer spectrum. Miss Clerke says:—

"Now the chromospheric ray agrees in position with the iron line, which is one of secondary importance; yet it cannot at present be asserted confidently that it really emanates from glowing iron vapour. If it did it should be ordinarily associated with other iron lines, and none have been ascertained to make part of the fundamental chromospheric spectrum."

If the spark spectrum of iron had been considered instead of the arc spectrum, these remarks would, we think, have been modified. The iron line at 1474 K is not of secondary importance in the spark spectrum; indeed, the fundamental chromospheric spectrum consists largely of iron lines—not the ordinary lines of the arc spectrum, but lines such as those at λλ 1474 K, 5018, 4924, 4584, and 4233, which are enhanced in relative importance in passing from the arc to the spark.

In connection with the subject of the temperature of the stars, the behaviour of lines of magnesium at different temperatures is referred to. Other conditions being the same, the magnesium line 4352 becomes finer with increase of temperature, while that at 4481 becomes thicker, and this opposite behaviour provides a test of increasing or decreasing temperature. But it is not pointed out that the test must be applied with caution; for the line 4352 in the spectra of hot stars is not due to magnesium, but is really an enhanced line of iron. If 4352 in the hot stars were a magnesium line, then other lines of the same series ought to be present, but they are not.

The chapter on new stars is characteristic of a large part of the book. Details are given of observations of new stars from Nova Aurigæ to Nova Persei, but the record can scarcely be described as complete, and the chief lesson taught by Novæ is overlooked. Many years ago, Sir Norman Lockyer expressed the view that "new stars, whether seen in connection with nebulæ or not, are produced by the clash of meteor swarms." When this conclusion was arrived at, few precise observations of the spectra of Novæ were available, but it is not too much to say that visual and photographic inquiries made since then into the phenomena of new stars have substantiated it in a very remarkable manner. By the meteoritic hypothesis, new stars approximate to nebulæ as they fade, until their light at the last stage is indistinguishable from that of a nebula. This association of new stars with nebulæ is now an accepted fact, but the consequences have not been so clearly acknowledged. As a new star reverts to the condition of a nebula when it cools, evidently nebulæ are not masses of gas at transcendental temperatures. Just as in biology, the course of evolution is traced in the development of the embryo, so we may consider that in its brief life a new star passes in some respects through the various stages which mark the growth and decay of worlds.

The spectroscopic history of Nova Aurigæ was a surprise to astronomers, who regarded the meteoritic interpretation of the phenomena of new stars as a hypothesis of doubtful validity. For, though there might be a difference of opinion as to the meaning of the displacement of the bright and dark lines in the spectrum, there could be none on the fundamental fact that the Nova became a planetary nebula, both visually and spectroscopically, as it sank into obscurity; and this course of events was precisely that previously found to have been exhibited by new stars which had been subjected to spectroscopic analysis. Rarely has hypothesis received such decided confirmation, but Miss Clerke does not even mention the paper in which it is put forward. The history of several new stars is concluded with words to the effect that "the regular cycle had been run through: a planetary nebula replaced the faded star," but there is no reference to the analysis of spectroscopic records before Nova Aurigæ, which showed that the reversion to a nebular type is a common characteristic of new stars.

The case of Nova Persei is of even greater significance from the point of view of cosmogony than that of Nova Aurigæ, for its light revealed the existence of vast areas of dark matter in interstellar space. Miss Clerke describes the vicissitudes through which the object passed, and the apparent expansion of the nebula associated with it. With regard to this phenomenon we read:—

"An explanatory hypothesis of considerable plausibility was hit off independently by Prof. Kapteyn and Mr. W. E. Wilson.[1] It affirms the nebula to have been pre-existent, and to remain unchanged. But since we see it by the unchanged light of the Nova, its various spires and condensations have come successively into view as the flare of the explosion travelled outward in widening circles. Hence an illusory effect of radial expansion was produced, while in point of fact, the temporarily illuminated cosmic folds were as immovable as aligned snow-peaks, in turn set aglow by the setting sun."

In other words, cosmic dust, or meteoritic particles, or dark nebular matter—whatever you care to term it—existed in the part of space in which the new star made its appearance. The fundamental idea of the meteoritic hypothesis is here accepted, and its application to the phenomena of new stars acknowledged. Astronomers have, in fact, been driven to the belief in the existence of sheets or streams of non-luminous matter in space; and dark nebulæ, as Prof. Turner has termed them in an article in the *Fortnightly*

[1] NATURE, January 30, 1902.

Review, are no longer considered hypothetical, but as real as dark stars.

A new class of celestial bodies has thus been brought under notice, and Miss Clerke does not sufficiently appreciate its significance. This, however, is a matter of opinion, but surely for the sake of historical completeness she might have mentioned that the association of nebulæ with new stars was first put forward in the meteoritic hypothesis. She is careful to give credit in most cases, but in connection with Nova Persei no reference is made to the fact that Sir Norman Lockyer first suggested in these columns that the dark nebula existed before the star appeared. In the issue of December 12, 1901, he wrote:—

"It is impossible to think that the great nebula which has now been photographed while the new star is still in being did not exist there a few months ago; and it is important, further, to remark that the nebulous matter already photographed in the region round the Nova is very probably only a portion of the actual amount of matter existing there, and that if the disturbances continue, more of the remaining portion may become visible."

Here we have a definite statement of the pre-existence of the dark cosmic matter in the neighbourhood of Nova Persei before the new star became visible, but it has been overlooked by Miss Clerke. This is to be regretted because, a few years hence, astronomers will be just as interested in knowing how the idea of dark nebulæ passed from hypothesis to demonstration as we are in Bessel's discernment of the existence of dark companions of Sirius and Procyon before these bodies came within the sphere of astronomical discovery.

One other point connected with Novæ is worth mention. In the description of the spectrum of Nova Aurigæ it is stated that "an exceptional feature was the predominance of 'green' helium; D_3 and the rest of the lines belonging to the 'yellow' set were comparatively faint; while λ 4922, λ 5016 and their fundamental λ 6678, shone lustrously." An unnecessary difficulty is raised in the attempt to account for the appearance of these lines in the Nova spectrum; for the first two lines mentioned were really not due to helium, but were enhanced lines of iron at λ 4924 and λ 5018. This identification does not rest solely upon these two lines, for other enhanced lines of iron appeared in the spectrum of the Nova.

Other details upon which there are differences of opinion might be mentioned, but no useful purpose would be served by doing so. In directing attention to the various points referred to in the foregoing remarks, the object has been to show that, though Miss Clerke writes with exceptional facility and grace, she is not an infallible guide, and has a tendency to works of supererogation. Notwithstanding this, we do not hesitate to say that, by writing the record of astrophysics, she has done a great service to astronomers. Her book makes it possible to obtain a view of the chief fields in which astronomical inquiries are now being carried on, and of the achievements which have been reached. To readers interested in the progress of knowledge relating to the sun, stars and nebulæ, whether they are laymen, or men of science so deeply engrossed in other investigations that they have not been able to keep in touch with astronomy, the book will be a revelation. Those who are engaged in the work of astrophysics will be saved many hours of tedious research among scientific books and papers by this chapter from the history of science.

R. A. GREGORY.

THE GERMINAL LAYERS OF THE VERTEBRATA.

Furchung und Keimblattbildung bei Tarsius Spectrum. By A. A. W. Hubrecht. Pp. 115 + plates. (Amsterdam: Müller, 1902.)

EMBRYOLOGISTS will certainly unite to congratulate Prof. Hubrecht on the completion of this memoir. To have obtained and figured a complete series of developmental stages of any animal is in itself no mean achievement, but when this animal is one of the rarest of mammals, procurable only in a distant quarter of the globe, we may well wonder at the persevering patience which has succeeded in overcoming difficulties which, to an ordinary worker, would have been insurmountable.

Tarsius has always been regarded as a member, though a very aberrant member, of the Lemuroidea. The embryological evidence which has now been brought before us is practically conclusive in favour of its removal from this suborder. The placentation is most pronouncedly of the so-called "deciduate" type, while the arrangement of the fœtal membranes, with the diminutive yolk-sac, rudimentary allantois, and large extra-embryonic cœlomic space, is identical with that found in man and monkeys, but nowhere else.

The placenta, and the important changes leading to the formation of the "Bauchstiel"—so long a puzzle to human embryologists—have already been the subjects of two publications by Prof. Hubrecht. In the present treatise we are introduced to the processes of maturation, fertilisation, segmentation, the histology of the formation of the amnion, and, above all, to the germinal layers.

First to appear are the above-mentioned extra-embryonic cœlom and the yolk-sac. The material for the former springs from the posterior end of the blastoderm. In continuity with it is formed the primitive streak in the centre of which is the rudimentary blastopore or neurenteric canal. The mesoblast, however, is also formed from an anterior tract of hypoblast (as frequently in Amniotes) and from a peripheral ring (as described by the author in Sorex).

These facts, admirably illustrated by a very complete set of figures, form the basis for some very bold speculations. The germ layers of the Vertebrata have proved a stumbling-block to many an embryologist. The solution of the problem here proposed (due originally to van Beneden, and first expounded in Oxford) is one which cuts all the old ground from under our feet. We are taken back, not to Amphioxus, or even to an Annelid, but to a Cœlenterate, and asked to see in the gastrovascular cavity and stomodæum of this, the latest ancestor of all the Vertebrates, the forerunners of the blastopore and notochord respectively Such a theory involves the assumption that the

archenteron communicates with the segmentation cavity in all Anamnia, which is hardly the case; on the other hand, it seems to get over the difficulty of deriving the conditions found in the Amniotes from those observed in lower forms.

We imagine, however, that few morphologists will accept so imaginative an hypothesis. It is not difficult to explain the differences between these two great divisions of the Vertebrates more logically by reference to the Gymnophiona. But putting that aside, it is open to grave doubt whether it is possible to attach any phylogenetic significance, any morphological value in the determination of homologies, to the germ-layers of the Vertebrates, or, indeed, of any other group. Their significance is rather physiological, and can only be analysed by the ordinary physiological methods of observation and experiment.

PSYCHOLOGICAL STUDIES.

Harvard Psychological Studies. Vol. i. Edited by Hugo Münsterberg. Pp. 654. (New York: The Macmillan Company, 1903.)

THIS, the fourth volume of monograph supplements to the *Psychological Review*, consists of sixteen papers by the students of the Harvard School of Psychology, fifteen of which represent the principal results of the work done in the laboratory in the last few years. Most of the papers show, properly enough, the influence of Prof. Münsterberg's vigorous and original mind, and it is no doubt owing in part to his teaching and direction that each of the researches deals with a well-defined problem by appropriate and original methods. But the individual workers have preserved their independence, and the standard of treatment and achievement reached is in all cases a high one.

Of six studies in perception, Mr. Holt's explanation of the bands seen on passing a rod across the surface of a rapidly rotating disc bearing coloured, or black and white, sectors, is an admirable example of neat and convincing experiment. Of three studies in memory, those of Messrs. Meakin and Moore are interesting as achieving valuable results by systematically conducted introspective observation of the primary memory-image. Even the "purest" and most old-fashioned psychologist could hardly raise objection to their procedure. Their results suggest that much valuable knowledge is to be gained by those who have the patience to follow up this line of research, but the absence of all objective control of the results makes the method a dangerous one, unless subjects innocent of psychological theory can be found to carry out the introspective observations.

Of four studies in æsthetic processes, the principal are elaborate and ingenious researches on the constitution of objective rhythm-forms and on symmetry. In the case of the latter, the experimental conclusions are supported by analyses of pictorial compositions ranging from the ornamental designs of primitive people to the altar-pieces of Raphael. In two studies in animal psychology, Mr. Yerkes breaks new ground by registering accurately the reaction-times of the leg of the green frog in response to a variety of stimuli, and he shows that the frog and the crayfish are alike capable of learning by experience, of acquiring new associations, though but slowly; he thus refutes the view that they are but unconscious automata, a view that has been based on the belief that they are devoid of such capacity.

The volume is completed by a short paper in which Prof. Münsterberg briefly restates the main conclusions reached in his "Grundzüge der Psychologie" (Leipzig, 1900). He claims that under the term psychology two fundamentally different sciences are commonly confused together; the one treats of "the inner life as objective content of consciousness, as phenomenon, the other of the inner life as subjective attitude, as purpose." The former science is descriptive and explanatory, those who pursue it are "phenomenalists"; the psychical objects with which they deal are abstractions, comparable to the physical objects dealt with by the physicist. The other science, improperly called psychology, is "voluntarism"; it is teleological and interpretative, but not explanatory, it includes the normative and historical sciences, and gives "a more direct account of man's real life than psychology can hope to give." These remarks prepare the way for a comprehensive tabular classification of all the sciences, which, whether it be found acceptable or no, is certainly novel and extremely interesting.

W. McD.

OUR BOOK SHELF.

A Gloucestershire Wild Garden. By the Curator. Pp. xii+230. (London: Elliot Stock, 1903.) Price 6*s.* net.

GARDENING books are becoming noted for containing a small amount of gardening information largely diluted with something that has little or no relevance to horticultural pursuits. The diluting medium may be cookery or hygiene, tirades against vivisection, stale jokes, spiritualism, anything, in fact. In the present book gardening, or one phase of it, represents the slices of bread between which are inserted, sandwich-fashion, dissertations on the molecular structure of the brain and nerve centres, and discussions on the origin of thought and the nature of religious impressions.

The "Curator" is the gardener who evidently knows plants and loves them. To him appear when he is tired of work, or, at any rate, without preface or apology, a somewhat prosy "Professor," who supplies the anatomical details above mentioned, and explains them from the materialistic standpoint, and an orthodox "Padre," who is somewhat shocked at the views propounded by the professor. The Curator acts as moderator, and when discussion seems likely to become dangerous, suggests a pipe of tobacco or a cup of tea as effectual "shunters." At any rate, we pass abruptly from metaphysical subtleties either to the tea-table or to another chapter, in which we are told how to construct a "wild" garden. As if all this were not enough, a love story—a very short one—is introduced, and so the book has one quality which a garden should possess, and that is, variety.

The author tells us that he does not write for critics, but we hope he will not mind our saying that the gardening part of his book is on a higher level than that to which we are accustomed in similar books, and as for the remainder, we should prefer in this Journal not to express any opinion, but to leave the reader to form his own conclusions.

Geographen-Kalender. In Verbindung mit Dr. Wilhelm Blankenburg, Prof. Paul Langhans, Prof. Paul Lehmann, und Hugo Wichmann, herausgegeben von Dr. Hermann Haack. Erster Jahrgang, 1903–1904. (Gotha: Justus Perthes, 1903.)

THIS is the first issue of what is likely to prove an indispensable work of reference to geographers of all nationalities, as it gives in a compact form a mass of information on the yearly progress of geographical science in all its branches, besides containing much information of a statistical kind which will be of use to the general public no less than to the expert. Although, perhaps, as is but natural, the greatest amount of attention is given to German work, the book possesses a decidedly international character, account being taken of the most important work done by geographers throughout the world. A set of general tables, &c., for purposes of reference is followed by sections on the main events of the year with a bearing on political geography, on the progress of exploration, the geographical literature of the year, and so on.

A striking feature is the attention paid, in a special section from the pen of the general editor, to the progress of geographical education, though in this, more than any other section, the attention is focused on German work, hardly anything being said as to the steps lately taken in other countries to improve the position of geography in the school and college curriculum. Thus, when speaking of periodical publications devoted to this object, Dr. Haack makes no mention of the *Journal of Geography*, published in the United States, or of the *Geographical Teacher*, the organ of the Geographical Association in this country. From a purely practical point of view, a most useful section is the very complete "Adressbuch," which gives the names and addresses of geographers of all nationalities, with a brief statement of their special lines of study or research. The little book, which is most tastefully got up, concludes with an excellent series of maps illustrating the principal geographical events of the past year.

Biological Laboratory Methods. By P. H. Mell, Ph.D., Director of Alabama Experiment Station, Professor of Geology and Botany, Alabama Polytechnic Institute. Pp. xii+321; 127 figs. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1902.) Price 6*s.* 6*d.* net.

THIS is a well-conceived and eminently useful book, which within convenient compass and in clear language gives an account of microscope and microtome, staining and mounting methods, photomicrographs, and so on. It begins at the beginning, and expounds with simple accuracy the various instruments and methods of the well-equipped biological laboratory. After describing the microscope and the microtome and their accessories, the author discusses, in successive chapters, fixing, imbedding, staining, mounting, and drawing. Five chapters are devoted to photomicrography, and others follow on bacteriological methods, special methods (*e.g.* decalcification, injection, maceration and polarisation). The book ends with useful formulæ and tables, and with an appendix on laboratory furniture. We have tested the book as to various points, and have found it practical and lucid in every case. It is in part a compilation of hundreds of duly acknowledged useful hints and recipes from workers all over the world, but it also expresses the work of one who has faced detailed difficulties in actual practice and overcome them. We have come across many illustrations of American neatness and ingenuity which were fresh to us, and we confidently recommend the book as a worthy companion to Bolles-Lee's *vade mecum* and similar works.

Ijain; or, the Evolution of a Mind. Pp. ix + 207. *Isola; or, the Disinherited.* Pp. xv + 153. By Lady Florence Dixie. (London: The Leadenhall Press, Ltd.)

THESE are youthful productions of a versatile writer, whose object is to spread the truth about everything at whatever cost. "Ijain" traces the development of the mind of an unusually thoughtful child, and "Isola" is a drama, the object of which is to secure greater freedom and fuller opportunities of work for women.

LETTER 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.*]

Radio-active Gas from Bath Mineral Waters.

PROF. J. J. THOMSON has shown that the air extracted from Cambridge tap-water and from the waters of certain deep-level springs is mixed with a radio-active gas (NATURE, vol. lxviii. p. 90). It appeared of special interest to determine whether such a constituent existed in the hot mineral springs of Bath. Samples of water direct from the King's Bath Spring have been examined at the Blythswood Laboratory, and have been shown to contain a radio-active gas in solution. In the first experiments the gas was expelled from a flask containing a litre and a half of water by boiling under a pressure of about half an atmosphere. The amount of gas obtained after passing through a number of drying tubes was small, as was shown by the fact that the pressure only altered by a few centimetres. Yet this was sufficient to produce a marked increase in the ionisation in the testing vessel. The gas was also extracted from the water by exhausting the testing vessel and allowing a current of air to bubble through the water and a series of drying tubes into the vessel. In this case the ionisation current increased from four to five times.

Whichever method was employed for introducing the gas into the testing vessel, it was found that the effect did not assume its full value instantaneously, but gradually increased to a maximum and then diminished. The activity reached a maximum in rather more than one hour after the admission of the gas. About half an hour later the activity had diminished to one-half the maximum value. Rutherford (*Phil. Mag.*, v. p. 448, 1903) has observed a similar effect when the emanation from radium is introduced into a closed space. In this case the maximum activity is reached after five or six hours, and the activity decays to half value in 3·71 days. The gas from the Cambridge water lost from 5 to 10 per cent. of its activity in twenty-four hours. The gas from the Bath water appears to be intermediate in character between the radium emanation and the Cambridge gas on the one hand, and the thorium emanation on the other. The activity of the thorium emanation diminishes to one-half in one minute.

If the therapeutic action of the Bath waters is due in any degree to the radio-activity of the gases contained in them, the fact that the activity of the gas now being investigated begins to decrease so soon after the gas has been liberated acquires special significance. The opinion is commonly held that the waters of various spas possess greater efficacy when used on the spot. It is probable that this opinion, though doubtless fostered by interested individuals, has some basis in fact, and it is possible that the underlying fact may here find an explanation.

Prof. Dewar has shown that the Bath waters contain helium. The presence of a radio-active and of an inert gas in the same water is of interest from the point of view of the possible transmutation of such elements.

Blythswood Laboratory, Renfrew. H. S. ALLEN.

THE SOUTHPORT MEETING OF THE BRITISH ASSOCIATION.

SINCE the publication of the first article on the approaching meeting of the British Association (July 9, p. 224), the following additional arrangements have been made:—

Sir George Pilkington will give a garden party to 100 members at his residence, Belle Vue, Southport, on Monday, September 14. Mr. William Vernon will give a garden party to 100 members at Wyborne Gate, Birkdale, on Tuesday, September 15.

An exhibition of meteorological and magnetic instruments, diagrams, books, &c., will be held in the laboratory and lower corridor of the Science and Art Schools, immediately adjoining the reception room. The exhibition, owing to the presence of the International Meteorological Committee in Southport, is likely to be of unusual interest. Exhibits are promised by the Royal Observatory, Greenwich; the Solar Physics Observatory; the Meteorological Office; Kew Observatory; the Scottish Meteorological Society; the Royal Meteorological Society; Captain Wilson-Barker; the Scientific Instrument Co., Cambridge; Mr. W. H. Dines; Prof. Pernter; Dr. A. L. Rotch; Captain Creak; Dr. Mill; the Radcliffe Observatory, Oxford; Mr. C. T. R. Wilson; Mr. J. Aitken; Mr. Joseph Baxendell; and Mr. Halliwell.

A loan museum of objects of local scientific and archæological interest is being organised.

The printing of the "Handbook" is now complete. The contents are as follows:—(1) "Southport: Historical and Descriptive"; (2) "Southport as a Health Resort," by Dr. J. J. Weaver and Dr. A. V. Wheeler; (3) "The Meteorology of the Southport District," by Joseph Baxendell; (4) "The Geology of the Southport District," by Harold Brodrick and Edmund Dickson—(*a*) "The Ribble Estuary," by Edmund Dickson; (5) "The Botany of the District," by W. H. Stansfield and Henry Ball—(*a*) "A note on *Hypopitys Monotropa*," by Henry Ball, (*b*) "The Mosses of the District," by J. A. Wheldon, (*c*) "The Hepaticæ of the District," by J. A. Wheldon; (6) Zoology—(*a*) "Protozoa-Foraminifera," by Dr. G. W. Chaster, (*b*) "Lepidoptera," by F. N. Pierce and J. R. Charnley, (*c*) "Coleoptera," by Dr. G. W. Chaster and E. J. Burgess Sopp, (*d*) "Araneæ," by Dr. A. R. Jackson, (*e*) "Mollusca," by Dr. G. W. Chaster, (*f*) "Marine Fauna and Fisheries," by Prof. W. A. Herdman, F.R.S., and Isaac C. Thompson, (*g*) "A Note on the Vertebrate Fauna of the District"; (7) "Martin Mere and its Antiquities," by Harold Brodrick; (8) "Archæology," by Willis Brunt; (9) "Sketch of the Life and Works of the Rev. Jeremiah Horrocks," by G. Napier Clark.

The Cambridge Scientific Instrument Company will fix a Callendar temperature recorder in the reception room, the instrument being connected electrically with a thermometer suitably exposed to the air outside the building.

The committee of the British Association appointed at Belfast for the investigation of the upper atmosphere by means of kites will, if possible, show the working of the kite apparatus during the meeting of the Association at Southport, in illustration of the experiments carried out by Mr. W. H. Dines, under the auspices of the Royal Meteorological Society and of the British Association, with the aid of grants of money from the Association and from the Government Grant Committee of the Royal Society. The committee hoped to have the advantage of the services of an Admiralty vessel for a sufficient period to include the meeting at Southport, for, in compliance with the request of the Royal Society, the Lords Commissioners were good enough to assign a vessel for the experiments, but unfortunately she met with an accident at Devonport and sank in the harbour. She is consequently not available. The local committee of the British Association is trying to assist the committee to obtain a steamer for the purpose of carrying out the experiments at Southport.

The title of Dr. J. S. Flett's lecture to working men on Saturday, September 12, is "Martinique and St. Vincent: the Eruptions of 1902," with lantern illustrations.

The railway companies, as before stated, will issue tickets to Southport available from September 8 to 18 inclusive, but in the case of the Irish railways the tickets will be available from September 7 to 19 inclusive. The committees of the principal clubs have agreed to extend the privilege of honorary membership to non-resident members of the Association during the week of the meeting.

The Saturday afternoon excursion to Hoole and Rufford will take the form of a motor-car run. More than twenty cars have been placed at the disposal of the committee by their owners, and it is hoped that this excursion will be a popular one. Tea will be served at Rufford Old Hall. The excursion to the Wirral Peninsula is specially intended for geologists and botanists, and geological and botanical parties will be formed in connection with the Windermere excursion.

A specially prepared plan of the town in colours will be inserted in the local programme, and a plan of the Municipal Buildings, where most of the meetings of the Association will be held, will also be included.

A list of those members who had intimated their intention of being present at the meeting up to July 14 has been printed, and can be obtained at the local office. The following names of foreign and American corresponding members, and members of the International Meteorological Committee, are included in the list:—Prof. G. S. Atkinson, Cornell University, U.S.A.; Dr. Von. Bebber, Hamburg; Dr. R. Billwiller, Zurich; Prof. Ludwig Boltzmann, Vienna; M. Teisserenc de Bort, Paris; Captain Chaves, St. Miguel, Azores; Mr. W. Davis, Cordoba, Argentine; Prof. G. Gilron, Louvain; M. A. Gobert, Brussels; the Comte A. de Gramont, Paris; Prof. Hellman, Berlin; Prof. H. Hergesell, Strassburg; Prof. H. H. Hildebrandsson, Upsala; Prof. Lignier, Caen; Prof. C. Lombroso, Turin; Dr. T. P. Lotzy, Leyden; Mr. G. G. MacCurdy, Newhaven, Conn., U.S.A.; Prof. E. Mascart, Paris; Prof. H. Mohn, Christiania; Prof. Willis Moore, Washington, U.S.A.; Prof. Simon Newcomb, Washington, U.S.A.; Prof. L. Palazzo, Rome; Prof. Paulsen, Copenhagen; Prof. J. M. Pernter, Vienna; Dr. A. L. Rotch, Blue Hill Observatory, Mass., U.S.A.; General Rykatcheff, St. Petersburg; Prof. M. Snellen, Utrecht; Prof. R. H. Thurston, Cornell University, U.S.A.; Dr. H. C. White, University of Georgia, U.S.A.; Prof. E. Zacharias, Hamburg.

The Mayor of Southport (Mr. T. T. L. Scarisbrick) has issued more than a hundred invitations to members of the Association and to distinguished foreigners who will be present in Southport to a dinner at his residence, Greaves Hall, Banks, on Wednesday, September 16, to meet Sir Norman Lockyer, president of the British Association, and Prof. E. Mascart, president of the International Meteorological Committee.

The Southport Literary and Philosophical Society, which was responsible for the preliminary negotiations which resulted in the holding of this year's meeting of the Association at Southport, has arranged to hold the opening meeting of its winter session on Thursday, September 17. On this occasion Prof. A. R.

Forsyth, F.R.S., has consented to deliver an address on "Universities: their Aims, Duties, and Ideals." Invitations have been issued to many members of the British Association, as well as to others interested in educational work.

THE CENTENARY OF HEIDELBERG UNIVERSITY.

ON August 5–8 the University of Heidelberg celebrated the centenary of its re-establishment. The university, one of the oldest universities of the modern world, was originally founded in 1386 by the Palsgrave Ruprecht I. of the Palatinate. At that time Heidelberg was the seat of the princely residence and capital of this wealthy State of the middle ages, and the young university did good work from the point of view of those times. The "German Medici," Otto Heinrich (1556), delivered the university from the chains of scholastic pedantry and inspired in her the ideas of the Renaissance and of the Reformation. The thirty years' war had a disastrous effect on this town and its university, as, indeed, it had on all Germany; nevertheless, the Elector, Karl Ludwig (1650), again gave it a short period of prosperity. But with the year 1685 commenced for the Palatinate and the university a long period of sorrow and loss.

Soon the positions held by broad-minded inquirers and teachers were occupied by imperfectly educated members of Catholic Orders, and the university sank to a mere confessional school. Scientific research degenerated into the school-divinity of the middle ages, appointments were given by those in control to their relatives, and very strict tests in matters of faith were imposed.

The result was that, during the eighteenth century, scarcely any work of scientific value was done by the university, and the number of students sank to a minimum. The condition of affairs was made still worse by the loss of the income hitherto derived from the possessions on the other side of the Rhine, which were then in the hands of the French.

Though the Bavarian Prince, into whose hands Heidelberg had fallen in 1799, commenced to break the dominion of the monks, and though he sought to procure new incomes for the impoverished university, her renovation was really the work of the Badish Prince, Carl Friedrich.

By the division of Germany in 1803, Heidelberg came into the possession of the Elector, Carl Friedrich, who later became the Grand Duke of Baden. Without delay, he commenced to re-establish the Heidelberg University, to give to her a broad constitution resting on high ideals, and last, but not least, to procure the necessary money.

He endowed the university with an annual sum of 50,000 florins, which had to be raised by the State. He reserved to himself the office of "Rector" of the university, a charge which since that time has rested in the hands of the Grand Dukes. The essential principle of the reorganisation is to be found in the rule that "the professors' chairs shall be filled by the most worthy competitors, without any consideration of their religion."

The names of the first professors of that time are still well known. I only recall the names of the theologians Daub, De Wette, Paulus, the jurists Thibault and Zachariae, the physician Naegele, and the philosophers T. H. Voss, Creuzer, and Bökh. It is the centenary of this reorganisation that the university has just now celebrated.

Indeed, what these beginnings promised, the nineteenth century has seen fulfilled, and the university has taken her place among the foremost of the world. Excellent scientific laboratories, observatories, and hospitals have been built, a monumental library-building is in the process of construction, and the first modest annual endowment of 50,000 florins has grown to one of 800,000 marks, to which has been added a regular special grant, amounting in the budget of 1902–03 to almost exactly a million of marks, so that at the present time about 65,000 pounds sterling are expended annually upon the university.

If one remembers that Baden has about two millions of inhabitants, and that it possesses not only one, but three universities (Heidelberg, Freiburg, and the Karlsruhe Polytechnicum), it must be confessed that a great work has been accomplished. The number of professors and *docents* of the Heidelberg University is now 151, that of students 1884.

The work of the university during the nineteenth century has received the acknowledgment of educated men all over the world. The development of the history of Christianity is connected with the Heidelberg names, Hitzig, Ulmann, Rothe, Schenkel, and Holsten; lawyers and political economists appreciate fully the influence of Vangerow, Windscheid, Bluntschli, Mittermaier, Renaud, and Knies; physicians will remember the names of Chelius, Pfeuffer, Arnold, and Gegenbaur. The names of the philosophers Hegel and Zeller are known far and wide. Well known, too, are the philologists Koechly, Ribbeck, Wachsmuth, Zaugemeister, and Bartsch, and the historians Schlosser, Häusser, Gervinus, and Treitschke. The mathematicians Hesse and Fuchs, and the leaders in natural science, Hofmeister, Kekulé, Kopp, and above all Bunsen, Kirchhoff and Helmholtz, have spread the glory of Heidelberg over the world.

The greatest credit for the success of the Heidelberg University in the past century must be attributed to the Grand Duke Friedrich, now seventy-six years old, who—during the fifty-one years in which he has been Rector—has made the university what she is to-day.

In the evening of August 5 the students formed a torch-light procession in honour of the Grand Duke. The next morning, after a festival divine service, the Actus was held in the Aula of the university, where the Grand Duke, the Minister, the deputations of other universities and corporations, and the acting Prorector of the university (Prof. Czerny) delivered addresses. After a banquet a reception was given by the city in the poetical ruins of the celebrated Heidelberg Castle.

On August 7 the historian of the university (Prof. Marks) gave a historical address, concerning the development of the scientific life of the university during the past century. In the evening the students held their great "Commers."

The announcement of the *honoris causa doctores* took place next morning. In the branch of medicine the following men of science were elected:—M. T. H. Dunant, Geneva; Prof. Sv. Arrhenius, Stockholm; Sir W. Ramsay, London; Prof. P. Lenard, Kiel; G. Schweinfurth, Riga; G. Moynier, Geneva.

In the branch of natural science the following were elected:—Mathematics, M. G. Darboux, Paris; physics, Dr. R. T. Glazebrook, London; astrophysics, Sir William Huggins, London; chemistry, Prof. S. Cannizzaro, Rome; mineralogy, Prof. F. Fouqué, Paris; astronomy, Prof. E. C. Pickering, Cambridge, U.S.A.; zoology, Prof. E. Maupas, Algiers; botany, A. Cogniaux, Nivelles.

In the evening of August 8 a reception was given by the Grand Duke and the Grand Duchess at their castle in Schwetzingen. Sunday, August 9, was devoted to excursions in the neighbourhood, and at night an illumination of the castle, and a great display of fireworks on the Neckar, brought the festivities to a close.

The present generation has expressed by these splendid meetings that it appreciates highly the benefit

resulting from the reorganisation of the university by Carl Friedrich, and the work done by the scientific men of past generations, and has indicated how it hopes that, in the century just begun, the development will not cease but continue, that new successes will be achieved by the more and more unrestrained unfolding of all intellectual forces, and that these successes may help to brighten the minds of the people, and to connect them more and more by the bridges of science, notwithstanding political boundaries. M. W.

BRITISH MEDICAL ASSOCIATION SWANSEA MEETING.

THE seventy-first annual meeting of the British Medical Association was concluded at Swansea on July 31. It will be remembered that last year the meeting was held at Manchester, and although as was *a priori* to be expected the numbers at Swansea fell short of those at Manchester, yet nevertheless the meeting will always live in the memory of those who attended it as an unqualified success.

The president this year was Dr. Griffiths, of Swansea, and in an excellent opening address he touched upon many points of interest and importance both to the profession and to the public. Not the least interesting of these to the readers of NATURE was the president's reference to the much discussed question of hospitals for paying patients. Sooner or later the very serious attention of the profession, and most probably also of the Government, will have to be directed to this question. An increasing number of patients requiring skilled medical or surgical treatment, such as they cannot obtain at their own homes, is occurring among a class the financial position of which, while being such as to render them the unethical recipients of charity, yet nevertheless is not adequate to meet the charges of private nursing homes. From the point of view of the economist, it seems truly absurd that this class cannot be catered for.

Another point of interest in the president's address was the repetition of the great want of complete remodelling of the Public Health Government Department. The need for something in this country corresponding to the German Gesundheitsamt has from time to time been emphasised in these columns. Numerous departmental committees appointed by various departments, the minutes of reference to which, however, have all borne directly upon the public health, have embodied in their reports a specific recommendation to this effect. Stress has also been laid upon the inadequacy of the present Governmental machinery for dealing with the important questions which modern technical industry and knowledge, using these terms in the widest sense, are apparently intermittently, but actually constantly, forcing into public hygiene. The policy adopted by the different departments of State concerned has heretofore been one of empirical opportunism. When a question has been sufficiently acute a Departmental Committee has been appointed and a report of this kind issued, often after considerable lapse of time; with the exception of notices at the time of its appearance in the Press, this report and its recommendations are often never heard of again. This policy, although it may have the effect of saving the salaries of permanent officials, cannot in the present state of the question continue long, and we are pleased to see that it was brought prominently before the greatest professional organisation which exists, viz. the British Medical Association.

The address in medicine was delivered by Dr. F. T. Roberts, the subject chosen being infective and infectious diseases. The lecturer dealt chiefly with the influence which new scientific method has exercised upon the diagnosis and treatment of disease. The scientific methods considered were essentially those which have been introduced as a result of increased knowledge of pathology, comprising under this term chemical pathology and bacteriology. These sciences, true to their name, have been without doubt most ancillary to medicine, but their very helpfulness may in itself be a source of danger in so far as concerns the progress of our knowledge of the treatment and diagnosis of disease. These new methods have a tendency, according to the lecturer, to be studied and pursued at the expense of the purely clinical ones. Students, in short, are apt to spend too much time in the laboratory and too little in the wards. An interesting part of the address was devoted to the question of the use of alcohol as a therapeutic agent; in this connection we heartily recommend the remarks of the lecturer to all interested in this question. There can be no doubt that under certain conditions therapeutics possesses no more valuable agent; most clinicians, as the result of their experience, are enabled to maintain that numerous lives have been saved by the skilful administration of alcohol; but, on the other hand, it is equally true that the seeds of future intemperance have not infrequently been sown by the indiscriminate and indefinite instructions, or rather want of instructions, which often accompany the ordering of alcohol by the practitioner of medicine. Too much care cannot be exercised in the prescribing of a remedy so potent both for good and evil.

The address in surgery was delivered by Prof. Mayo Robson, who took for his subject the evolution of abdominal surgery during the last third of a century. The address practically confined itself to the enormous development which has taken place in this branch of the healing art during the above time. In conclusion, the lecturer remarked that the future progress of surgery will probably be intimately bound up with the work of the physician, the pathologist, and the bacteriologist, and the time will come when preventive measures will save much operative work.

Much good work was done at the meetings in the different sections, though apparently no papers of very striking original interest were communicated. The social arrangements left little to be desired, the profession at Swansea and the neighbourhood extending a very hearty welcome to the visitors. Many, no doubt, made the Association meeting at Swansea the starting point of their holidays, and we have little doubt that the mental food ingested there will in many cases be assimilated on the charming holiday grounds of Wales. F. W. T.

VENTILATION OF FACTORIES AND WORKSHOPS.[1]

ABOUT three years ago, Lord Ridley, when Secretary of State for the Home Department, appointed a committee consisting of Dr. J. S. Haldane, F.R.S., and Mr. E. H. Osborn, engineering adviser to the Chief Inspector of Factories, to inquire into and report upon the means of ventilation in factories and workshops, with especial reference to the use of fans and the use and construction of respirators for the protection of workpeople exposed to dust or dangerous fumes.

In the report before us the committee deals with a portion only of the question upon which it was directed to make inquiry. It is for the present mainly concerned in the attempt to strengthen the

[1] "First Report of the Departmental Committee appointed to inquire into the Ventilation of Factories and Workshops; with Appendices." (London: Eyre and Spottiswoode, 1903.)

hands of the Secretary of State in prescribing a standard of sufficient ventilation for factories and workshops based upon what it deems to be an adequate objective criterion of what constitutes reasonably "sufficient" ventilation, viz. the proportion of carbonic acid in the air. Looked at from the point of view of the Inspecting Department of the Home Office, it was necessary, at the outset, to determine whether it was practicable to make use of this proportion as a legal standard of "sufficient" ventilation, or whether such estimations, if made with the requisite accuracy, might not prove to be both expensive and troublesome.

Determinations of atmospheric carbonic acid are mainly carried out on the principle first made use of by Dalton and worked out by Hadfield, that is, absorption of the carbonic acid contained in a known volume of the air by a suitable alkaline solution, the amount so absorbed being ascertained by volumetric analysis. This process was first extensively applied by Pettenkofer, and is generally known by his name. With proper precautions it is capable of a very high degree of accuracy, and, indeed, practically all our knowledge concerning the distribution of carbonic acid in the atmosphere, whether in the free air or in inhabited places, has been obtained by its means. The apparatus needed is somewhat bulky on account of the necessity of using large volumes of air in cases where the amount of carbonic acid is relatively small, as in ordinary atmospheric air. At the same time, when it is merely necessary to determine whether the air of an inhabited room or that of a factory or workshop contains an excess of carbonic acid over the quantity that could reasonably be prescribed as an official limit, vessels holding a couple of litres would suffice for most purposes. It would be readily possible to put together for the use of inspectors a Pettenkofer "kit" which should be light and not too bulky, and would enable the estimation of carbonic acid to be carried out rapidly and with approximate accuracy.

The committee recommends *inter alia* that the limit of carbonic acid should be fixed, except on very foggy days, when no tests should be made, on account of the vitiated state of the outside air, at 12 volumes of carbonic acid per 10,000 of air, and that when gas or oil is used for lighting, the proportion should not exceed 20 volumes after dark or before the first hour after daylight, the only exception to this rule to be in cases where the extra carbonic acid is produced in other ways than by respiration or combustion, as in breweries, &c. It is further recommended that arrangements be made by the Factory Department of the Home Office for the analysis, by a specially qualified person or persons, of samples of air collected by inspectors, and that any analysis on which a prosecution immediately depends should have been performed by such qualified person or persons, and also that arrangements should be made for inspectors of factories to have the use, when desired, of a properly tested portable apparatus for estimating on the spot the proportion of carbonic acid in air.

Dr. Haldane has devised an apparatus for the use of inspectors of factories, a specimen of which has been submitted to us for examination by Messrs. Müller, Orme and Co., of 148 High Holborn, and this seems to fulfil all the necessary conditions. A description of it constitutes appendix iii. of the report before us. The estimation of carbonic acid is made by measuring the contraction in the volume of the air to be tested by bringing the air in contact with a 10 per cent. solution of caustic potash or soda. As the volume of the air taken for the test is only about 200 c.c., it is evident that special provision needs to be made, and great care in manipulation needs to be exercised if even approximate accuracy is aimed at. It is impossible in the absence of the diagrammatic representation of the apparatus which accompanies the report to explain the details of its construction, or to make clear the successive steps in its manipulation. We have had, however, an opportunity of making a number of experiments with it, and we are able to state that the amount of carbonic acid in the air of an inhabited room may be quickly ascertained, with sufficient accuracy, by means of it. An intelligent manipulator who understood the scientific principles involved would be able to obtain results accurate to within about one part in 10,000 with air containing ordinary proportions of carbonic acid, and to about two parts with air so highly vitiated as to contain, say, from 30 to 50 volumes of carbonic acid per 10,000. A trained gas analyst would, no doubt, obtain more accurate results. A determination is made in a few minutes when once the apparatus is put into working order.

Whether experiments of this kind should be entrusted to those factory inspectors who have had no training in physical science is perhaps open to question.

One possible source of considerable error was indicated during the experiments. After standing several days the potash solution used in the apparatus was found to be coloured yellow, doubtless from the action of the alkali upon the rubber tubing of the apparatus. Any sulphur thus dissolved would form alkaline sulphides which would absorb oxygen from the air under experiment, and so vitiate the result. As a matter of fact, the figures given when the apparatus was in this condition were wholly untrustworthy.

The following experiments may be cited in illustration of the degree of accuracy which may be obtained:—

I. *Experiments on the air of a laboratory.*

		Results. CO_2 per 10,000 of air.
2 or 3 Bunsens burning during the whole time of these experiments.	1st experiment.—At about 9.45 a.m., before any burners were lighted	5·0
	2nd. About twenty minutes later	5·9
	3rd ,, ,, ,, ,, than 2nd	6·3
	4th ,, ,, ,, ,, ,, 3rd	7·3
	5th ,, ,, ,, ,, ,, 4th	7·0
	6th ,, ,, ,, ,, ,, 5th	7·4
	7th ,, ,, ,, ,, ,, 6th	8·0

II. *With air containing* 24·4 *volumes of* CO_2 *per* 10,000.

1st experiment	23·3
2nd ,, ...	21·7

III. *With air containing* 45·2 *volumes* CO_2 *per* 10,000.

1st experiment	42·3
2nd ,, ...	41·6

GRAHAM BELL'S TETRAHEDRAL CELL KITES.

IN the June number of the *National Geographic Magazine* is a very interesting and instructive article by Dr. Graham Bell on the tetrahedral principle in kite structure. The article itself is so concise, and depends so much upon illustrations which are reproduced to the number of twenty in the text and seventy in an appendix, that an effective representation of the contents in an article of smaller dimensions is scarcely possible. Still the line of thought that runs through the work which the article represents is so clear and so suggestive that even an imperfect outline of it may be useful. Dr. Bell indicates certain stages in the development of his ideas as "milestones" of progress, and since the ultimate stage of the development is the possibility of building up very large kite structures by combining unit cells in such a way that the proportion of weight to wing area in the structure

is nearly the same as that of the constituent cell, the successive stages are noteworthy. They sketch out in a most interesting manner a reply to Newcomb's criticism of the limits of application of the aëroplane based upon the argument that increase of size means diminished efficiency because, for similar structures, the weight varies as the cube while the area, upon

FIG. 1.—A Winged Tetrahedral Cell.

which the lifting force depends, varies as the square of the linear dimensions.

The original stage, the ordinary kite, is a single plane structure. The first step in advance is the Hargrave box kite, with its upper and lower aëroplanes for its support, and side planes for stability. To stiffen the framework of the box kite it must be braced longitudinally and transversely; accordingly Graham Bell's development commences by replacing the rectangular framework of the box kite by a framework of triangular section which is by construction

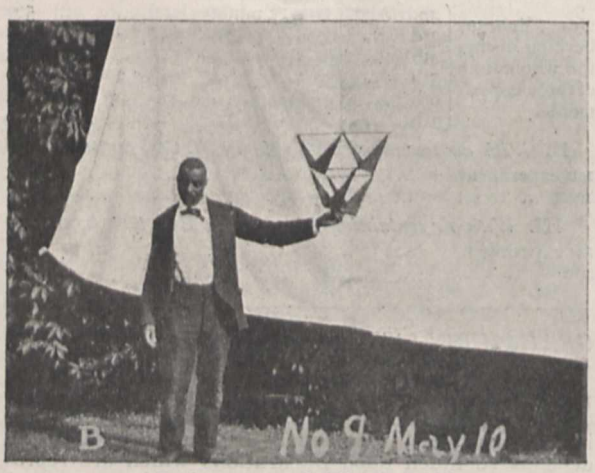

FIG. 2.—A Four-celled Tetrahedral Kite.

stiff so far as the cross section is concerned. The inclined sides are by the vector principle of resolution of forces regarded as equivalent to their geometrical projections, and, in so far as the principle applies, the inclined faces represent the combined effect of aëroplanes of the area of the projections.[1]

[1] This principle to be generally applicable would require the normal component of wind pressure to be uniform and independent of the angle between the plane and the wind. This is not the case with an aëroplane (see Rayleigh, NATURE, vol. xxv. p. 108); and for the principle to be applied approximately in the case of the kites some convention as regards the angle of exposure of the aëroplanes to the wind would be required.

The box kite of triangular section is, however, not stiff as regards longitudinal shear, and the next "milestone" marks the reduction of the triangular or prismatic form to the tetrahedron, an essentially stiff framework for all directions. A tetrahedron of rods with two adjacent faces covered with fabric forms a tetrahedral kite cell which, on the principle of projec-

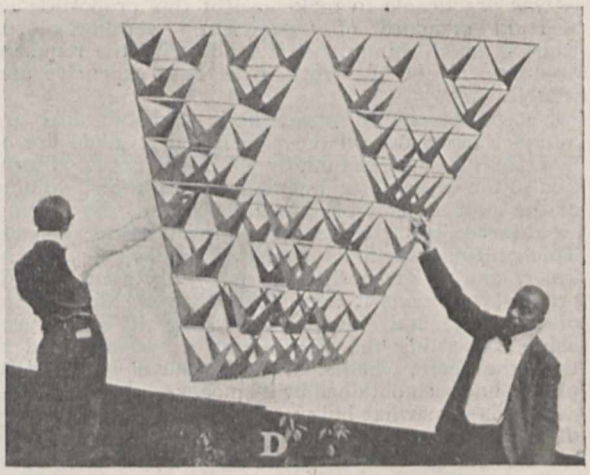

FIG 3.—A Sixty-four celled Tetrahedral Kite.

tion before referred to, is equivalent to three aëroplanes represented by the projections of the covered sides upon planes at right angles.

The further development of pure tetrahedral construction is obvious. Four cells can be combined to form a tetrahedron of double linear dimensions without additional framework; the weight and wing area are both simply proportional to the number of cells, and not to the linear dimensions. For each set of four cells thus combined there is an octahedral free space in the interior which corresponds to the free space between the two cells of the Hargrave kite. The tetrahedral

FIG. 4.—The Aëro drome Kite.

kites that have the largest central spaces preserve their equilibrium best in the air.

Combining four multiple cells to fill the outline of a tetrahedron of double size, again, we get a sixteen-cell kite, and repeating the process again a sixty-four cell kite, occupying a tetrahedron eight times the dimensions of a single cell. The building up of multicellular kites from the units is represented in the figures here reproduced from illustrations in Dr. Bell's article. Fig. 1 represents the unit cell, Fig. 2 a combination of four cells, Fig. 3 of sixty-four cells.

The kites fly with the points of the wings upward; the line of junction of the covered faces of the tetra-

hedron forms a kind of keel. No details as to the heights attainable are given. The most convenient place for the attachment of the flying end is said to be the extreme point of the bow. If the cord is attached to points successively further back on the keel, the flying end makes a greater and greater angle with the horizon, and the kite flies more nearly overhead; but it is not advisable to carry the point of attachment as far back as the middle of the keel. A good place for high flights is a point half way between the bow and the middle of the keel.

"Tetrahedral kites combine in a marked degree the qualities of strength, lightness, and steady flight; but further experiments are required before deciding that this form is the best for a kite or that winged cells without horizontal aëroplanes constitute the best arrangement of aëro-surfaces.

"The tetrahedral principle enables us to construct out of light materials solid frameworks of almost any desired form, and the resulting structures are admirably adapted for the support of aëro-surfaces of any desired kind, size, or shape."

The diagrams illustrating the article show various examples of the formation of complex kites from tetrahedral cells. One form suggested by Prof. Langley's aërodrome, but different in construction and appearance, is shown in Fig. 4, reproduced from an illustration in the article. That some of these complex kites are on a very large scale is evident from a case cited, in which an aërodrome kite, which was struck by a squall before it was let go, lifted two men off their feet, and subsequently broke its flying cord, a Manila rope of three-eighths inch diameter.

The simplicity of the construction of the cells, and the obvious possibilities of their combination, lend an additional fascination to a subject which is already full of interest.

BIBLE AND BABEL.

IN the number of the Johns Hopkins University *Circulars* for June (vol. xxii. No. 163), Prof. Paul Haupt has published an article entitled "Bible and Babel," referring to the somewhat heated controversy on Babel and the Bible which has raged recently in Germany, with which our readers are probably familiar. The line which he takes up is briefly that all the heterodox views which were expressed by Prof. F. Delitzsch in his famous lecture delivered in the august presence of the German Emperor had already been promulgated by himself, Prof. Haupt, at various periods during the last twenty-four years. Prof. Haupt claims to have made correct deductions in respect of the origins of the Biblical accounts of the Creation, the Deluge, &c., long before Prof. Delitzsch's lecture was delivered, but it must be clearly pointed out that, although such may be the case, he was not the first, even twenty-four years ago, to prove that the narratives usually accredited to Moses are merely modified recensions which we owe to the prophets of the captivity in Babylon. Whatever credit is due either to Paul Haupt or Prof. Delitzsch in this matter, it must never be forgotten that all important statements made by them with regard to the Creation and Deluge tablets are derived from the works, writings, and oral remarks which were made by the late General Sir Henry Rawlinson, G.C.B., and the late Mr. George Smith, of the British Museum. Both Profs. Delitzsch and Haupt are skilled elaborators, but in our opinion they are not discoverers, and certainly neither of them can be placed side by side with such publishers and translators of text as the two famous Englishmen we have already mentioned. Still less can either be regarded as the author of the heterodox views and statements which so thoroughly shocked His Majesty the German Emperor.

NOTES.

IN connection with the tenth meeting of the Australasian Association for the Advancement of Science, to be held at Dunedin next January, particulars of which we gave in our issue for May 28 (p. 85), we learn from the *Otago Daily Times* that the colonial Government is rendering the Association material assistance. The New Zealand honorary secretary, Mr. G. M. Thomson, has received from Sir J. G. Ward, Colonial Secretary, a letter which states that the Government will assist the association in the following respects:—(1) A sum of 500*l.* will be placed on the Estimates of the present year towards the expenses of the January meeting; (2) the Government printer will be instructed to do all printing required by the association free of cost to the association; (3) railway passes will be issued to visiting members of the association; and (4) any assistance that it may be in the power of the permanent departments of the Government service to render to the association will be readily afforded on application being made.

AN entire skull (partially restored) of the remarkable Egyptian Eocene mammal *Arsinotherium zitteli* is now exhibited in the central hall of the Natural History Museum. This magnificent specimen was obtained by Dr. C. W. Andrews during his last trip to the Fayum district, and has been cleaned and restored in the museum. Behind the enormous nasal horns are placed a pair of quite small horns, recalling the rudimentary back-horns of the giraffe. The dentition, although including a full series of incisors and canines, recalls that of the Proboscidea. It is hoped that the skull of the Siberian rhinoceros (*Rhinoceros antiquitatis*) recently dug up in Salisbury Square, E.C., may ultimately find a home in the museum, since it is by far the finest example hitherto discovered in this country.

AT an extraordinary general meeting of the members of the Jenner Institute of Preventive Medicine, held on Friday last, the resolution recently passed on July 22 to alter the name of the institute to "The Lister Institute of Preventive Medicine" was unanimously confirmed.

THE fourteenth annual general meeting of the Institution of Mining Engineers will be held on Wednesday, September 2, in the University College, Nottingham.

THE Amsterdam Academy of Sciences has awarded its Buis-Ballot medal, given once in ten years, to Prof. Richard Assmann and Dr. Arthur Berson, of the Aëronautic Institute at Tegel, near Berlin.

REUTER states that a scientific expedition, to explore the northern parts of the Pacific Ocean, will leave Stockholm next April by railway for Port Arthur by way of Siberia. At Port Arthur the expedition will embark on a ship under the leadership of M. Kolthoff, who will be accompanied by five or six other Swedish naturalists.

SIR TREVOR LAWRENCE, president of the Royal Horticultural Society, has announced that Sir Thomas Hanbury, K.C.V.O., has purchased for presentation to the society the estate and garden of the late Mr. G. F. Wilson, F.R.S., at Wisley, near Woking. The total area of the estate is 60 acres.

AT the meeting of the Wilts County Council on August 4, a letter was read from Sir Edmund Antrobus, the owner of Stonehenge, to Lord Edmond Fitzmaurice, M.P. (chairman of the council), in which Sir E. Antrobus said he was willing to sell Stonehenge, and eight acres of land surrounding it, to the nation for the sum of 50,000*l.* The council decided to send the letter to the Chancellor of the Exchequer.

MISS DOROTHY BATE, whose investigation of the fossiliferous caves of Cyprus has recently created much interest among palæontologists, has also paid attention to the birds of that British dependency, and has written a paper on the subject which will appear in the next number of the *Ibis*. She has succeeded in making some good additions to the late Lord Lilford's "List of the Birds of Cyprus," which was published in 1889.

MR. R. C. L. PERKINS, who was employed for some years by the Sandwich Island Exploration Committee of the British Association to make zoological collections in the Hawaiian Archipelago, has received an appointment as economic entomologist in those islands, with the services of two assistants at his disposal. All the exertions that can be made will be required, as it is said that the crops in several of the islands are being completely ruined by introduced insects of various kinds and by fungoid diseases. No better selection could have been made for such a post, as Mr. Perkins is an expert on Hawaiian insects, and is still engaged in work upon them for the British Association committee.

THE manatee which has lately been added to the Zoological Society's living collection is an animal of much interest, as it does not belong to the ordinary species of the American coasts, but is a representative of the smaller form (*Manatus inunguis*) which is confined to the fresh waters of the Amazon. Here it was first discovered by the Austrian explorer Natterer, in the Rio Madeira, in 1830, and designated *inunguis* from the complete absence of nails on the hand, which are always present in *M. americanus*. A single living specimen of the same form was previously received by the Zoological Society in 1896, and its anatomy was described by Mr. Beddard in the *Proceedings* of the Zoological Society for 1897. The present manatee, which is a young animal about three feet long, has been placed in one of the tanks in the reptile house, and is fed principally upon lettuce. An excellent coloured figure of the marine manatee, based upon life-sketches made by the late Joseph Wolf, will be found in the mammal volume of Salvin and Godman's "Biologia Centrali-Americana."

ON the night of August 8 a destructive hurricane, which lasted five hours, swept over Martinique. The storm passed over Fort de France at 1 o'clock in the morning, taking a north-westerly direction. The barometer went down to 28·70 inches.

REPORTS of the following earthquake shocks on the Continent have appeared in the daily papers during the past few days:—*August* 9. Lisbon, 10.8 p.m. Three distinct shocks. Duration, three seconds, two seconds, and eight seconds respectively. Interval of two seconds between each shock.—*August* 11. Malta, 5.33 a.m. Duration, one minute. Naples, 5.35 a.m. Duration, two seconds. Syracuse, 5.38 a.m. Rumbling sounds heard. Canea, 6.9 a.m. Duration, thirty-two seconds. Direction, north to south. Walls of houses cracked. The shocks were felt in almost the whole of Eastern Sicily.

A LARGE party of delegates to the twenty-fourth annual meeting of French geographical and colonial societies, held at Rouen last week, is paying a visit to London, and on Monday was received by the council of the Royal Geographical Society, and entertained at luncheon. Twenty-four French geographical societies, nine kindred societies, and three foreign geographical societies were represented at the Rouen congress, and the members visiting England number eighty-two. At the luncheon, in responding to the toast of "The Geographical Societies of France," proposed by the chairman, Major Leonard Darwin, M. Zévort, rector of the University of Caen, and president of the congress, said his claim to speak in that assembly was that he was the rector of a university, French in its character, founded by an English king, that he represented a city which was visited every year by hundreds of English people, and he was, moreover, the nephew of Pasteur speaking to a son of Darwin. Wherever the French had worked and the English had followed there had been great progress in civilisation and in the peaceful development of the human race. That was the spirit in which the delegates came to this country, and it was in that spirit they were welcomed.

A REPORT by the director on the work in the engineering and physics departments of the National Physical Laboratory during the half year ended June 30 gives interesting particulars of the research work in progress. In the wind pressure research in the engineering laboratory, the case of flat surfaces exposed to a perpendicular current of air has been worked out, and a general relation established which is now being tested for the case of larger surfaces exposed to the natural wind. The case of parallel plates at varying distances apart has been treated, and experiments are also in progress on the pressure on inclined surfaces. Drawings have been prepared, and some preliminary tests made for the research into the constants of steam. In the physics department Dr. Harker has continued his comparison between the air thermometer, the platinum thermometer and the thermojunctions, and the work is now complete for temperatures between 0° C. and about 1050° C. The first part of the work for temperatures up to 500° C. was done with M. Chappuis, at Sèvres, and the results have been published. Dr. Harker has also constructed and subjected to stringent tests a set of platinum thermometers for the British Association. A small research on the specific heat of iron at high temperatures—700° C. to 1000° C.—is nearly complete, and promises to be of interest. Mr. F. E. Smith's research on the resistance of mercury and the construction of a standard mercury resistance is practically complete. The value of the specific resistance of mercury will probably prove to be very close to that determined by the director and Mr. Fitzpatrick in 1888. On the assumption that the absolute value of the wire standards in the laboratory is known, the length of the column of mercury, 1 sq. mm. in section, having a resistance of 10^9 C.G.S. units, is found to be almost exactly 106·29cm. The difference between Mr. Smith's results and those of the Reichsanstalt will not be more than some few parts in 100,000. An investigation of some importance into the changes in insulating strength of various dielectrics due to continued heating, by Mr. A. Campbell and Mr. Rayner, undertaken for the Engineering Standards Committee, promises to lead to results of value. In the metallurgical division the solidifying points and cooling curves of a series of pure iron carbon alloys have been determined, using platinum platinum-iridium and platinum platinum-rhodium thermojunctions. The range of carbon is from 0·15 to 3·55 per cent.; the range of temperature from 1502° C. to 1111° C. on the thermojunction scale. In addition to the above research work, nearly 600 tests have been made during the half year.

WE have received from Mr. E. Bohm two incandescent electric lamps which are specially designed to give good illumination vertically downwards. In both lamps the lower half of the bulb is made of fluted glass, which, acting as a row of lenses, serves to concentrate the light downwards;

one lamp has, in addition, opal glass for the upper half of the bulb, the filament being of the ordinary shape. The filament of the other lamp is fixed horizontally, and is zig-zag in shape; the upper half of the bulb in this case is of clear glass. The result of these designs is to give a distribution of light having the maximum candle-power in the vertical direction; in one of the lamps which we tested the vertical candle-power was 17·5, and the mean horizontal candle-power 10, thus practically reversing the values obtained with ordinary lamps. For situations in which good illumination directly below the vertical is specially required, these patterns of lamps should prove useful.

A VERY ingenious electrical type-setting machine is briefly described by M. Tavernier in a recent issue of the *Comptes rendus* of the Paris Academy of Sciences. The apparatus is similar in principle to the familiar linotype machines, but the operations of typing the copy and casting the type are separated; the operator works at an electrical typewriter, which produces a perforated tape, and at the same time an ordinary typed copy of the manuscript, which enables corrections to be made in the tape before the type is set up. The perforated tape is passed automatically through the type-setting machine, which is also operated electrically. The advantage of thus dividing the two operations is that the casting machine can be worked at a uniform maximum speed, and is independent of the skill of the typist. A further modification of the machine allows it to be used telegraphically; the perforated tape produced by the type-writer is passed through a transmitter, which sends signals over the line and reproduces in a receiving apparatus a duplicate of the tape, which can be used in the type-setting machine. The details of the various pieces of apparatus are not given, but there can be no doubt that the invention is likely to prove of great utility.

WE have received the forty-sixth volume of the "Year-book" of the Austrian Meteorological Service for 1901. The operations of the central office include the usual work of a normal observatory, the control of about 400 stations of various classes, and telegraphic weather forecasts. There are, in addition, a large number of stations dealing with thunderstorms and hail, but purely rainfall observations are now under the control of another department. An active part is taken in the international balloon ascents; we have frequently referred to some of the preliminary results obtained. Another feature of the Austrian service is the erection of a number of stations for "weather shooting" for the dissipation of thunder clouds and prevention of damage by hail, but the operations hitherto have not led to the hope of unqualified success. A separate appendix accompanies the "Year-book," which includes very valuable discussions on thunderstorm observations and on isotherms for Austria, both papers illustrated by charts. In the discussion of thunderstorms, some very interesting and instructive conclusions are drawn as to their connection with geographical features and the distribution of barometric pressure. It may be interesting to note here that out of 94 cases of damage to trees by lightning in 1901, 27 were pine or larch, 20 oak, 17 poplars, and 10 pear trees. The beech tree, which is generally supposed to be practically free from lightning strokes, was only struck once, but there were several other trees which similarly escaped damage.

AT the recent congress of the Royal Institute of Public Health, Prof. Moore, of Liverpool, read a paper upon a "Chemical Theory of the Transmission of Certain Infective Diseases." He pointed out that in many of the specific fevers no micro-organism has been isolated, and suggested that in these a chemical body of the nature of an enzyme may be the ætiological agent. To account for the reproduction of this chemical substance, which is necessary to explain the phenomenon of infection, Prof. Moore supposes that, by its action upon some of the cells, more of itself may be formed. He points out that there are analogies to this action in the case of certain "catalytic" reactions.

A SECOND report of the Special Chloroform Committee of the British Medical Association has just been issued. Mr. Vernon Harcourt, F.R.S., describes some experiments made to estimate the amount of chloroform which may be dissolved by the blood, and an apparatus for the limitation and regulation of chloroform vapour when administered as an anæsthetic. Dr. Dudley Buxton discusses the clinical use of certain inhalers (including Mr. Harcourt's form), and Mr. Walter Tyrrell reports upon the use of Mr. Harcourt's inhaler. Prof. Sherrington, F.R.S., and Mr. Sowton describe a number of experiments made to measure that dosage of chloroform under which the mammalian heart can, and cannot, work efficiently. They conclude that the heart muscle rapidly takes up chloroform offered to it in the blood-vessels of its vascular system.

CAPTAIN LAMB, I.M.S., has made a series of experiments upon the action of the venoms of the cobra and of Russell's viper (*Daboia Russellii*) upon the red-blood corpuscles and upon the blood plasma (*Scientific Memoirs of the Government of India*, New Series, No. 4). Both these venoms are shown to have a marked hæmolytic action, both *in vivo* and *in vitro*. Cobra venom never induces intra-vascular clotting; in fact, it rather diminishes blood coagulability, while Daboia venom causes extensive intra-vascular clotting. *In vitro* cobra venom prevents the clotting of citrated blood or plasma which ensues on the addition of a soluble calcium salt; Daboia venom, on the other hand, increases the tendency of citrated blood and plasma to coagulate. In conclusion, Captain Lamb considers that his experiments do not support Martin's hypotheses that all snake venoms contain at least two toxic proteids, one being a neurotropic, the other a hæmotropic, poison, and that the action on blood coagulability is due to a setting free of nucleo-proteids.

THE current issue of the *National Geographic Magazine* contains an article by Dr. H. W. Wiley, chief chemist of the Department of Agriculture, on "The United States; its Soils and their Products." Little is said about the special features exhibited by the soils of the country, the article being, in fact, a brief summary of the acreage, yield, and value of the main crops grown in the United States, useful to the student who has no opportunity of consulting the "Year-book" of the Department of Agriculture. The two facts that are most striking are the relatively low yield per acre and the enormous diversity of the agriculture; Dr. Wiley, indeed, asserts that "within the borders of the United States are grown every agricultural crop known to the world." The article is illustrated by several interesting photographs, calculated to impress the reader with the magnitude of the scale on which farming is practised in the United States.

A MOST interesting and remarkable instance of local adaptation to abnormal conditions on the part of a mollusc is recorded by Baron E. Nordenskjöld in No. 704 of the *Zool. Anzeiger*. It appears that in the "Chaco" districts of South America a species of fresh-water limpet (*Ancylus moricandi*) is found during the wet season in the pools which are then abundant in the country. During the dry season, however, these pools are completely desiccated, and

the whole country then becomes a practical desert, over which clouds of fine dust are swept by the wind. In order to exist during this season of drought, the Ancylus closes up almost the whole of the inferior aspect of its limpet-like shell by a growth of shelly matter continuous with the margin of the latter, leaving only a small circular mouth at one end. As is well known, many land molluscs, more especially *Helix pomatia*, are in the habit of sealing up the apertures of their shells during seasons of drought or heat, but in none of these is the substance with which the mouth is closed identical with that of the shell. In localities where there is no marked dry season, the Chaco Ancylus remains throughout the year in its normal condition.

In part i. of the general report and statistics relating to mines and quarries for 1902, issued by the Home Office, we note evidence of a general increase in production with regard to coal, fire-clay, ironstone, gypsum, rock-salt, &c. It is interesting to find that gold ore showed an increase from 16,374 tons in 1901 to 29,953 tons in 1902.

In a paper on the diffusion of granite into schists (*Geol. Mag.*, May), Mr. E. Greenly suggests that the granitoid matter that has been injected *lit par lit* was intruded while the surrounding rocks were at a high temperature, and this view would help to explain the occurrence of lenticles of granite in complete isolation from the parent mass.

A useful map of Peru, on the scale of 1 : 3,000,000, or an inch to a little more than forty miles, has been issued by Mr. Eduardo Higginson, Consul of Peru, Southampton. It shows the various ports and havens, railways completed and in progress, telegraphs, roads, forests, petroleum deposits, &c. On the back of the map are printed numerous particulars relating to the country, such as climate, agriculture, artesian wells, mineral wealth, manufactures, and various statistics. Of the industries, that of indiarubber is especially described.

To the *Proceedings* of the Geologists' Association for June (vol. xviii. part ii.), Dr. Catherine A. Raisin contributes an article on the formation of Chert, with especial reference to the bands and nodules in Jurassic strata. In some cases the silica may have originated from hot springs aided by the action of algæ; in other cases silica may have been directly derived from the sea water, but more often through the agency of siliceous organisms. Molecular changes that subsequently took place in the rocks have led to the dispersal and concentration of the silica in patches or layers. Mr. Jukes-Browne gives an account of the zones of the Upper Chalk in Suffolk.

In a paper on "The Marl-Slate and Yellow Sands of Northumberland and Durham," Prof. G. A. Lebour (*Trans.* Inst. Mining Eng.) remarks that these Permian strata rest on the stained edges of eroded Carboniferous rocks. Discussing the origin of the yellow sands which occur at the base of the Permian group, he is disposed to agree with R. Howse that they were wind-blown, and that consequently the overlying Marl-slate may rest somewhat irregularly upon them. Some of the inequalities observable between the divisions are, however, due to the fact that springs carry away portions of the sands, and this subterranean erosion leads to subsidence of the overlying Marl-slate or Magnesian Limestone. The Marl-slate is made up of thin limestones and shales, with marine shells and remains of land-plants, as well as amphibia, and numerous fishes the nearest existing analogues of which inhabit rivers and lakes. The organic remains thus indicate estuarine or lagunal conditions.

A German Bohemian Archæological Expedition to Asia Minor, conducted by Drs. J. Jüthner, K. Patsch and H. Swoboda, and Architect F. Knoll, left Konia (Iconium) on April 4 on a roundabout journey to Isaura, to link on with the work of the Vienna Academy. They visited various towns and villages between Konia and the Lake of Bey Schehir, and investigated the interesting Hittite temple at Fassiler previously discovered by the American explorer Sterrett. In Kyzyldschakiöj they made their most valuable epigraphical discovery of two fragments of a limestone stele, which is important since it bears on the history of the second century B.C., and illustrates certain aspects of Greek public law. An illustration is given of the ruined gate of the acropolis of ancient Isaura which confirms the statement that very little now remains. More than three hundred inscriptions were found, and numerous photographs were taken of monuments and landscapes; the map accompanying the report in *Deutsche Arbeit* (vol. ii. Heft 10, p. 784) was drawn by Prof. Jüthner.

Prof. James Walker's "Elementary Inorganic Chemistry," published by Messrs. Geo. Bell and Sons, and reviewed in our issue for June 19, 1902, has been translated into German by Margarete Egebrecht and Emil Bose. The translation has been published by Messrs. F. Vieweg and Son, of Brunswick.

A second edition of the "Guide to the Search Department of the Patent Office Library, with Appendices," has been published at the Patent Office, Chancery Lane. The first appendix is a descriptive list of unofficial class-lists, and digests of English and foreign patent specifications, and the second contains a select dictionary of words and phrases associated with inventions introduced under letters patent.

We have received copies of the *Compte rendu* of the proceedings of the 1901 meeting of the Société Helvétique des Sciences Naturelles, held at Zofingen, and that of the 1902 meeting held at Geneva. The two volumes of *Verhandlungen* and *Actes*, containing the papers presented and addresses delivered in connection with the same meetings, have also reached us.

Subjects of scientific interest take a prominent place in the current issue of the *Century Magazine*. Mr. Frank W. Stokes, who accompanied the Swedish South Polar Expedition under the leadership of Dr. Otto Nordenskjöld, contributes an article entitled "An Artist in the Antarctic," which is accompanied by three beautifully coloured plates by the author, and these give a vivid impression of the region described. M. J. Deniker writes of Lhasa, under the title "New Light on Lhasa, the Forbidden City." Miss A. K. Fallows explains, in a well illustrated paper, the means adopted to secure for New York a supply of pure milk.

The first part of vol. ii. of "The Fauna and Geography of the Maldive and Laccadive Archipelagoes: being an Account of the Work carried on and of the Collections made by an Expedition during the Years 1899 and 1900," which is being edited by Mr. J. Stanley Gardiner, has been issued by the Cambridge University Press. The first part of vol. i. of this work was reviewed in our issue of April 3, 1902, and the remaining volumes will be dealt with after the publication of the concluding part. The present fasciculus contains reports by Prof. S. J. Hickson, F.R.S., and Miss E. M. Pratt on the Alcyonaria of the Maldives, by Sir Charles

Eliot on Nudibranchiata, by Mr. L. A. Borradaile on the sponge-crabs, and by Sir John Murray, F.R.S., and the editor on lagoon deposits.

THE *Proceedings* of the Washington Academy of Sciences for July 18 is made up of a full account of a meeting held in Columbia University, under the auspices of the Washington Academy, to commemorate the distinguished services to knowledge of the late Major John Wesley Powell, together with a list of the 251 papers and articles written by him during the years 1867 to 1903. Major Powell's work as director of the Bureau of American Ethnology is well known to anthropologists, and his services to science as an explorer, geologist and organiser are of the same high value. As an observer in many fields of natural science, and as one who exerted great influence on scientific progress, Major Powell's memory will long be held in honour.

MESSRS. CHARLES GRIFFIN AND CO., LTD., have now published a tenth edition of Mr. Bennett H. Brough's "Treatise of Mine-Surveying." The book was first published in 1888, and was reviewed at length in our issue of August 2 of that year. The prediction made on that occasion—"as soon as the book becomes known, no English-speaking mine-agent or mining student will consider his technical library complete without it"—has been fully justified, as the issue of a tenth and revised edition shows. Descriptions of appliances invented since the ninth edition appeared at the beginning of last year have now been inserted in the book, and among these additions will be found accounts of Sir Howard Grubb's new sight for mining dials, of Gothan's instrument for surveying bore-holes, and of the Dunbar-Scott mine tacheometer. Besides these improvements, references to important papers lately published and recent examinations questions have been added.

THE current number of the *Popular Scientific Monthly*, in addition to other articles of general scientific interest, reprints the Romanes lecture delivered last June by Sir Oliver Lodge, F.R.S., and publishes the third of a series of papers on Hertzian wave wireless telegraphy by Prof. J. A. Fleming, F.R.S. Other papers are on the bird rookeries on the island of Laysan, and bacteria in modern economic agriculture. From the columns headed the progress of science we learn there are now somewhat more than 100,000 students in the colleges, universities, and technical schools of the United States, and somewhat more than 50,000 in the professional schools of theology, law and medicine. In 1901, 16,513 students graduated from colleges and technical schools, and of these 5050 were women. The number of pupils in secondary schools was in 1901 upwards of 600,000, as compared with less than 100,000 in 1878.

THE additions to the Zoological Society's Gardens during the past week include a Vervet Monkey (*Cercopithecus lalandii*) from South Africa, presented by Mr. — Townshend; two Malayan Bears (*Ursus malayanus*) from Malacca, presented by the Right Hon. Earl of Crawford; two Norwegian Lemmings (*Myodes lemmus*) from Norway, presented by Major-General C. S. Sturt; two Dwarf Chameleons (*Chamaeleon pumilus*) from South Africa, presented by Mrs. Mainwaring; four Tuberculated Iguanas (*Iguana tuberculata*) from Venezuela, three Elephantine Tortoises (*Testudo elephantina*) from the Aldabra Islands, two Radiated Tortoises (*Testudo radiata*) from Madagascar, deposited; a Japanese Deer (*Cervus sika*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

BORRELLY'S COMET (1903 *c*).—The following elements and ephemeris for Borrelly's comet have been computed by Dr. Aitken, of the Lick Observatory, from observations made on June 22 and 30, and July 10 (Lick Observatory *Bulletin*, No 47):—

Elements.

T = 1903 August 27·6056 G.M.T.

ω = 127° 19′ 25″·5
Ω = 293 32 55·0 } 1903·0
i = 84 59 45·3
log q = 9·518126

Ephemeris 12h. G.M.T.

1903	True α	True δ	log Δ	Brightness
	h. m. s.	° ′		
Aug. 13·5	10 54 23	+39 24·1	—	—
,, 15·5	10 48 12	+37 42·9	9·947	6·7
,, 17·5	10 42 2	+35 58·0	—	—
,, 19·5	10 35 58	+34 7·2	9·996	7·4
,, 21·5	10 29 54	+32 7·0	—	—
,, 23·5	10 24 3	+29 54·8	0·038	8·2
,, 25·5	10 18 30	+27 27·0	—	—
,, 27·5	10 13 31	+24 47·3	0·074	7·9
,, 29·5	10 9 20	+21 54·6	—	—
,, 31·5	10 5 59	+18 53·8	0·100	6·2

PROJECTION ON MARS.—In the first *Bulletin* issued by the Lowell Observatory, Flagstaff, Arizona, Mr. Percival Lowell describes the observations of a projection which was discovered on the terminator of Mars by Mr. Slipher at 15h. 34m. (G.M.T.) on May 25. Messrs. Lowell and Slipher afterwards alternately observed the projection, which lasted for about thirty-one minutes; the position angle varied from 204°·0 to 199°·8, and the projection was variously estimated as being removed from the terminator by a perpendicular distance of 0·067–0·075 of the radius of the disc; its length was 1″·58, and it disappeared at 16h. 8m.

The projection was "suspected" again at 15h. 58m. on May 27, and, if really seen, had moved 7° in latitude and 8° in longitude during the twenty-four hours' interval. The observations lead to the conclusion that the projection was probably a cloud of *dust* about 300 miles long, travelling at about 16 miles an hour in a north-easterly direction, and dissipating as it went.

THE SATELLITE OF NEPTUNE.—Using the Crossley reflector, Prof. Perrine has obtained a series of photographs of Neptune's satellite which cover one complete revolution, January 4–January 16, 1902.

The measurements of forty-five plates show that a correction of +0°·55, with a probable error of ±0°·09 in position angle, and of −0″·006, with a probable error of ±0″·020 in distance, must be applied to Hall's elements as published in No. 441 of the *Astronomical Journal*.

The observations are recorded in *Bulletin* No. 39 of the Lick Observatory, which also contains a series of determinations of the position of the planet itself, at certain times, as determined from the same photographs.

THE ESTIMATION OF STELLAR TEMPERATURES.—The question of the relative temperatures of the different types of stars is one of the most important in astrophysics, and has lately been the subject of much discussion in consequence of the discovery that spark lines appear in the arc spectrum under certain special conditions. In *Astr. Nach.* (No. 3882), after reviewing the recent contributions to the discussion, Prof. Kayser suggests a method of estimating the temperatures of stars which is based on an idea put forward in 1876 by Sir George Stokes in a note appended to a paper by Sir Norman Lockyer (Roy. Soc. *Proc.*, vol. xxiv. pp. 352–4). In the case of an incandescent solid body the proportion of the more refrangible radiations increases with the temperature, and Stokes suggested that a line spectrum might behave in the same manner, so that at different temperatures different lines would be most persistent. Prof. Kayser thinks that, while this may not hold for the whole spectrum, it may be true for the lines of a definite series, such as those of hydrogen, or one of the series of lines of helium. On this supposition he has recently undertaken a preliminary investigation for the

detection of such variations in the spectra of hydrogen, helium, and lithium, and has obtained indications that the energy of the shorter waves is relatively increased with increase of temperature, assuming that the temperature in Geissler tubes rises with increased potential and current strength. It is considered probable that further laboratory experiments combined with photometric or photographic estimates of the intensities of the stellar lines may result in a fairly accurate knowledge of the temperatures of some of the stars; great progress will have been made if the temperatures can only be ascertained within one or two thousand degrees.

OBSERVATIONS OF THE MINIMA OF MIRA.—In No. 3888 of the *Astronomische Nachrichten*, Prof. A. A. Nijland records his observations of the last minimum of Mira, which took place during December. Plotting his observations on a curve, he found that the actual minimum occurred on December 17, 353 days after the minimum of December 29, 1901, the magnitude on that date being 8·70 on the Harvard photometer scale.

The following table shows the differences between the dates of minima as predicted by Guthnick (*Astronomische Nachrichten*, No. 3745) and those actually observed :—

Observed	Guthnick	O-G
1901 Feb. 16 ...	1901 March 6 ..	−18 days
,, Dec. 29 ...	1902 Jan. 31 ...	−33 ,,
1902 ,, 17 ...	,, Dec. 28 ...	−11 ,,

THE SIZE OF STELLAR SYSTEMS.—In an editorial article in the *Observatory* for August, a table is given which compares the dimensions of various stellar systems with those obtaining in the solar system. As the writer states, these are not generally known or not remembered, therefore he has tabulated a few of the more interesting and approximately known data, which must, however, only be taken as approximations owing to the uncertainty of the original data from which they are computed.

Object	Separation of components		Motion across the line of sight, in millions of miles per annum
—	In astronomical units	In millions of miles	—
Earth	1·0	93	—
Saturn	9·5	883	—
Procyon	17·3	1,608	372
Uranus	19·2	1,782	—
Sirius	21·1	1,962	316
α Centauri	23·3	2,167	465
Castor	27·5	2,557	140
Neptune	30·1	2,792	—
o_2 Eridani (B and C)	34·5	3,207	2,000
η Cassiopeiæ	44·7	3,947	580
θ Ursæ Maj.	63·0	5,860	1,300
61 Cygni	68·0	6,324	1,116
Polaris	250	23,250	133
Aldebaran	282	26,226	170
θ_2 Eridani (A and B)	455	42,315	2,000

RECENTLY DETERMINED STELLAR PARALLAXES.—No. 10 of the *Publications* of the Groningen Astronomical Laboratory contains the details of the observations and reductions of parallax for the stars and clusters "*h* and χ Persei," "745 Groombridge," and "61 Cygni and the surrounding stars." The photographs from which the parallactic values were determined were obtained by Prof. A. Donner, and have been reduced by Prof. J. C. Kapteyn and Dr. W. de Sitter.

In the summary given for the cluster *h* and χ Persei, 178 stars are included, and it will be possible, when it has been decided, from observations of their proper motions, whether or not the individual stars actually belong to the cluster, to determine the parallax of this cluster with extreme accuracy.

The parallax of 745 Groombridge relative to stars of the mean magnitude 9·0 was found to be $+0''·083 \pm 0''·024$, and on consideration of the star's magnitude (8·2) and its annual proper motion ($0''·64$), $+0''·068$ was accepted as the most probable value of this parallax.

The final value of the parallax of 61 Cygni relative to the four comparison stars (mean magnitude =7·4) is given as $+0''·326 \pm 0''·035$; the plates from which this result was obtained do not confirm the existence of any real difference of parallax between the two components.

No. 11 of the same *Publications* contains a discussion on "The Luminosity of the Fixed Stars" by Prof. J. C. Kapteyn.

EXPERIMENTS IN RADIO-ACTIVITY, AND THE PRODUCTION OF HELIUM FROM RADIUM.[1]

(1) *Experiments on the Radio-activity of the Inert Gases of the Atmosphere.*

OF recent years many investigations have been made by Elster and Geitel, Wilson, Strutt, Rutherford, Cooke, Allen, and others on the spontaneous ionisation of the gases of the atmosphere and on the excited radio-activity obtainable from it. It became of interest to ascertain whether the inert monatomic gases of the atmosphere bear any share in these phenomena. For this purpose a small electroscope contained in a glass tube of about 20 c.c. capacity, covered in the interior with tin-foil, was employed. After charging, the apparatus if exhausted retained its charge for thirty-six hours without diminution. Admission of air caused a slow discharge. In similar experiments with helium, neon, argon, krypton, and xenon, the last mixed with oxygen, the rate of discharge was proportional to the density and pressure of the gas. This shows that the gases have no special radio-activity of their own, and accords with the explanation already advanced by these investigators that the discharging power of the air is caused by extraneous radio-activity.

Experiments were also made with the dregs left after liquefied air had nearly entirely evaporated, and again with the same result; no increase in discharging power is produced by concentration of a possible radio-active constituent of the atmosphere.

(2) *Experiments on the Nature of the Radio-active Emanation from Radium.*

The word emanation originally used by Boyle ("substantial emanations from the celestial bodies") was resuscitated by Rutherford to designate definite substances of a gaseous nature continuously produced from other substances. The term was also used by Russell ("emanation from hydrogen peroxide") in much the same sense. If the adjective "radio-active" be added, the phenomenon of Rutherford is distinguished from the phenomena observed by Russell. In this section we are dealing with the emanation, or radio-active gas obtained from radium. Rutherford and Soddy investigated the chemical nature of the thorium emanation (*Phil. Mag.*, 1902, p. 580) and of the radium emanation (*ibid.*, 1903, p. 457), and came to the conclusion that these emanations are inert gases which withstand the action of reagents in a manner hitherto unobserved except with the members of the argon family. This conclusion was arrived at because the emanations from thorium and radium could be passed without alteration over platinum and palladium black, chromate of lead, zinc dust, and magnesium powder, all at a red-heat.

We have since found that the radium emanation withstands prolonged sparking with oxygen over alkali, and also, during several hours, the action of a heated mixture of magnesium powder and lime. The discharging power was maintained unaltered after this treatment, and inasmuch as a considerable amount of radium was employed it was possible to use the self-luminosity of the gas as an optical demonstration of its persistence.

In an experiment in which the emanation mixed with oxygen had been sparked for several hours over alkali, a minute fraction of the total mixture was found to discharge an electroscope almost instantly. From the main quantity

[1] By Sir William Ramsay, K.C.B., F.R.S., and Mr. Frederick Soddy. Received at the Royal Society July 28.

of the gas the oxygen was withdrawn by ignited phosphorus, and no visible residue was left. When, however, another gas was introduced, so as to come into contact with the top of the tube, and then withdrawn, the emanation was found to be present in it in unaltered amount. It appears, therefore, that phosphorus burning in oxygen and sparking with oxygen have no effect upon the gas so far as can be detected by its radio-active properties.

The experiments with magnesium-lime were more strictly quantitative. The method of testing the gas before and after treatment with the reagent was to take 1/2000th part of the whole mixed with air, and after introducing it into the reservoir of an electroscope to measure the rate of discharge. The magnesium-lime tube glowed brightly when the mixture of emanation and air was admitted, and it was maintained at a red-heat for three hours. The gas was then washed out with a little hydrogen, diluted with air and tested as before. It was found that the discharging power of the gas had been quite unaltered by this treatment.

The emanation can be dealt with as a gas; it can be extracted by aid of a Töpler pump; it can be condensed in a U-tube surrounded by liquid air; and when condensed it can be "washed" with another gas which can be pumped off completely, and which then possesses no luminosity and practically no discharging power. The passage of the emanation from place to place through glass tubes can be followed by the eye in a darkened room. On opening a stopcock between a tube containing the emanation and the pump, the slow flow through the capillary tube can be noticed; the rapid passage along the wider tubes; the delay caused by the plug of phosphorus pentoxide, and the sudden diffusion into the reservoir of the pump. When compressed, the luminosity increased, and when the small bubble was expelled through the capillary it was exceedingly luminous. The peculiarities of the excited activity left behind on the glass by the emanation could also be well observed. When the emanation had been left a short time in contact with the glass, the excited activity lasts only for a short time; but after the emanation has been stored a long time the excited activity decays more slowly.

The emanation causes chemical change in a similar manner to the salts of radium themselves. The emanation pumped off from 50 milligrams of radium bromide after dissolving in water, when stored with oxygen in a small glass tube over mercury turns the glass distinctly violet in a single night; if moist the mercury becomes covered with a film of the red oxide, but if dry it appears to remain unattacked. A mixture of the emanation with oxygen produces carbon dioxide when passed through a lubricated stopcock.

(3) *Occurrence of Helium in the Gases Evolved from Radium Bromide.*

The gas evolved from 20 milligrams of pure radium bromide (which we are informed had been prepared three months) by its solution in water and which consisted mainly of hydrogen and oxygen (*cf.* Giesel, *Ber.*, 1903, 347) was tested for helium, the hydrogen and oxygen being removed by contact with a red-hot spiral of copper wire, partially oxidised, and the resulting water vapour by a tube of phosphorus pentoxide. The gas issued into a small vacuum-tube which showed the spectrum of carbon dioxide. The vacuum tube was in train with a small U-tube, and the latter was then cooled with liquid air. This much reduced the brilliancy of the CO_2 spectrum, and the D_3 line of helium appeared. The coincidence was confirmed by throwing the spectrum of helium into the spectroscope through the comparison prism, and shown to be at least within 0·5 of an Ångström unit.

The experiment was carefully repeated in apparatus constructed of previously unused glass with 30 milligrams of radium bromide, probably four or five months old, kindly lent us by Prof. Rutherford. The gases evolved were passed through a cooled U-tube on their way to the vacuum-tube, which completely prevented the passage of carbon dioxide and the emanation. The spectrum of helium was obtained and practically all the lines were seen, including those at 6677, 5876, 5016, 4932, 4713, and 4472. There were also present three lines of approximate wave-lengths, 6180, 5695, 5455, that have not yet been identified.

On two subsequent occasions the gases evolved from both solutions of radium bromide were mixed, after four days' accumulation which amounted to about 2·5 c.c. in each case, and were examined in a similar way. The D_3 line of helium could not be detected. It may be well to state the composition found for the gases continuously generated by a solution of radium, for it seemed likely that the large excess of hydrogen over the composition required to form water, shown in the analysis given by Bodländer (*Ber., loc. cit.*) might be due to the greater solubility of the oxygen. In our analyses the gases were extracted with the pump, and the first gave 28·6, the second 29·2 per cent. of oxygen. The slight excess of hydrogen is doubtless due to the action of the oxygen on the grease of the stopcocks, which has been already mentioned. The rate of production of these gases is about 0·5 c.c. per day for 50 milligrams of radium bromide, which is more than twice as great as that found by Bodländer.

(4) *Production of Helium by the Radium Emanation.*

The maximum amount of the emanation obtained from 50 milligrams of radium bromide was conveyed by means of oxygen into a U-tube cooled in liquid air, and the latter was then extracted by the pump. It was then washed out with a little fresh oxygen, which was again pumped off. The vacuum tube sealed on to the U-tube, after removing the liquid air, showed no trace of helium. The spectrum was apparently a new one, probably that of the emanation, bur this has not yet been completely examined, and we hope to publish further details shortly. After standing from July 17 to 21, the helium spectrum appeared, and the characteristic lines were observed identical in position with those of a helium tube thrown into the field of vision at the same time. On July 22 the yellow, the green, the two blues and the violet were seen, and in addition the three new lines also present in the helium obtained from radium. A confirmatory experiment gave identical results.

We wish to express our indebtedness to the research fund of the Chemical Society for a part of the radium used in this investigation.

ON THE INTENSELY PENETRATING RAYS OF RADIUM.[1]

RADIUM is known to emit three types of radiation. These are:—

(1) The α rays, very easily absorbed by solids, and carrying a positive electric charge.

(2) The β rays, more penetrating than these, and negatively charged.

(3) The γ rays, intensely penetrating, and not conveying an electric charge at all.

In a paper published in the *Phil. Trans.* for 1901, I investigated the relative ionisations of gases by the α and β rays. The present communication may be regarded as a sequel to that one, and deals with the γ rays.

The radium employed was of activity 1000 (uranium = 1), and was contained in a glass cell, over which was cemented a piece of thin aluminium. The cell was placed in a cavity in a block of lead, and over it was placed a disc of lead 1 cm. in thickness. This it was considered would suffice to suppress all but the γ rays, which are much the most penetrating.

In measuring the electrical leakage, the electroscope method was employed. The apparatus was that described in a paper published in the *Philosophical Magazine* for June, p. 681.

The radium, covered by the thick lead, was placed under the apparatus, and the rate of leak determined when the different gases filled the testing vessel.

The conditions were, of course, arranged so as to use a saturating E.M.F. The γ rays are so penetrating that there can be no question of their being appreciably absorbed in a moderate thickness of gas.

For the methods of preparation of the gases I must refer to the former paper (*Phil. Trans.*, A., vol. cxcvi., 1901, p. 508).

[1] By Hon. R. J. Strutt, Fellow of Trinity College, Cambridge. Communicated to the Royal Society by Lord Rayleigh, F.R.S. Received August 5.

The results were as follows; the rates of leak are given in scale divisions per hour, and are corrected to 30 inches pressure :—

Gas	Rate of Leak	Mean
Hydrogen	10·4, 10·5, 10·4, 11·2, 10·4, 11·2, 9·86, 10·1, 10·2 ...	10·5
Air	65·2, 66·6, 66·6, 60·0, 57·0, 61·5, 60·2, 63·0, 58·2, 58·3, 56·6, 56·2	62·1
Oxygen	75·0, 74·2, 71·0, 74·1	73·6
Carbon dioxide	96·0, 95·4, 94·5, 95·1, 94·1, 94·7	95·0
Cyanogen	107, 104, 106, 106	106·0
Sulphur dioxide... ...	132, 126, 134, 135	132·0
Chloroform	297, 298, 290, 327	303·0
Methyl iodide	298, 292, 310, 291	298·0
Carbon tetrachloride ..	363, 351, 344, 349	352·0

The following table gives the relative ionisations, referred to air as unity. The values of the same constants for the α and β rays formerly found are included, and also measurements of relative ionisation under Röntgen rays. These latter form part of an investigation not hitherto published.

Relative Ionisations.

Gas	Relative density	Relative Ionisation			
		α rays	β rays	γ rays	Röntgen rays
Hydrogen	0·0693	0·226	0·157	0·169	0·114
Air	1·00	1·00	1·00	1·00	1·00
Oxygen	1·11	1·16	1·21	1·17	1·39
Carbon dioxide	1·53	1·54	1·57	1·53	1·60
Cyanogen	1·86	1·94	1·86	1·71	1·05
Sulphur dioxide	2·19	2·04	2·31	2·13	7·97
Chloroform	4·32	4·44	4·89	4·88	31·9
Methyl iodide	5·05	3·51	5·18	4·80	72·0
Carbon tetrachloride ...	5·31	5·34	5·83	5·67	45·3

The determinations for the γ rays are less accurate than the former ones for the α and β rays, on account of the very much smaller rates of leak which have to be measured. I think, if this be taken into account, there is no reason to doubt that, within the limits of experimental error, the γ rays give the same values as the β rays. These values are nearly proportional to the density of the gas, except in the case of hydrogen. The law which holds in the case of Röntgen rays is totally different.

This conclusion throws some light on the nature of the β rays. The view seems to be gaining ground that these are Röntgen rays, produced by the impact of the β rays on the radium itself.[1] This theory seems to have much to recommend it. The β rays should, by analogy with the kathode rays in a vacuum tube, produce Röntgen rays when they strike a solid obstacle, and these Röntgen rays should be much more penetrating than the β rays themselves. The γ rays seem at first sight to be just what should be expected. But the present paper shows that in one respect, at all events, the γ rays behave quite differently from Röntgen rays, while, on the other hand, they resemble the α and β rays. There seems to be a possibility that they too are of a corpuscular nature, though uncharged with electricity. This would account for the absence of magnetic deflection.

I do not think that the absence of conspicuous Röntgen radiation is very hard to understand, if we consider that the current emitted in kathode rays by a square inch of intensely active radium is only 10^{-11} amperes; the current through a focus tube is of the order 10^{-2} amperes, and probably a great part of this is carried by the kathode rays.

[1] See, for instance, Madame Curie, "Thèses presentées à la Faculté des Sciences," 1903, p. 83.

THE COLORATION OF THE QUAGGAS.

IT is well known that, in different districts of their range, the zebras of the type commonly known as Burchell's, but which, for reasons elsewhere given, I propose to call "quaggas," present distinct and easily determinable colour variations, sufficiently constant in character to be worthy of nominal recognition. Grant's quagga occurs in North-East Africa, Crawshay's quagga in Nyasaland, Selous's quagga in Rhodesia, and Chapman's quagga in Angola. Still further south came Burchell's quagga, and south of this again the two or more extinct types which, as Mr. Lydekker has shown, pass currently as the quagga proper.

The first and last of this category are the extremes in pattern variation. Grant's quagga may claim to rank as one of the most completely striped of existing horses. Apart from the ears, which are sometimes nearly white, and the muzzle and fetlocks, which are usually black, he is a mass of stripes from head to tail, from hoof to spine; and in sharpness of contrast between the blackness of the stripes and the whiteness of the interspaces, he rivals the Abyssinian race of Grévy's zebra and the Angolan race of the mountain species, while surpassing both in the inferior extension of the stripes to the middle line of the belly. Place him alongside Gray's quagga, with his pale stripeless limbs, underside and hind-quarters, his brown and confusedly banded body and fawn-lined neck and head, and you will hardly believe them to be the same species. Yet there is no avoidance of the conclusion, since all intermediates have been seen either as living specimens or mounted skins. And one of the chief interests centred in the existence of these intermediates lies in the progressiveness of the change this species undergoes as it passes from north to south over its geographical area. Even in British and German East Africa the pale interspaces on Grant's quagga begin to be washed with brown, and to be filled in with narrower intervening stripes. It will be difficult, perhaps impossible, to distinguish such forms from the quagga of the Mashonaland plateau. The latter, indeed, may be taken as illustrative of the first step in the change above alluded to leading from Grant's to Gray's quagga. From it may be traced a series of gradations represented by the local races named after Chapman, Wahlberg, and Burchell, in which the stripes gradually disappear and thin out upwards from the fetlocks to the shoulders and haunches, while those on the body lose their connection with the mid-ventral band, and, becoming shorter, leave the belly unstriped. Concomitantly the intervening "shadow" stripes increase in number and definition as they extend forwards towards the neck, the normal stripes themselves turn brown, and the ochre-stained ground colour deepens in hue. In the typical form of Burchell's quagga the "shadow" stripes reach the head, and the last of the complete stripes is the one that extends backwards from the stifle to the root of the tail, the hind-quarters and legs being practically, and the belly actually, stripeless. It is but a step from this to the extinct Gray's quagga, in which the stripes of the body were fused together and blended to a great extent with the brown of the intervening areas, those on the neck being exceedingly broad and broken up by paler tracts of hair.

The tendency of these modifications is to convert a striped and conspicuously parti-coloured animal into one which, even at a short distance, must have appeared to be an almost uniform brown, paling into cream on the underside, limbs and back of the haunches. What is the meaning of this change? Inferentially we may conclude it was protective in the sense of subserving concealment.

The testimony of observers in the field has established the truth that the coloration of the coat renders a zebra invisible under three conditions, namely, at a distance on the open plain in midday, at close quarters in the dusk and on moonlit nights, and in the cover afforded by thickets. The procryptic result is achieved by the cooperation of several factors. The white stripes blend with the shafts of light sifted through the foliage and branches and reflected by the leaves of the trees, and in an uncertain light or at long range they mutually counteract each other and fuse to a uniform grey. It is probable, too, that the alternate arrangement of the black and white bars contributes something to the effect produced, by imparting a blurred appear-

ance to the body and destroying the evenness of its surface owing to the difference in light-reflecting power between hairs of these hues to which domestic horses bear witness. Moreover, the extension of the stripes to the very edge of the body and legs breaks up the continuity of the outline, and this, I believe, is the reason for the alteration in their direction on the hind-quarters and limbs, so that, except on the forehead, the whole animal is barred transversely with reference to its spinal and appendicular axes.

We have also the positive assurance of observers that the asses of the deserts of North-East Africa are perfectly adapted to their surroundings in colour, and no one can doubt that the assimilation is equally perfect in the case of the kiang and Prjevalsky's ponies[1] of Central Asia. In the matter of colouring the kiang forcibly recalls the typical quagga, despite a decided difference in the deepness of the brown pervading the upper parts in the two species. Notwithstanding this difference, there can, I think, be no question that the explanation to be given of the significance of the colours of the kiang applies with equal truth to the quagga. This explanation is the hypothesis of the counteraction of light and shade put forward by the American artist, Thayer.

It would be hard to find a better and simpler instance of this style of coloration than the kiang. The upper parts on which the light falls are of a rich ruddy hue, darker than ordinary sand, while the muzzle, the lower side of the head, the throat and the belly are creamy white. Surely no one with a knowledge of the truth enunciated by Thayer will

FIG. 1.—Gray's Quagga lying, to show the unbroken continuity of the white on the underside.

dispute that the arrangement and nature of the colours in the kiang must render it practically invisible when standing in the desert at a distance. But this is not all. Why are the legs, or at least the greater part of them, and the backs of the thighs up to the root of the tail also white? This is doubtless the reason. When the kiang rests on the ground in the attitude characteristic of ungulates, with the hind-quarters depressed, the fore-legs folded and the hind-legs tucked in close to the body, the white on the back of the thighs is brought into line with that of the belly, and a continuous expanse of white, obliterating the shadow, extends all along the underside from the knee to the root of the tail. So, too, with the quagga. This, then, is the meaning of the change in pattern presented by the African species as it passed southwards into Cape Colony. In correlation with the adoption of a life in the open, a new method of concealment by means of shadow counteraction was required, and was gradually perfected by the toning down of the stripes on the upper side and the suppression of those on the hind-quarters, belly and legs.

The same alignment of the white on the rump and belly may be seen in many antelopes, like gazelles, and the co-operation of the legs in increasing the underlying area of white is especially well shown in the bonte-bok.

Now the rump-patches, be it noted, only subserve the purpose here suggested when the animals that possess them are lying on the ground. This, however, is the time, as they drowsily rest or chew the cud, when concealment is of the greatest importance to ungulates, which are, for the most part, clumsy risers, and slow at getting under way. When standing and on the alert, their need for concealment, though seldom absent, is certainly less, and when they are on the run all idea of it is thrown to the winds. It is then that the rump-patches act, as Mr. Wallace suggested, as danger signals and "follow-the-leader" marks, showing the young and inexperienced which way to go, and helping the members of a herd to foregather in the dark when dispersed by the panic of a night attack.

The pattern of a zebra, in its entirety, is also believed by Mr. Wallace to have a double significance analogous to the above. It is known to be procryptic; but he holds that it acts as a badge of recognition, enabling the zebras to distinguish their own kind amongst the herds of other beasts that may be feeding in the same place. It may be so; for although seemingly contradictory, the two explanations are not mutually exclusive. The procryptic effect of the pattern is largely a matter of distance and light. At close quarters in broad daylight a zebra is conspicuous unless under cover, and the colouring is strikingly unlike that of other animals. On the other hand, it must be remembered, as I have elsewhere pointed out (NATURE, October 11, 1900), that the species, like wildebeests, zebras, spring-buck, or even ostriches, which formerly at all events fed together upon the veldt,[1] are so dissimilar in size and shape that the need for a distinctive type of coloration to prevent the postulated likelihood of specific confusion can hardly have been a sufficiently important factor in survival to have guided the evolution of the colour for the purpose supposed. And since we have evidence of the best kind that the pattern of zebras and quaggas is procryptic, it seems unnecessary to look further for its explanation.

R. I. POCOCK.

[1] A suspicious inconstancy about their coloration inclines me to the opinion that these ponies are the descendants of "runaways."

AGRICULTURAL NOTES.

IN the recently published number of the *Journal* of the South-eastern Agricultural College, Wye, Mr. Theobald gives an account of some injurious flea-beetles (Halticæ) which he has recently studied. He finds that the damage ascribed to the turnip "fly" (*Phyllotreta nemorum*) is very often due to related genera. A troublesome attack of the "fly" at the College farm drew attention to a new culprit, *Haltica oleracea*, and in observations made in Yorkshire, Cambridge, Huntingdon, Surrey, Kent and Devon, this species was found to be much more destructive than *P. nemorum*. The characteristics of five injurious genera are described, and observers are asked to collect and report upon these very destructive insects. Mr. Theobald's experience leads him to remark that "The present economic entomologist relies on the past economic entomologist, and so errors go on until they really seem facts. . . . John Curtis wrote the most excellent article on the turnip flea that can be imagined, and we have all copied it." Mr. Theobald's request for "serious reporting and collecting" should appeal to a wider circle than is reached by the College *Journal*. The entomologist is not the only worker who relies on the achievements of the past, nor is economic entomology the only branch of applied science that may learn something from this study of the Halticæ.

In the same number Principal Hall, until recently head of the College, summarises the results of manurial experiments on the hop, which have been carried on at various centres for from three to eight years. He concludes that the hop plant is "an all-round feeder," in this respect differing from such crops as swedes, which depend mainly on phosphates, and from potatoes, which must be liberally dressed with potassic manures. No one special manure can

[1] These odd friendships are a great puzzle; but perhaps the following suggestions may throw some light upon their occurrence and use. It is unlikely in the extreme that all the species concerned have their sense organs developed to an equal pitch of excellence. In one the sense of smell, in another the sense of sight, in a third the sense of hearing will be pre-eminently keen. Hence the sensory imperfections of one species will be made good by the proficiencies of the others; and each will be benefited by the association. Ostriches, for instance, in virtue of their stature and long sight, will see an enemy in open country at a much greater distance than will zebras or gnus, and will give the alarm by starting to run. Zebras, on the other hand, will scent a lion creeping up under cover long before the ostriches will see him; and by making off will warn these birds and other duller scented members of the incongruous assemblage that danger is afoot.

be recommended to hop-growers; the first point in successful management must be to ascertain and make good the manurial deficiencies of the particular soil. In some cases phosphates, and in others potash, may be found profitable as an addition to a dressing of a nitrogenous manure. Specific instructions are given for the manuring of the Farnham hop soils.

To part i. vol. v. of the *Journal* of the Khedivial Agricultural Society, one of the editors, Mr. E. P. Foaden, contributes an article on "Manures in use in Egypt." With the rapid advances made in the material welfare of the country, and the increased use of irrigation, there has been "an extraordinary increase in the value of land," and the subject of suitable manures for use in intensive cultivation is a pressing one. Nile mud, upon which the cultivators have so largely depended in the past, has been proved by experience to be insufficient, and by analysis to lack nitrogen, though supplying an abundance of potash for most, and of phosphate for many, crops. The supply of farmyard manure is very inadequate. In Egypt as in India, the lack of wood leads to the use of dried cow-dung cakes for fuel. Pigeon manure forms a concentrated fertiliser extensively used in Upper Egypt, and dried sewage is becoming popular. Two interesting natural products are mentioned; one, *Coufri*, is a manure collected on ancient village sites, but it is of low quality, seldom containing more than 0·5 per cent. of nitrogen; the other, known as *Marog* or *Tafia*, is a blue clay or a marl found in hills in the deserts in Upper Egypt. This is an important manure in common use in parts of Upper Egypt, and of great value to the country. Analyses of seven samples are quoted, and these show that *Marog* contains notable quantities (from 2·5 to 24 per cent.) of nitrate of soda, associated with which is common salt. The percentage of salt in the analyses quoted varies from 6·8 to 21·5, but there is no constant relation between the salt and nitrate of soda. It is suggested that *Marog* might be treated so as to yield commercial nitrate of soda. In its present crude form the heavy cost of transport prevents the use of *Marog* in Lower Egypt. The article deals briefly with common artificial manures such as nitrate of soda, sulphate of ammonia and superphosphate, all of which are now being imported into Egypt for application to cotton, sugar-cane, and the more valuable cereal and market-garden crops.

When the "Sale of Milk Regulations" came into force in September, 1901, the standard of 3 per cent. fat and 8·5 per cent. non-fatty solids required by the Board of Agriculture was regarded as being very low, and the opinion was freely expressed that the milk of well-fed, healthy cows was rarely so poor in quality. It has since been shown that milk is more variable in composition than was formerly supposed, and that a sample representing a single milking may frequently contain a smaller percentage of solids than is required by the Board's regulations. When milk is drawn at equal intervals, the mixed milk of a herd of cows will usually be satisfactory, but if the milk of the individual cows be tested, it will be found to show wide, and at present inexplicable, variations. On this question some experiments have recently been made by Messrs. Dymond and Bull at Chelmsford, under the auspices of the Essex Technical Instruction Committee. The experiment consisted in testing, twice daily, the milk of six shorthorn cows which were housed, fed and milked under careful supervision and under favourable conditions. Two of the cows were under observation for short periods only. The following figures show the number of times on which the milk of the others failed to reach the standard:—

	Average daily yield lbs.	No. of milk analyses	Fat deficient	Non-fatty solids deficient
Cow I.	30·8	206	8 times	68 times
,, II.	28 8	206	117 ,,	52 ,,
,, III.	16·6	156	1 ,,	0 ,,
,, IV.	18·8	206	0 ,,	0 ,,

The first two animals were in full milk, having calved six weeks before the test began; the other cows had calved eight months, and were beginning to go dry. The feeding was varied in the course of the experiments, and on several occasions the animals were exposed to low temperatures, but the milk was little, if at all, influenced. The quality depended on the cow, not on the conditions under which she was kept. The mixed milk did not fall below standard during the experiments, but the analyses given indicate that when a herd is largely composed of newly-calved cows the milk *may* frequently fall below standard.

An illustrated article in a recent number of the *Scientific American* describes scientific poultry raising as practised on the largest poultry farm in the States (at Sidney, Ohio). On this farm 3000 Leghorns supply on an average 200 dozen unfertile eggs for culinary purposes *per diem*, and 900 Plymouth Rocks produce 450 eggs daily, which the hatchery—a building 480 feet long—converts into 300 healthy chicks. The chicks, when a day old, pass to the "nursery," and spend a month in this building, which is capable of holding 6000 at a time. They then pass to a second building, where they remain until three months old. The chickens are not allowed to mix, but are divided up into small colonies, so that if anything goes wrong the mischief is prevented from spreading. The hens are provided with automatic nests, so constructed that the egg is removed as soon as it is laid; the new-laid eggs are thus collected at once, and are washed, dated, and placed in refrigerators for transport, so that they reach their destination absolutely fresh. Electric light is employed in the testing of eggs, and the progressive poultryman, assisted by the researches of the U.S. Department of Agriculture, feeds his fowls on the most approved principles. The net result of science in the poultry yard is a "marvellous development of the incubator industry" and of the poultry business. It is stated that one town in Illinois turns out more than 50,000 incubators a year. Among leading poultry farms are mentioned those of ex-President Cleveland and of President Diaz, of Mexico.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Royal Commissioners for the Exhibition of 1851 have made the following appointments to science research scholarships for the year 1903, on the recommendation of the authorities of the several universities and colleges. The scholarships are of the value of 150*l*. a year, and are ordinarily tenable for two years (subject to a satisfactory report at the end of the first year) in any university at home or abroad, or in some other institution approved of by the Commissioners. The scholars are to devote themselves exclusively to study and research in some branch of science, the extension of which is important to the industries of the country. The nominating institutions and the scholars are as follows:—University of Glasgow, A. W. Stewart; University of St. Andrews, D. McLaren Paul; University of Birmingham, N. L. Gebhard; Yorkshire College, Leeds, R. Gaunt; University College, Liverpool, J. F. Spencer; University College, London, H. Bassett; Owens College, Manchester, L. Bradshaw; Durham College of Science, T. P. Black; University College, Nottingham, G. Tattersall; University College, Sheffield, Catherine Radford; University College of North Wales, Bangor, K. J. Thompson; Royal College of Science, Dublin, S. A. Edmonds; Queen's College, Belfast, T. B. Vinycombe; McGill University, Montreal, H. L. Cooke; University of Sydney, A. Boyd. The following scholarships granted in 1902 have been continued for a second year on receipt of a satisfactory report of work done during the first year:—University of Edinburgh, J. K. H. Inglis; University of Glasgow, A. Wood; University of Aberdeen, A. C. Michie; University of Birmingham, J. A. Lloyd; Yorkshire College, Leeds, H. D. Dakin; University College, Liverpool, F. Rogers; University College, London, E. P. Harrison; Owens College, Manchester, G. C. Simpson; Durham College of Science, C. R. Dow; University College, Sheffield, G. B. Waterhouse; Queen's College, Galway, W. Goodwin; University of Toronto, W. C. Bray; Dalhousie College, Halifax, Nova Scotia, T. C. Hebb; University of Melbourne, R. Hosking; University of New Zealand, M. A. Hunter. The following scholarships granted in 1901 have been exceptionally renewed for a third year:—Yorkshire College, Leeds, R. B. Denison; University College, London, G. Owen; University College of London, Dr. G. Senter; University College of North Wales, Bangor, Alice

E. Smith; McGill University, Montreal, R. K. McClung; Queen's University, Kingston, Ontario, Dr. C. W. Dickson.

THE August number of the *Fortnightly Review* contains the ninth of the series of essays by Mr. H. G. Wells, entitled "Mankind in the Making," the subject being the organisation of higher education. Among many other important considerations, the suggestions made for "suitable arrangements of studies that can be contrived to supply the essential substantial part of the college course" are of particular interest. The first such course proposed is an expansion of the physics of the school stage, which may be conveniently spoken of as the natural philosophy course. "Its backbone will be an interlocking arrangement of mathematics, physics, and the principles of chemistry, it will take up as illustrative and mind-expanding exercises, astronomy, geography, and geology conceived as a general history of the earth. Holding the whole together will be the theory of the conservation of energy in its countless aspects and a speculative discussion of the constitution of matter." The second course "is what one may speak of as the biological course. Just as the conception of energy will be the central idea of the natural philosophy course, so the conception of organic evolution will be the central idea of the biological course. A general review of the whole field of biology—not only of the natural history of the present but of the geological record—in relation to the known laws and the various main theories of the evolutionary process will be taken, and in addition some special department, either the comparative anatomy of the vertebrata chiefly, or of the plants chiefly, will be exhaustively worked out in relation to these speculations." The other two college courses proposed are named classical and historical respectively. Of a purely mathematical course Mr. Wells writes, "few people, however, are to be found who will defend the exclusively mathematical 'grind' as a sound intellectual training, and so it need not be discussed here." Educationists who study the paper will find in it much material for thought.

THE Home Counties Nature-Study Exhibition will be held at the offices of the Civil Service Commission (formerly the buildings of the University of London), Burlington Gardens, London, W., on October 30–November 3.

MR. ANDREW CARNEGIE has presented to Dunfermline, his native town, the sum of half a million sterling in Steel Trust bonds, to be employed, among other purposes, for the advancement of technical education in the district, which is the centre of the linen industry in Scotland.

M. ANDOYER has been appointed professor of physical astronomy, and M. Painlevé professor of general mathematics, at the University of Paris. M. Padé, of the University of Poitiers, has been appointed professor of mechanics at the University of Bordeaux, and M. Lebœuf professor of astronomy at the University of Besançon.

THE opening address of the Edinburgh summer meeting was delivered on August 4 by Sir John Murray, who reviewed the history of the meetings, and explained that this year the special subject for study was Edinburgh and its region. The chief object of the course of study arranged was to train teachers of nature-study in accordance with the present requirements of English and Scottish schools. Sir John Murray gave it as his opinion, at the conclusion of his address, that "the great battles of the future would be not between man and man, but a struggle for possession of the forces of the earth; and no nation could hope to keep in the forefront if it were not continually making additions to the sum total of human knowledge."

AN Agricultural Education Bill was introduced in the House of Commons by Mr. Collings on August 6. It is similar to the one which passed the second reading in 1895. The object of the Bill is to provide for the teaching in elementary schools of agricultural and horticultural subjects, to give facilities for nature-studies, and generally to cultivate habits of observation and inquiry on the part of the pupils. To this end the Bill provides for school gardens and such collections of objects as may be necessary for practical illustration. The education specified in the Bill is to be compulsory in all schools in rural and semi-rural districts. The Bill cannot be proceeded with this session.

THE prospectus of the Department of Education at Owens College, Manchester, for the session 1903–4, has now been published, and gives full particulars of the courses of training provided for teachers in primary and secondary schools. The instruction received by primary school teachers is for the most part of an undergraduate standard, while that for teachers in secondary schools is of a post-graduate character. Special lectures are provided for those who are already engaged in teaching, and opportunities will be offered of individual study and research in education without reference to any preparation for a diploma or certificate. Among the public lectures arranged in connection with the department are one by the new Sarah Fielden professor—Dr. Findlay—on training for the teaching profession, and one by Prof. M. E. Sadler on the need for scientific investigation in education.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 18.—"Separation of Solids in the Surface-layers of Solutions and 'Suspensions.'" Preliminary Account. By W. **Ramsden,** M.A., M.D., Oxon., Fellow of Pembroke College, Oxford.

In this paper it is shown that the free surfaces of a large number of colloid solutions become coated with solid particles derived from the solutions under conditions excluding evaporation, or chemical change due to the gases in contact with the free surfaces. This is the case not only with proteid solutions of every kind, but also with solutions of certain aniline dyes, soaps, saponin, methyl orange, colloid ferric hydrate, &c. These surface coatings give rise to an intense viscosity confined to the surface layers and absent from the bulk of the solutions. In some cases the solid particles become mutually coherent to form a solid membrane, and then cause an intense superficial resistance to "shear." A magnetised needle floating on the surface of a colloid solution as limpid as water may be in some cases so rigidly fixed that it rotates the vessel containing the solution if this be suspended by a thread and a magnet be brought near.

By simple mechanical means, adapted to produce heaping up of any surface coatings, masses of solid material can be separated from all these solutions—in some cases when they contain only one part of dissolved solid in a million. Various solids can in this way be completely removed from solution without filtration, addition of chemicals, or necessary alteration of temperature. The "mechanical coagula" described by the author some years ago are simply heaped-up surface membranes of solid proteid.

These accumulations at the free surfaces are explained by the observation that the dissolved substances are always such as possess the property of diminishing the surface-tension of the free surface of water. The most stable mechanical arrangement of such solutions must involve a relative concentration of the dissolved substance at any surfaces the surface-tension of which can be thereby diminished, and in some cases the formation of a coating of de-soluted solid completely separating the solution from the adjacent medium.

Every limpid solution capable of forming unusually persistent thin films or bubbles yields solid or highly viscous "mechanical surface aggregates," and is therefore regarded as having a surface coating of solid or highly viscous matter. On some of these bubbles the presence of a coherent surface membrane can be directly demonstrated by their behaviour on collapse. Unusual persistence of a thin film derived from a limpid solution is invariably associated with the presence of solid or highly viscous particles on its free surfaces. Particles of this nature and in this situation would act partly by serving as *points d'appui*, partly by offering mechanical resistance to deformation of the surface, and partly, in virtue of their effect upon the "surface energy," by calling out resistance to such deformation as would expose a fresh surface of greater "surface-tension."

Precisely similar phenomena are met with at the interfaces of certain immiscible liquids one of which is a solution, and the great persistence of many emulsions is due mainly to the accumulation of solid or highly viscous particles at the interfaces of the two liquids.

Superficial resistance to "shear," the capability of yielding "mechanical surface aggregates" and "coagula," the possession of marked bubbling-power, and the formation of very persistent emulsions by certain limpid liquids, are all explained as due to the accumulation of certain substances in a solid or highly viscous condition at the surfaces concerned, and to the physical properties of the matter thus accumulated.

PARIS.

Academy of Sciences, August 3.—M. Albert Gaudry in the chair.—The relations between multi-fluid batteries, by M **Berthelot.**—Remarks concerning the relations between batteries formed of the same liquids, between two different or identical electrodes, by M. **Berthelot.**—On a double carbide of chromium and tungsten, by MM. Henri **Moissan** and A. **Kouznetzow.** A double carbide of chromium and tungsten of the formula $CW_2.3C_2Cr_3$ has been prepared by two different methods. It is similar to analogous compounds indicated by MM. Carnot and Goutal as existing in metallurgical products. The carbide is very stable, not attacked by acids or by ordinary reagents, and is remarkable for its extreme hardness, scratching quartz and topaz with ease. It is possible that this compound may be formed by the addition of tungsten to chrome steels, and may be the cause of some of the special properties of these steels.—Does arsenic exist in all the organs of the animal economy? by M. Armand **Gautier.** A review of the work done on this question since the author's first memoir in 1899, together with a minute study of the influence of arsenic in the reagents on the results.—The addition of hydrogen to aldehydes and ketones by catalysis, by MM. Paul **Sabatier** and J. B. **Senderens.** The direct action of hydrogen in presence of reduced nickel at a low temperature readily transforms aldehydes and ketones into the corresponding alcohols. The method possesses the advantage of furnishing the alcohols free from secondary products, and in high yields.—The residue of secular perturbations, by M. Jean **Mascart.**—On quasi-periodic functions, by M. **Esclangon.**—On the functions of n variables represented by series of homogeneous polynomials, by M. H. **Dulac.**—On the integrals of S. Lie, by M. N. **Saltykow.**—On the changes in phase resulting from the normal reflection in quartz on silver, by MM. J. Macé **de Lepinay** and H. **Buisson.**—A description of an instrument designed to measure accurately the optical constants of microscope objectives and eye-pieces, by M. V. **Legros.**—On telekine, by M. L. **Torres.** The name telekine is applied by the author to a system of a spring and governor, controlled from a distance by wireless telegraphy. Among the applications suggested by the author as possible are the direction of submarine torpedoes and of balloons.—New laws of tonometry, deduced from Raoult's experiments, by M. E. **Wickersheimer.**—Pressure curves of univariant systems containing one gaseous phase, by M. A. **Bouzat.** Four groups of univariant systems are distinguished, for which it is found that the ratio of the absolute temperatures corresponding to a given pressure in any two systems of the same group is constant for any value of the pressure. This is equivalent to the proposition that the variation of entropy resulting from the liberation of one molecule of gas under a given pressure has the same value for all systems in one group.—The estimation of pyridine in aqueous solution, by M. Maurice **François.** The method is based on the formation of the chloroaurate, $C_5H_5N.HCl.AuCl_3$, and its insolubility in ether. The chloroaurate is ignited, and the amount of pyridine deduced from the weight of gold left.—On secondary amides, by M. **Tarbouriech.** By the action of acid chlorides upon primary amides in sealed tubes at 110°–115°, several mixed secondary amides have been prepared, the physical and chemical properties of which are given.—The reduction of the ethereal salts of acids of complex function, by MM. L. **Bouveault** and G. **Blanc.**—The action of phenyl hydrazine on alkyl bromides and iodides, by M. J. Allain **Le Canu.**—Thermochemical researches on colouring matters. Rosaniline and pararosaniline, by M. Jules **Schmidlin.**—On the estimation of ammonia in wine and its use in differentiating *mistelles* from liqueur wines, by M. J. **Laborde.**—On the salol ferment present in certain samples of milk, by M. A. **Desmoulière.** Remarks on a paper on the same subject by MM. Miele and Willem.—On the properties and chemical composition of the phospho-organic reserve material of plants containing chlorophyll, by M. S. **Posternak.** It is shown that the phospho-organic reserve material of green plants possesses characteristic properties by means of which it can be easily differentiated from other phosphorus compounds already known.—Excretion in hydroids, by M. A. **Billard.**—The mechanical laws in the development of the skull of Cavicornes, by M. U. **Duerst.**—The digestive apparatus of the Silphidæ, by M. L. **Bordas.**—On the Heteropods collected during the voyages of the *Hirondelle* and the *Princesse Alice*, made under the direction of the Prince of Monaco, by M. A. **Vayssière.**—Sections of the Tertiary strata of Patagonia, by M. André **Tournouër.**—On the geological constitution of the district of Mirsa Matrouh, by M. D.-E. **Pachundaki.**—The sensitisers of the tubercle bacillus, by MM. J. **Bordet** and O. **Gengou.**

NEW SOUTH WALES.

Royal Society, June 3.—Mr. F. B. Guthrie, president, in the chair.—Language of the Bŭngandity Tribe, South Australia, by Mr. R. H. **Mathews.** The paper dealt with the grammatical structure of the aboriginal tongues of the tribe. The author also briefly referred to the social organisation of South Australian tribes from the Lake Eyre basin to Port Lincoln and Mount Gambier.—Notes on tide gauges, with description of a new one, by Mr. G. H. **Halligan.** The author gave a brief history of the development of the automatic tide recorders, and exhibited a new gauge of his own design.

CONTENTS.