THURSDAY, JUNE 28, 1894.

STUDIES IN FORESTRY.

Studies in Forestry. A Short Course of Lectures on Silviculture, delivered at the Botanic Garden, Oxford, 1893, by John Nisbet, D.Oec. (Oxford: Clarendon Press, 1894.)

DR. NISBET is an officer of the Indian forest department, specially trained in forestry in Germany, and after spending a number of years in the charge of extensive forests in Burma, he was, a year or two ago, permitted by the Secretary of State for India to make a further study of German forestry in Bavaria. Whilst in Bavaria he wrote six useful essays on forest subjects, which have been published by order of the Secretary of State for India, and they are now being circulated to subscribers to the *Indian Forester*, a monthly magazine published in Dehra Dun, where Dr. Nisbet is now serving as deputy director of the Indian Forest School.

The author states in his preface that he has, with the consent of the Secretary of State, embodied much of the matter in these essays in the "Studies in Forestry," and much of the remainder occurs in Dr. Nisbet's "British Woodlands," or in his translation of a German work on forest protection.

Much of the matter contained in the "Studies" will also be found in Dr. Schlich's "Manual of Forestry," vols. i. and ii., which works are largely founded on the same authorities as those used by Dr. Nisbet, whose work must have been greatly simplified by having ready to hand Dr. Schlich's well-chosen English equivalents of the various German technical forest terms.

As all the books just referred to have been already reviewed in NATURE, a detailed notice of the present work is hardly called for, though it will prove instructive to those who have not seen the former books, if they allow for the author's want of practical experience in the British Isles, where forestry is under different climatic conditions to those prevailing in Germany. The first chapter of the book, however, on "Forestry in Britain," is very forcibly and well written, and contains much suggestive matter to which the attention of everyone interested in forestry should be drawn.

Taking the area of British forests roundly at 3,000,000 acres, and allowing ninety years as their average rotation, their cost of production is estimated as equivalent to:—

(Annual rental of 3,000,000 acres + cost of forming, or regenerating them) × $1{\cdot}0r^{\frac{90}{2}}$;

where r is the rate of interest at which a forest owner is content to lock up his capital of soil and growing stock.

This rate he, perhaps erroneously, urges should be higher than that used in agriculture, on account of the greater risk incurred by forests from storms, insects, fire, &c. Scotch owners who have suffered from the hurricane last December, which blew down 1½ million trees in Perthshire and Forfarshire, will be disposed to agree with the author here; but the fact is that all these risks would be very greatly reduced if British forests were properly managed so as to withstand storms and the other dangers referred to. However, owing to the appreciation of *broad acres*, Dr. Nisbet puts the rate of interest at 2½ per cent., that of funded property, which is probably the correct figure after all. Placing therefore the average rental of woodland at 5*s*. an acre, and the cost of formation at £2, that of planting Scotch pine in Perthshire; he arrives at the following figures:—(3,000,000 × £2 – 5*s*.) 1·025 = £20,500,000 nearly, which is the cost of production of our woodlands, the prospective value of the mature crop being much greater. On comparison with results in Germany, and assuming that our forests are as well managed as German forests, which is at present far from being the case, they should yield an annual revenue of £2,000,000, or at 25 years' purchase be worth £50,000,000. Forty years' purchase and £80,000,000 would, however, be the correct figure at 2½ per cent.

After this estimate comes a reference to the value of our timber imports from Northern Europe, which in 1892 was £9,207,905, and the fact, to which Dr. Schlich in 1890 first drew public attention, that all this material might be produced on waste land in the British Isles, and employment thus provided for several hundred thousand people.

The rapidly approaching exhaustion of the North American forests is also referred to; and considering that the United States is now importing annually enormous quantities of timber from the Dominion of Canada, and that the Canadian forests are being worked in the same destructive manner as in the United States, it is surely time for Canadian legislators to attend to the formation of large State timber reserves, and provide for the education of a trained forest staff to look after them. *Quis custodiet ipsos custodes?* the negligence shown by the Canadian Executive in this respect looks as if the lumber trade was more attractive than attention to the future welfare of the country. A reference to the latest number of the *Garden and Forest* shows that the United States Government has done nothing yet to protect and manage the vast tracts of forest which there, at any rate, have been for the present saved from alienation as State property. One of the strongest reasons in favour of our establishing national instruction in forestry on a proper scale, and bringing our own Crown forests into a high state of production, is the example it would set to our colonists, and the chances that more of them might come here to study forestry, as they do at present to study engineering, law, and the arts.

Dr. Nisbet refers in hard but not undeserved terms to the results of the Parliamentary Committees on Forestry, remarking that the solemn farce of appointing a Committee, and then letting the question slide, has twice been played with regard to forestry in Britain. The only results from the Committee of 1887 have been that the Treasury pays £100 a year to a lecturer on forestry at Edinburgh University, and £250 (half the salary of the professor of agriculture and forestry) at Newcastle, also £150 each to the Royal Botanic Gardens, Edinburgh and the Glasgow Technical Institute for free classes to foresters and gardeners.

The second Committee of 1889, to inquire into the administration of the Crown forests, came to the conclusion that they were being carefully administered, which does not tally with the previous finding of the 1887 Committee.—"*In respect of the Crown forests, the difference between skilful and unskilled management would itself more than repay the cost of a forest school.*"

Certainly it would be for the national benefit, if purely pleasure-grounds, such as Windsor Park, were excluded from the Crown forests, and handed over to the Board of Works, and that the 57,300 acres of the Crown forests actually under timber crops, and worth at least £1,500,000, should be brought up to the highest degree of productiveness, and serve as models of economic forestry to all the private forest-owners in Britain.

Dr. Nisbet states that the salaries and allowances of the officers in charge of the Crown forests average £900 a year, and urges that in all future appointments to these posts a high degree of qualification in forestry should be required, and also from one of the Commissioners of Woods and Forests.

A most amusing account, taken from the Report of the Forestry Committee of 1887, is given by Dr. Nisbet of the examination of a lecturer in forestry of the Cirencester Agricultural College, who stated that he taught forestry in six or seven lectures, but admitted that he had himself learned forestry there, though he did not consider the course sufficient *even for land-agents.* Other quotations from the evidence of Mr. Britton, a leading timber merchant of Wolverhampton, and the late Mr. MacGregor, then in charge of 20,000 acres of the Athole forests in Perthshire, testify to the utter ignorance of forestry possessed by land-agents and factors in both England and Scotland.

In the present state of agriculture, where economic forestry alone will pay on the poorer lands, it is essential that land-agents should possess a fair knowledge of forestry. Broillard, the French silviculturist, goes even further and advises land-owners to learn how to manage their forests for themselves.

Dr. Nisbet refers to the well-equipped forestry staff at Cooper's Hill College, where the three years' course costs £183 a year, including the cost of a fourteen days' tour in the Norman forests, and five months' practical forestry instruction in Germany. He states, however, that the Forestry Branch was added to Cooper's Hill, to prop up an Engineering College which had ceased to pay its expenses, and that there is nothing in the situation of the college to have induced the Government to have located the Forestry Branch there. As a matter of fact, Cooper's Hill is admirably situated from a forest point of view; the 9,000 acres of the Windsor Forest, exclusive of the park, and stocked with every species of tree which will grow in Central Europe, is close to the college, and in it the college has leased 800 acres, chiefly of Scotch pine forest, for practical work for the forest students. There are excellent forest nurseries, osier beds on the Thames, a good Crown coppice with standards of 800 acres at Esher, and large areas of beech selection forests on the Chiltern Hills, all of which are regularly visited by the students, whilst the magnificent oak and beech forests of Normandy are only a night's journey distant, and in them the students spend fourteen days every year. One reads nothing but praise of the old Indian College at Haileybury; and *esprit de corps* among the scientific branches of the Government of India is certainly fostered by training engineers, telegraphists, and foresters at the same college in the loveliest and most wooded part of England. There are more distractions at Oxford, and longer vacations; and after allowing for the cost of all the necessary excursions and practical work in continental forests, it is doubtful whether living at Oxford would be cheaper than at Cooper's Hill, if it had been selected instead of the latter place for the training of future Indian forest officers.

There can, however, be no question that independently of the training of Indian forest officers, in which already men from the colonies have joined, and there is plenty of room for more, there should be available at our principal universities regular instruction in forestry for the benefit of land-agents and land-owners. Dr. Nisbet suggests that two chairs of forestry, each at £700, should be established by the State at Oxford, Edinburgh, and Dublin, and four instructorships in forestry, at £150 each, at Dunkeld, Grantown, Coleford, and Lyndhurst. This would cost in round numbers £5000 a year, which is a slight insurance to pay for the better management of woodlands which have already cost £20,000,000, and will most likely be considerably added to in the immediate future, being less than ¼*d.* an acre on land actually under timber.

Forestry is, however, eminently a practical profession, and the best teaching will not suffice unless extensive well-managed tracts of our Crown forests are also made available for practical illustration of the matter taught by professors.

Sir J. Lubbock quite recently stated at a public meeting that good forestry could only be initiated by the State, and it must be satisfactory to all lovers of forestry that he is again disposed to take interest in the matter, although when member of the Committee on Forestry his attention was unfortunately distracted by other pressing business, and no satisfactory results followed.

W. R. FISHER.

THE COMPARATIVE PATHOLOGY OF INFLAMMATION.

Lectures on the Comparative Pathology of Inflammation, delivered at the Pasteur Institute in 1891 *by Elias Metchnikoff, Chef de Service à l'Institut Pasteur.* Translated from the French by F. A. Starling and E. H. Starling, M.D. With sixty-five figures in the text, and three coloured plates. (London: Kegan Paul, Trench, Trübner and Co., 1893.)

THE work before us is a translation of Prof. Metchnikoff's well-known book on the comparative pathology of inflammation. This work has been so well reviewed by Prof. Ray Lankester in NATURE (vol. xlv. p. 505), that it is almost superfluous to give a fresh account of it.

Readers of NATURE will remember that the book is really an attempt at establishing a biological theory of inflammation, which is summed up by the author as follows:—"Inflammation generally must be regarded as a phagocytic reaction on the part of the organism against irritants. This reaction is carried out by the mobile phagocytes, sometimes alone, sometimes with the aid of the vascular phagocytes or the nervous system." This definition of inflammation of course differs essentially from that adopted in pathological text-books, for Metchnikoff places the vascular phenomena in the second rank, and reduces to a minimum the part played by the nervous system. It must be acknowledged, however, that the author brings forward a formidable array of facts observed in the various branches of the animal kingdom in order to place his theory on a sure footing; and he clearly establishes one point, namely, that inflammation may take place without the blood-vessels or nervous system playing any part in it. On the other hand, a critic might object that, in the higher animals at least, there are many forms of inflammation in which the amœboid cells take little, if any, part at all. The proposition is, nevertheless, for the most part true, and it has undoubtedly given us a key to the understanding of many obscure points connected with the problem of immunity against microbes.

To a large extent the process of resistance of the animal body against the invasion of micro-parasites is due to the action of cells derived from the mesoblast. This, Metchnikoff has demonstrated by a number of extremely interesting experiments, and has shown that, in vertebrate and invertebrate alike, this function is at all times carried on. He and his pupils have proved that it is a normal physiological function taking place in certain parts of the body, such as the tonsils and the Peyer's patches of the intestine.

The theory of Prof. Metchnikoff has not been accepted by the majority of pathologists, and has been treated with scant respect by many bacteriologists, more especially in Germany. In this country it has, however, been received with greater favour, and it is well that such a book should have been translated by Dr. and Mrs. Starling. Indeed, for the translation we have nothing but praise; it is worded in excellent English, and, what is more, the meaning of the author is, with very few exceptions, exactly reproduced.

It is interesting, however, to see how much of the work is controversial in character, and one might almost wish that Prof. Metchnikoff had not wasted so much time in disputing the many rival theories which have since been shown to be erroneous, and are no longer held even by their promoters. The theory, for instance, that the defence of the organism was due to the so-called bactericidal power of the serum, a theory which was defended by so well known an observer as Dr. Klein, has now been almost universally given up. Metchnikoff and his pupils hit the right nail on the head when they proved that the bactericidal action of the serum in a test-tube was a very different thing from the action of the serum in the living body. Indeed, it is difficult to understand how such a notion should have received any favour, when not a single fact could be produced to show that this bactericidal action ever takes place in the human or animal body. The experiments of Sanarelli, which seemed at one time to support it, have now received another interpretation from their author. When, later on, it was shown that the bactericidal action of the serum in immune animals was very much more marked than in non-immune animals, it was thought that a strong point had been scored against the phagocytic theory; but the discoverers of this fact, Messrs. Behring and Nissen, had to confess that this stronger bactericidal action was not always present in immune animals, and that it occurred in some diseases only. Lastly, the theory was finally buried when Metchnikoff showed that this bactericidal action of the serum had no power to check the reproduction of micro-organisms, and that the immunity was produced by the action of the despised amœboid cells. Indeed, to thinking pathologists, it was apparent from the first that a theory based on the action of the serum was an impossible one, for all the facts relating to serous effusion in the human and animal body pointed to an opposite conclusion. In the majority of cases, serous effusion produces no immunity, and, in many cases, the fact that a large quantity of fluid is exuded from the vessels shows that the disease must end fatally.

Of the anti-toxic theory, which was promoted at one time by Behring and his school, Prof. Metchnikoff speaks with great respect; but in a series of interesting pages he shows how it does not apply to all cases, and that even when the blood contains a large amount of anti-toxine the patient nevertheless dies of the disease; and conversely, that an animal may be immune against a disease without its blood having any anti-toxic power whatever on the toxines secreted by the bacillus which is the cause of the disease.

Prof. Behring himself has now been obliged to give up this theory, and it has been lately shown by Buchner and others that, as a matter of fact, the serum of an immune animal has no anti-toxic power at all, and that in such cases the animal recovers owing to the rapidity with which the immunity is produced.

Of the other rival theories it is unnecessary to speak, as Prof. Metchnikoff has himself shown that a great many facts which have been brought forward to support them cannot be maintained. Of all the theories, therefore, which have been thought to explain the natural and acquired immunity of animals and man against infectious disease, the phagocytic theory is the only one which still holds the field, and, although it will not explain all the phenomena of immunity, it is the only one which is based on accurately observed facts, and which will explain how microbes are destroyed in the body. Moreover, those who will read the present book, will see that Metchnikoff himself has always allowed that probably there are other factors in the production of resistance against infectious disease, but that the chief factor was the part played by cells derived from the mesoderms, and especially by the wandering amœboid cells.

OUR BOOK SHELF.

The Camel, its Uses and Management. By Major A. G. Leonard. (London: Longmans, Green, and Co., 1894.)

THE author treats in this work of the management of the camel in connection with military operations, the result of his experience in India, Afghanistan, Egypt, and the Sudan. He does not claim to have produced a scientific essay on the animal, but rather to furnish officers and others in charge of camel transport with a practical description of the camel, his treatment and management, so as to enable them to avoid the causes to which the enormous mortality of baggage camels in recent expeditions has been mainly due. After describing the anatomy and temperament, the author considers it to be essentially a stupid animal, and incapable of looking after itself, though a model of patience under most trying conditions.

In mentioning the principal breeds of African camels, the Maazee tribe north of Kena is omitted, also the Howetat, who, though now poor and few in numbers near Cairo since the railway has robbed them of the carrying trade between Cairo and Suez, are still a large and important tribe in the Sinai peninsula. The Kabbabish tribe from the neighbourhood of Dongola, mentioned as a powerful and wealthy tribe, has, since the beginning of the Mahdist movement, been practically wiped out.

The author strongly advocates the establishment of stud farms to improve the breeds, as has been done by the French in Algeria, and then goes on to the important subject of watering, strongly combating the common belief that a camel does best on a small supply of water, and that before a desert march they should be watered at intervals, so as to train them, and to make them drink the more before starting. Doubtless many errors on this subject and that of feeding have sprung from information obtained from Arabs, who, though skilled in management, cannot always be depended on for their explanations, as in the case of a Sheikh whom we heard say that "a camel required less food on a hard desert march than when in camp, because the stomach shrunk when in work." Without doubt they should always start on such marches in the best possible condition, and not weakened by previous fasting, while, as the author points out, a main reason of the Arabs' success with their camels on long and arduous marches is that they do not hurry them, and afterwards graze them for days and even weeks to recruit, a thing impracticable on service, where work is at high pressure, and a large reserve of baggage camels is rarely available.

The importance of careful loading and suitable saddlery is strongly insisted on, and this latter point might with advantage have been gone into more fully with figures of the various riding and baggage saddles in use, since we have not yet got a satisfactory service pattern saddle. A diagram of the camel's skeleton might also have been added to the chapter on loading and marching. Chapter iii., setting forth the author's views on the instinct and intelligence of various animals, might have been omitted or greatly curtailed, seeing how little of it relates to the camel.

The subject is of great importance, and, as a practical work, the result of much experience, this book meets a want, though reference would have been greatly facilitated by an index.

Modern Plane Geometry. By G. Richardson, M.A., and A. S. Ramsey, M.A. (London: Macmillan and Co., 1894.)

A CLOSE examination of this small treatise shows at a glance that the usual method of treatment has undergone considerable alteration. The proofs contained therein are of those theorems in the syllabus of modern plane geometry which was issued by the Association for the Improvement of Geometrical Teaching. The range of the subject treated may be gathered to a certain extent from the statement that the work is intended to serve as a sequel to Euclid, or to the "Treatise on Elementary Plane Geometry" issued by the above-mentioned Association, and, as the authors state, as a systematic means of procedure from Euclidean geometry to the higher descriptive geometry of conics and of imaginary points. The chapters treat of the geometry of the triangle, quadrangle and circle, harmonic ratio, geometrical maxima and minima, that relating to the first being fully considered and containing an introduction to more recent work on special points connected with the triangle. Other chapters deal with cross ratios, involution and reciprocal polars, and projection. The authors inform us that there has been practically no departure from the syllabus referred to above, with the exception of a few additions and the interpolated examples and problems. The theorems are for the most part accompanied by clearly drawn figures which considerably facilitate the rendering of the text.

A little familiarity with this treatise will commend it to many of our readers, for the authors are clear and concise in their treatment of the theorems with which they have dealt.

Chemistry Demonstration Sheets. (London: Blackie and Son, 1894.)

IN our opinion, the series of diagrammatic sketches of chemical apparatus just published by Messrs. Blackie may be put to extremely harmful use. "The sheets have been designed," say the publishers, "as a lecture-room aid in the teaching of chemistry. They present, drawn in bold outline, the apparatus used in the experiments of a first course, and underneath each diagram is set down the chemical formula of the experiment. The diagrams are drawn in elevation, and are just what a student requires to sketch in the examination room, while the formulæ, being constantly before the eye along with the diagrams, will become indelibly imprinted on the memory." If the sheets are merely used to describe the arrangement of apparatus for experiments actually performed, no one will, of course, object to them. But if (and this is more likely) the sheets are employed to impress upon the student's memory chemical reactions and apparatus never seen in reality, they could not be condemned too strongly. Teachers are often too glad to avoid experimentation and to refer their classes to text-books for descriptions of chemical changes brought about by various means. Messrs. Blackie's wall sheets will facilitate such a shirking of responsibility.

LETTERS TO THE EDITOR.

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

Panmixia and Natural Selection.

MR. WELDON'S letter on this subject, in NATURE of May 3, calls, I think, for a few further observations. He first criticises the statement that "the survival-mean must, on cessation of selection, fall to the birth-mean," by showing that there are probably cases in nature in which the survival and birth-means may coincide, owing to the removal by selection of all individuals above and below the mean, they being approximately equal in number. This is, no doubt, the case with certain characters of a species, but probably never with all or even with most characters. Darwin states that in France and Germany white pigeons are killed off by kites, and that on the coast of Ireland black fowls are also killed off by sea-eagles. These and other analogous facts render it probable that in many species of animals colour is kept to the inconspicuous and protective mean tint by the elimination of all individuals which vary much on either side of it, and thus, as regards colour, the birth-mean and the survival-mean may be almost identical. But with many other characters this is not the case. In sheep, cattle, and horses it has been observed that when the larger low-land breeds are taken to bleak mountain regions they gradually dwindle in size, only the smaller and hardier of each generation surviving the severe winter and spring climate and the comparatively innutritious food. Here the elimination is clearly in one main direction; and the absence of this selection due to the transference of the whole body of such reduced individuals to a milder climate and better pastures, would no doubt lead to a slight increase of average size, indicating that the birth-mean had been above the survival-mean. So also in the case of the half-wild horses of Circassia, which are greatly exposed to attacks of wolves and to extreme vicissitudes of climate, swiftness, strength, wariness, and a hardy constitution must be kept at a high level of efficiency by the elimination of the less gifted in these qualities; so that here again the birth-mean must be below the survival-mean. In such cases as these there seems no difficulty in the fact that the mean characters do not change for many generations; for this is in accordance with Darwin's principle that natural selection "cannot produce absolute perfection, but only relative perfection." When the average characters of a species have reached a point such that it can permanently maintain itself in a given area, then no further change will occur; but, the less efficient being constantly weeded out, the survival-mean will be necessarily a little above the birth-mean. Both means will, however, be sensibly permanent as long as the environment remains unchanged.

Mr. Weldon says that it has not been shown that, in some given case, Panmixia does in fact occur; and further, that in the only case which has been experimentally investigated—that of the stature of civilised Englishmen—the consequences said to result from it do not, in fact, occur. To obtain absolute evidence of Panmixia, or of the action of Natural Selection, is extremely difficult, because we cannot first compare and measure minutely a large number of individuals in a state of nature, and then follow those same individuals throughout their lives and see how nature deals with them. We can, however, observe what happens in the case of semi-wild animals, and the examples already cited show that natural selection must, and actually does, act on the character of colour, weeding out those which diverge on both sides towards whiteness or blackness, and in the case of physical and mental activities destroying those which fall below the standard of excellence requisite for the preservation and continuance of life.

In our domesticated animals, on the other hand, we find what are probably examples of the effects of Panmixia. The wing-bones of our pigeons, fowls, and ducks, as compared with wild individuals, were found by Darwin to be decidedly reduced in size in proportion to the leg-bones; but a part of this may be due to disuse in the individual, and to determine the share of the two causes seems impossible. There are, however, a few characters in which we see Panmixia alone at work in our domesticated animals. Such are, for example, the constant appearance and increase among them of prominent *unsymmetrical* markings, as in dogs, cats, cattle, and horses. Such markings never occur in wild races, or if they occur in individual cases they never increase; and I have given reasons for thinking that symmetrical colour and marking is kept up in nature for facility of recognition, a factor essential to preservation, and to the formation of new species. In this case, there can be no question of disuse, while as we know that white and unsymmetrical individuals do occasionally occur in wild species, but never increase, the fact of their increase under domestication must be due to the absence of whatever form of natural selection eliminates them in nature; that is, to Panmixia. Another illustration may perhaps be found in the fact of curled tails appearing in domestic pigs and some races of dogs, while no wild animal is known which has a curled tail. We can hardly doubt that the special form of tail in each animal is of use to it, and that any abnormality, like a curled tail, would be eliminated under nature. Its appearance and perpetuation under domestication is therefore a fair example of Panmixia.

The slow increase of the stature of civilised Englishmen, which Mr. Galton is said to have proved, may, it seems to me, be partly a result of Panmixia, and partly due to more healthy conditions of life acting on the individual. It is, I presume, a fact, as generally stated, that old armour shows that the knights of the middle ages were rather short men. This may have been a result of natural selection, because, as a rule, the strongest and most active men are rather under than over middle height; while tall men would certainly be more exposed to danger, would have to carry a greater weight of armour, and by thus overloading their horses would be under a disadvantage in battle. Tall men would thus be killed off rather faster than short men; and the same might be the case even after the disuse of armour, so long as rapine and civil war prevailed over a large part of the country. But during the last two centuries of comparative peace tall men have been under no such disadvantage, and their survival may have aided in bringing about the slight increase of average stature which has been observed.

One other point in Mr. Weldon's communication requires notice. He considers that the frequent occurrence of abnormalities and the wide range of variation in many species, show that "natural selection is in most cases an imperfect agent in the adjustment of organisms." This conclusion does not appear to me to be a logical one, since it ignores the admitted fact of the exceedingly intermittent character of selection and its constantly varied *locus* of action. Each species of animal is subject to a number of quite distinct dangers—hunger, cold, wet, disease, and varied enemies—and all these are separately intermittent in their action. Some affect the species at one time of the year only, some at another; but most of them only reach their maximum of intensity at long intervals—once or twice, perhaps, in a century. Whether cold winters or hot summers, excessive drought or excessive wet, deep snow or phenomenal hail or wind-storms, all are intermittent and occur with extreme severity only at long intervals. These intermittent waves of meteorological phenomena have their corresponding "waves of life," as Mr. Hudson well terms them, such as phenomenal swarms of locusts or of wasps, of caterpillars, mice, or lemmings, and to a less conspicuous degree of almost every living thing. It follows, that during a succession of favourable seasons variation can go on almost unchecked, and even hurtful abnormalities and imperfections may survive for a few years, but soon there comes a check to the increase, and the most abnormal forms die out; while after a greater or less interval either adverse seasons or an increase of living enemies weed out all the extreme disadvantageous variations, leaving only the pick of the typical form to continue the race. This may occur again and again, each special period of stress affecting different organs or faculties—now abnormal colour, now deficient agility, now again incaution or a weak digestion—till in turn every departure from the best adapted mean form is eliminated, to again arise and again be extinguished as favourable or unfavourable conditions prevail. Thus, I am fully in agreement with Mr. Thiselton Dyer when he said: "I feel more and more that natural selection is a very hard taskmaster, and that it is down very sharply on structural details that cannot give an account of themselves." (NATURE, vol. xxxix. p. 9.) The appearance of imperfect adjustment is thus only a temporary phenomenon, while that there is an underlying permanent adjustment is indicated by the long-continued identity of specific characters to which Mr. Weldon refers.

As it is very important to obtain some direct evidence of the action of natural selection, I wish to suggest a mode of doing so which might probably be successful. There is much evidence to show that the migrating birds which visit us in early summer are very largely old birds which have lived through two or more migrations; and, consequently, that of the large number of young birds which migrate in autumn for the first time a very small proportion return to our shores. If this is so, then the extreme severity of the selection during migration would afford us the opportunity of determining some of the physical characters which influence it, combined no doubt with mental characteristics which we have no means of gauging. I would suggest, therefore, that two or three common species of migrants should be chosen, of which the young birds of the year can be distinguished with certainty. Of these birds a number of observers should collect specimens just before their autumnal migration, and should carefully record the characters fixed upon in the case of the young and old birds separately. Probably the weight, the total length, and the length of the wing, would be sufficient, since heavy birds with comparatively short wings would hardly be adapted for long-continued flight. By laying down the dimensions of some hundreds of specimens in curves of variation, whatever difference existed between the young and old birds would be easily detected; and this difference would presumably be the difference between the birth-mean and the survival-mean, so far as the selective influence of migration is concerned. In the following spring another set of specimens of the same species should be collected and measured; and we should then perhaps be able to determine the characters which had led to the selection of the young birds which had survived the double migration. ALFRED R. WALLACE.

Discontinuous Colour-Variation.

I HAVE just received a copy of Mr. Bateson's most valuable work on the "Study of Variation"; and although it will take many weeks to read it as it deserves to be read, a few remarks are now ventured as the result of perusing pp. 42–48, which relate to the discontinuity of certain colour-variations.

Without attempting to discuss Mr. Bateson's general propositions, I desire to point out that the facts related in the portion of the work cited, and the "many similar cases" which might be added, do not altogether support the idea of *discontinuous progressive colour-variation*, as distinguished from *atavism*.

Various writers, including myself, have on sundry occasions endeavoured to demonstrate that both in plants and animals a definite succession of colours may be observed. In flowers, for instance, from pink to purple, and from yellow to red; in birds and insects, and many molluscs, the yellow to red succession is commonly observed. In such instances as these, it has been held that one colour represents a lower stage of evolution or a less degree of metabolism than the other; and it has been many times pointed out, that *discontinuous atavistic variation*, *e.g.* from red to yellow, is commonly to be seen.

Now I take it that Mr. Bateson considers the evidence which he adduces, to illustrate the frequency of *discontinuous progressive variation* in colour, not merely *reversion*. Let us examine this evidence a little more closely.

According to the views held by the writers above mentioned, red is "higher" than yellow, and red varying to yellow is reversion. Such reversion is well known to be often discontinuous, as in the yellow-fruited yew, the yellow tomato, the yellow-fruited raspberry, the yellow varieties of various red moths, and so forth.

But is the yellow to red variation, which is supposed to be the progressive one, discontinuous? Let Mr. Bateson himself tell us. On p. 45 he cites the variations of the yellow *Gonepteryx rhamni* towards orange. Are these discontinuous? Do we find among the yellow *rhamni* some that are entirely orange? Not so, "there are records of specimens . . . more or less flushed with orange."

Exactly: whereas among the red species of *Callimorpha*, *Arctia*, *Zygœna*, &c., we find varieties not flushed with yellow but entirely yellow in place of red (the dark markings being of course as usual), in the yellow *G. rhamni* we find continuous variation towards orange, none yet having attained actual red.

In birds red species may vary to yellow; green also to yellow, and such variation may be sudden. But yellow to green? or yellow to red? We have got our canary yellow easily enough, but all the art of the breeder cannot get him redder than orange, and the variations thereto are fairly continuous.

We cannot get a blue rose; but the blue *Delphinium*, the blue *Pentstemon*, these readily vary to pink. We may have a yellow rose, but it is pretty well agreed that if we ever do see a blue one, it will be by a process of *continuous* variation and selection. Will not Mr. Bateson admit that he would be immensely astonished to see a blue rose arise from seed of a red one, or a scarlet canary from eggs laid by a yellow one? Yet red from blue, or yellow from red, would seem scarcely worth comment in any group of animals or plants, so numerous are the recorded instances of this kind of variation.

On p. 44, Mr. Bateson cites instances of blue in place of red, which should be progressive variation. This occurs in *Catocala nupta*, for instance, but *very rarely*, and instances which seem rather intermediate are on record. Another sample cited is the blue-flowered *Anagallis arvensis*. Here the case is different, for the blue and red varieties are entirely distinct, and come true by seed. I have myself lived in districts where the blue and red varieties respectively abounded, and in neither locality did I ever see intermediates. They had all the appearance of true species, which they have often, I think with justice, been considered. The locality for the blue variety was Funchal, Madeira, and there the red pimpernel also occurs. But in England, where the red variety is so common, I never saw the blue one truly wild.

In *Primula* we have yellow species and red species, and, as everyone knows, our common primrose may vary to red. But also, as everyone knows, the variation is continuous. How well I remember as a child looking for those that were tinged with red, always hoping to get one redder than that last found!

The subject admits of much greater amplification than is now possible; and it is by no means denied that many instances may be selected, out of the thousands available which appear to indicate discontinuous progressive colour-variation. But nevertheless, taking the evidence as a whole, I will venture to urge the validity of the following statements:—

(1) Colour-variation occurs in a definite order, the colours forming one or more series.

(2) Variation from those lower to those higher in the scale of evolution, or from those representing less to those representing greater metabolism, is usually continuous.

(3) Reversion from a higher to a lower colour is usually discontinuous. T. D. A. COCKERELL.

Las Cruces, New Mexico, U.S.A., June 1.

Niagara River since the Ice Age.

MUCH new light on the Quaternary history of the great lakes tributary to the St. Lawrence river has been contributed in three recent papers by Mr. F. B. Taylor, all published within the short time since Mr. G. K. Gilbert's writing on "The Niagara River as a Geologic Chronometer," which appeared in NATURE for May 17 (page 53). These papers are in the *Bulletin of the Geological Society of America* (vol. v. pp. 620–626, April 30, 1894), and in the *American Geologist* (vol. xiii. pp. 316–327 and 365–383, May and June, 1894). Supplementing the earlier observations and studies of Whittlesey, Newberry, Gilbert, Spencer, Lawson, Leverett, Wright, Baldwin, and the present writer, among others, these latest explorations and discussions by Mr. Taylor enable us to form a very definite and closely connected historical statement of the relationships of the ice-dammed lakes which preceded the present Laurentian lakes, and of their dependence on the gradual departure of the ice-sheet and on the accompanying northward uplift of that region.

The largest element of uncertainty in the estimate of 7000 years for the Post-glacial period, from the retreat of the ice-sheet to the present time, drawn from the rate of recession of the Falls of Niagara, consists, as Mr. Gilbert has shown, in the probability or possibility that for some considerable time, next following the melting away of the ice upon the area crossed by the Niagara river, the outlet of lakes Superior, Michigan, and Huron may have passed to the St. Lawrence by a more northern course, flowing across the present watershed east of lake Nipissing to the Mattawa and Ottawa rivers. Mr. Taylor's observations now indicate, however, if interpreted on the hypothesis of glacial lakes (which is believed by Mr. Gilbert and by the majority of other geologists of America to be the true view), that the glacial lake Warren, filling the basins of Superior, Michigan, Huron, and Erie, continued with its outlet flowing past Chicago to the Des Plaines, Illinois, and Mississippi rivers, while the country including lake Superior, the northern part of lake Huron, and lake Nipissing, that is, the whole northern side of lake Warren, was uplifted about 350 to 450 feet along its extent of 600 miles from east to west. The existence of lake Warren was terminated by the recession of the ice-sheet from the area between lakes Erie and Ontario, when the Niagara river began to flow and to channel the gorge six miles long below its receding falls, from which the computation for the time since the Ice Age is derived. The Niagara gorge measures the time after the outflow past Chicago ceased, lake Warren being then succeeded in the basins of the upper lakes, above Erie, by the glacial lake Algonquin, while in the Ontario basin the ice-bound lake Iroquois outflowed past Rome, N.Y., by way of the Mohawk and Hudson to the sea.

Seven-eighths of the differential uplifting which carried the watershed east of lake Nipissing above the level of lake Algonquin had taken place before the north-eastward retreat of the ice-sheet uncovered the Niagara area. For some later time the ice-barrier must have remained upon the Mattawa and Ottawa areas, forbidding any outflow there from lake Algonquin; and it seems very probable that within that time the continuation of the uplift had raised the watershed so high that no discharge from the upper lakes ever passed over it. During the ensuing existence of lake Iroquois the Ontario basin was undergoing a rapid northward uplift, which doubtless was shared by the Nipissing area, so that if any outflow occurred there it must have been very brief, being ended when the land east of lake Nipissing rose higher than the present course of outflow by the St. Clair and Detroit rivers to the Erie basin and Niagara river. The duration of the outlet to the Mattawa could probably have been only a few hundred years, at the longest, if it ever existed. With this possible exception, the present volume of the Niagara river has been maintained during all the time of its gorge erosion. Only an insignificant addition to the estimate of 7000 years can therefore be required by the diversion of the waters of the upper lakes.

The view held by Taylor, Spencer, and Lawson, that the high shore lines around the great Laurentian lakes are of marine formation, seems to be inconsistent with the total absence of marine fossiliferous beds overlying the glacial drift in all that region. So far as the sea did extend, after the further recession of the ice-sheet permitted it to come into the St. Lawrence and Ottawa valleys and into the basin of lake Champlain, marine fossils abound; but none are found above the Thousand Islands at the mouth of lake Ontario. We may therefore confidently accept the Niagara gorge as a measure of all the time since the departure of the ice-sheet from the northern United States.

In a recent paper in the *Journal of Geology* (vol. ii. p. 142, February–March, 1894) Mr. Andrew M. Hansen, of Norway, notes the approximate concurrence of about thirty independent measurements and estimates of the duration of the Post-glacial period, which have been made in North America and in Europe, all coming within the limits of 5000 and 12,000 years. He accordingly says: "With full regard to a legitimate calculation of probabilities, it may be predicated that the number of 7000 to 10,000 years is as nearly an exact estimate of the duration of Post-glacial time as can ever be expected."

Minneapolis, Minn., June 9. WARREN UPHAM.

The Teeth and Civilisation.

NONE of the writers of the interesting letters which have appeared upon this subject seem to have kept before them a distinction which is of the utmost importance in its investigation, and which I should like to state, in order that the attention of those who, like Mr. Wenyon, have opportunities of observation of any segregated community, may be drawn to it.

Dental caries is very prevalent, and its increase seems to be very rapid, so that the last few generations show a marked increase; at least so it is generally believed.

But its victims may be divided into two groups, namely, those whose teeth are apparently perfect in their construction, but nevertheless fall a prey to caries, and those whose teeth show, to the trained eye, clear evidence of structural weakness.

As the latter class present a problem in heredity, and for various reasons are likely to be more interesting to the readers of NATURE than the former, I will dismiss these with a very few words.

There is good reason for supposing that the proximate cause is to be found in vitiation of the oral secretions, as caries often occurs in an extreme degree after diseases of the digestive tract, and examples such as those quoted by Mr. Wenyon are probably to be explained as due to dyspepsia induced by the unhealthy way of feeding.

To the explanation that the enamel may be cracked by alternations of temperature which could be borne in the mouth, I am not inclined to attach importance. In the first place, as a matter of experiment, I have failed to crack enamel by plunging teeth alternately into boiling and ice-cold water, and, as a matter of clinical experience, teeth do not decay along the cracks which from some cause are common in the enamel, but in natural pits of larger size, or on surfaces of contact; the cause is to be sought either in decreased power of resistance, or in the intensification of deleterious influences.

Abnormal conditions of life are known to deleteriously affect the teeth of animals; for example, stall-fed beasts are more liable to diseased conditions in the mouth than those which are fed up in rich pastures; and it has been pointed out by Mr. Bland Sutton, that some animals in the Zoological Gardens suffer in this way, notably the Lemurs, whose teeth frequently loosen and fall out.

It is rare to meet with good teeth in children whose parents have had bad teeth, and peculiarities of form in the teeth and jaws are often inherited with curious exactitude. But it is quite common to meet with instances of healthy parents with good teeth bearing a family of children, also apparently healthy and well-grown, whose teeth, although to the casual observer normal in shape, size, and general aspect, are to the eye of the dentist doomed to early destruction, and speedily undergo it.

These teeth have an appearance somewhat difficult to describe; they have a glassy look, are more translucent than they should be, are softer, and are believed, though the proof is not complete, to be somewhat deficient in their proper proportion of lime salts. This kind of tooth is very apt to run through a whole family, and its causes must be sought either in some condition of inheritance, or if it be due to anything acting upon the individual, it must be something which commences to act immediately after birth. Comparative anatomy teaches us that the teeth are less variable than the jaws. In long-muzzled dogs the teeth are spaced; in short-muzzled dogs they are crowded, reduction in size having gone on faster in the bones than in the teeth; and the same thing is observed in the human subject.

Moreover in animals, whilst some variability is often observable in the teeth, that variability does not take the form of structural difference, but only of differences of size and shape.

Again, in rickets, where the bones are starved of lime salts, the teeth contrive to get more than their share; it is therefore not a little remarkable that we should find the teeth, and apparently the teeth alone, to have deteriorated in one generation.

On the other hand, it is equally difficult to find any cause which shall have operated alike upon all the children of a family if we reject inheritance as being at the bottom of it; it does not appear to be determined by the greater frequency of hand-feeding, as I know of instances in the same family where some children were nursed and others were not, and yet their teeth were alike of the poor structure to which I have alluded.

Upon the whole, I am rather inclined to attribute it to some causes operating shortly after birth, rather than before it, for the milk teeth, which are well started in utero, are far less liable to structural variation than are the permanent teeth, whose calcification is mainly effected after birth; but I need hardly say that the period of occurrence does not by any means exclude inheritance.

However the question, interesting and important as it is, is not so simple as some of your correspondents imagine, and there is a considerable amount of literature upon the subject which seems to have escaped them, some of it accurate and valuable, some of it quite the reverse.

CHARLES S. TOMES.

Electrical Theory of Vision.

IN my letter to Prof. Lodge, published in your last issue, I notice a printer's error, which I think should be corrected, as it gives an entirely wrong meaning to the sentence in which it occurs. As it stands it reads as follows: "The energy thus lost by the tissues was then *suppressed* from without by the vibrating fingers," whereas I said the energy was *supplied* from without by the fingers, the idea being that the shaking back of the eyes to their normal state of rest, evinced by the sensation of darkness, is perfectly analogous to the tapping back of Prof. Lodge's "Coherer" to its normal position, evinced by the return of the galvanometer needle to zero.

E. OBACH.

Old Charlton, Kent, June 23.

CLIMBING AND EXPLORATION IN THE KARAKORAM-HIMALAYAS.[1]

THE mountain district explored by Mr. Conway lies on the southern side of the watershed of the Karakoram chain, and is drained by tributaries of the Upper Indus. For most of the time he was in Baltistan, but ended his journey by a visit to Leh. Here, at about 11,500 feet above sea-level, is a small meteorological observatory, which enabled Mr. Conway to check his observations by a comparison of barometers. Besides himself, the party consisted of the Hon. C. G. Bruce, Mr. McCormick, the artist, Messrs. Eckenstein and Roudebush, Matthias Zurbriggen, the well-known guide from Macugna, four Gurkas, who took readily to ice work, and one or two two other native attendants, with, of course, a considerable but variable party of coolies.

As the author states, the party spent in all eighty-four days on snow or glacier. They were often encamped at

[1] "Climbing and Exploration in the Karakoram-Himalayas." By William Martin Conway, M.A., F.S.A., &c. With 300 Illustrations by A. P. McCormick, and a Map. (London: T. Fisher Unwin, 1894.)

elevations ranging from 12,000 to 15,000 feet above the sea, occasionally even up to 20,000 feet, and some of them accomplished the ascent of a peak approximately 23,000 feet—the highest summit which man has reached. But

FIG. 1.—The Ogre's Fingers, Biafo Glacier.

mountain climbing was far from the only purpose of the expedition. Mr. Conway surveyed the district, and has made many important additions to and corrections in the map which was constructed, about thirty years ago, by Colonel Godwin-Austen, after a journey—for that time—hardly less adventurous. He got together considerable collections, and noted, with the eye of an expert, the archæology and other peculiarities of this remote region. A supplementary volume, to be issued in the course of a few months, will contain reports on the zoology, botany, and geology, and on the other scientific results of the expedition. The separation of the two parts is to be regretted, but was probably almost inevitable.

Incidentally, however, Mr. Conway tells us something of the natural history and geology of the mountain regions, and a note on the latter subject has been communicated recently to the Royal Society. This part of the Karakoram-Himalayas evidently consists of strips of sedimentary rocks infolded in crystalline masses, and often resembles the Alps of Europe not only in structure but also in mineral characters. Many of its glaciers are enormous; for instance, one proved to be forty miles in length; others are hardly less; their ice-falls sometimes are even more formidable than those in the Alps. This Mr. Conway attributes not so much to their greater steepness of slope as to the irregular form of their beds. They lie among peaks which often range from about 22,000 to 26,000 feet above sea-level, and in one case—the nameless K2—reach 28,278 feet. The snow-line, however, is much higher than in Central Europe. In the middle of April, at the beginning of his journey, Mr. Conway found the snow lying thickly below 13,000 feet, but later in the season an elevation of 15,500 feet in his district seems to correspond roughly with that of 8000 feet in the Alps. But in this respect, evidently, there is considerable variation; for the "col" between the vast Hispar and Biafo glaciers is only 17,600 feet above the sea, while further to the east, passes on the route from Yarkand to Leh rise to this height, or even more, and are almost free from permanent snow.

The first-named pass entailed the longest march over glacier and snow, for it occupied the explorers from July 11 to July 26; but the greatest height above sea-level was reached at the head of the Baltoro glacier. Here, on the flank of a huge mountain, called the Golden Throne, the party encamped for five nights at stations from 18,200 to 20,000 feet above sea-level, Mr. Conway sleeping two nights at the latter elevation, and he ascended, in company with Mr. Bruce, one of its peaks (Fig. 2). This, according to a barometric observation, is 22,600 feet in height, but by its level compared with K2 it should be not less than 23,000. On several occasions they reached elevations ranging from 17,000 to over 19,000 feet, and frequently camped out above the level of Mont Blanc. Thus they had exceptionally good opportunities of observing the effects of diminished atmospheric pressure. Their experience fully bears out that of Mr. Whymper in the Andes, though it affords some interesting differences in detail, while the effect produced, as usual, depended much upon the individual; it also seemed to vary with the environment. Occasionally the attendants suffered at from 13,000 to 14,000 ft., but, as a rule, the Europeans and stronger members of the party were not materially affected till about 15,000 feet, and then but slightly, unless they spent the night on the spot. This, it will be remembered, accords with Prof. Tyndall's experience on Mount Blanc.

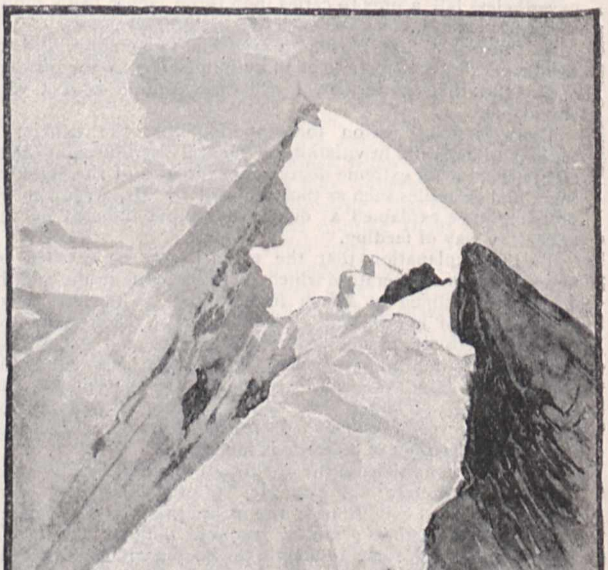

FIG. 2.—Pioneer Peak (Golden Throne) from about 20,700 feet.

The usual symptoms were felt: panting for breath, and quick, irregular action of the heart after the slightest exertion, with headache, more or less nausea, and a general sense of extreme lassitude and exhaustion. The travellers were most severely affected at the highest camp on Golden Throne, though even here, when completely at rest, the inconvenience was comparatively slight. The ascent from this camp—probably about 3000 feet, without any exceptional difficulties—took $8\frac{3}{4}$ hours. In such a district as the Pennine Alps this distance would probably have been accomplished in half the time. It is therefore obvious that the difficulties in reaching such a point as K2 will be extremely great, though possibly not insuperable. Among these the weather will be one of the most serious. This, in the Alps, is frequently not good; in Baltistan, unless Mr. Conway's experience was exceptional, it is habitually abominable.

Much interesting information in regard to physical geology can be gleaned from this volume. The beautiful illustrations enable us to form a good idea of the magnificent snow peaks; the lower mountains, as a rule, seem to be more precipitous and shattered, more weird and desolate than in the Alps (Fig. 1). The climatal conditions are probably favourable to rapid denudation; mud avalanches are frequent, sometimes on a gigantic scale; the fans of débris also are enormous. Mr. Conway's account of the alluvial deposits in the beds of the valleys, especially on the route to Leh, are most interesting (Fig. 3). These often make it difficult to discover the limits to what glaciers have extended. At the present day the larger ice-streams seem to end at 10,000 to 11,000 feet above sea-level, but here, as in other mountain regions, they were once much greater. Mr. Conway mentions the occurrence of old moraines at various elevations down to about 6000 feet, and we cannot be certain that this is the lowest limit.

The volume contains, in addition to a map, three hundred illustrations, process-block reproductions of drawings by Mr. McCormick, some from photographs, and some from original sketches. They represent not only the scenery, but also incidents of travel, and greatly enhance the value of the book. It is worthy to take a place, for literary and artistic excellence, with Mr. Whymper's "Travels amongst the Great Andes of Ecuador," for it is a record of an adventurous journey, carefully planned and bravely effected, as well as a real contribution to knowledge. Clearly and pleasantly written, full of interesting information, not only on the geography, geology, and natural history, but also on the people, buildings, and customs of a rarely visited region, the book does honour to its genial and able author and to his companions in travel.

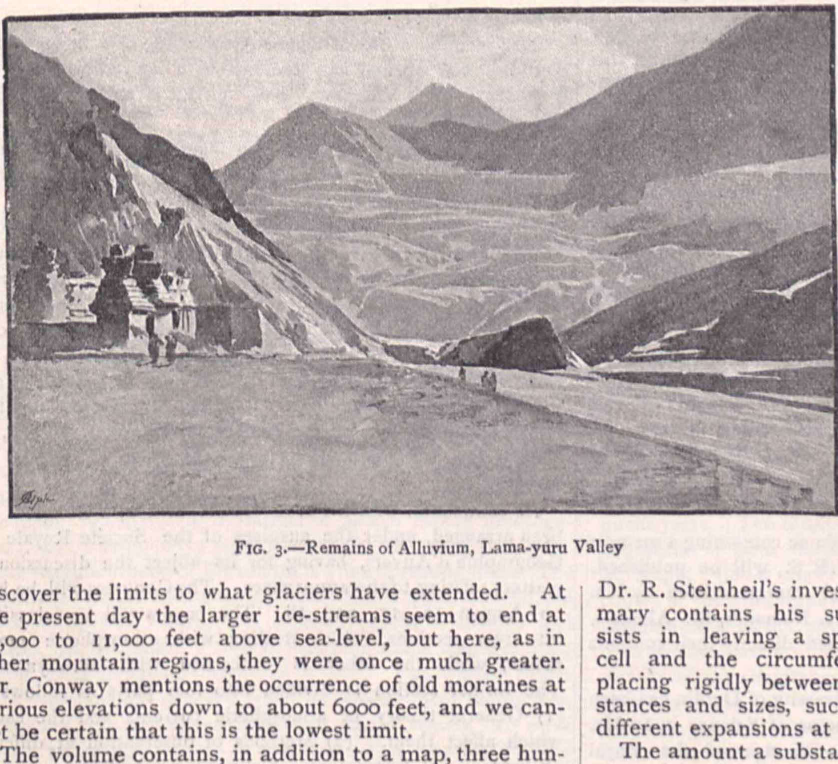

FIG. 3.—Remains of Alluvium, Lama-yuru Valley

A NEW FORM OF OBJECT-GLASS MOUNTING.

AMONG the numerous details in telescopic construction that have become of greater importance in consequence of the increase in size of refractors, may be mentioned that relating to the form of mounting of the object-glass, which plays a leading *rôle* in the good working of a telescope.

The chief difficulty which has to be overcome is the great dearth of substances which have the same coefficient of expansion as glass. For small objectives brass fastenings are used, but for larger discs these have been replaced by the adoption of steel, the coefficient of expansion of which more nearly approaches that of glass. In the latter case allowances have to be made for the difference of expansions of the two substances (glass and steel), and this is done by breaking the metallic band which encircles the objective, and connecting the two ends thus freed by means of one or more screws. In this way the pressure of the band on the circumference of the discs can be regulated by tightening or slackening the screws as the case may be, and the inequality of expansion or contraction can thus be counterbalanced.

If only one disc of glass were in question, the problem would be somewhat simple, but since an objective consists of two discs, and these of different kinds, each possessing its own special coefficient of expansion, the matter is distinctly complicated. With two discs it will be seen at once that the metallic ring may be made fast for one, while the other can be free to move, and therefore quite loose; this naturally raises numerous disturbances in the centering of the lenses.

The functions of a perfect cell are then, firstly, it must be capable of holding the lens firmly and without change of form; while, secondly, it must be so arranged as to allow for the different changes brought about by temperature without disturbing the centering of the lenses.

To produce such a cell as this has been the object of Dr. R. Steinheil's investigations[1] and the following summary contains his suggestions. The principle consists in leaving a space between the inside of the cell and the circumference of the two lenses, and placing rigidly between them blocks of particular substances and sizes, such that they compensate for the different expansions at work.

The amount a substance expands or contracts depends not only on its increase or decrease in temperature, but on its length; thus, for instance, a long rod when heated expands more than a short rod of the same substance. Making use of this fact, we may either assume the *length* of the blocks referred to above, and calculate of what substances it must be composed to give the exact coefficient of expansion required, or we may take any substance with a *known* coefficient of expansion, such as zinc, and determine the length it is required to be. The latter method, of course, by its simplicity commends itself, and if the length of the block be denoted by l we have the formula

$$l = \frac{\phi - \gamma}{\sigma - \phi},$$

[1] See "Ueber eine neue Art von Objektivfassungen" in *Zeitschrift für Instrumentenkunde*, Heft 5, p. 170, 1894.

which gives l in terms of the coefficient of expansion of (ϕ) the cell material, (γ) the glass, and (σ) the material for the blocks. It will be seen from the formula that the shorter the blocks the more equal must be the coefficients of expansion of the glass and cell material, and also the greater the relative distance between the coefficients of expansion of the blocks and cell material.

Dr. Steinheil, as an example, determines the length of these blocks for an objective of 50 cm. aperture, the lenses being composed of common flint silicate marked O.544 in the Jena glass factory, and common crown silicate marked O.1022.

If the material for the blocks used be of zinc (coefficient of expansion $=\sigma=0{\cdot}00002918$), then their length, adopting for the flint glass (544) the value $\gamma=0{\cdot}00000788$ and for the cell material the value $\phi=0{\cdot}00001061$ for their coefficients of expansion, is given by the equation

$$l=\frac{1061-788}{2918-1061}=\frac{273}{1857}=0{\cdot}147.$$

Similarly for the crown glass, the coefficient of which is $0{\cdot}00000954$, we obtain the length of its blocks

$$l=0{\cdot}0576.$$

As the radii of the glass discs are the same and equal to 25 cm., the lengths of the blocks for each of the lenses must be $0{\cdot}147\times25$ cm. and $0{\cdot}0576\times25$ cm. or 3·675 cm. and 1·44 cm.

Dr. Steinheil proposes that for each lens three blocks should be used and placed at intervals of 120° round the circumference of the discs, the blocks fitting tightly between the discs and the sides of the cell. It might at first be thought that such tight-fitting as seems necessary could not be exactly enough done, but it is stated that accuracy in the length of the zinc block to 1 mm. can be safely depended on, and the danger of strain by eliminating the disturbances of centering thereby reduced to a minimum.

That this new mounting for object-glasses has many points in its favour cannot be denied, but it is in such questions as these that we must look to the results after the method has been practically applied. Thus, practice would better settle the proper number of blocks for each lens; three seem at first sight somewhat too few, and might lead to local strains due to the weight of the lenses, whereas such strains must be avoided in any sort of cell.

W. J. S. LOCKYER.

NOTES.

WE are requested to state that a volume containing a memoir of the late Dr. Geo. J. Romanes, F.R.S., will be published. Those who possess letters of general interest written by him are requested to forward them to Mrs. Romanes, St. Aldate's, Oxford. The letters will be returned directly their contents have been noted and copies made.

A GRACE of the Senate of the University of Dublin has been passed, conferring the degree of Doctor of Science upon Mr. Daniel Morris, C.M.G., Assistant-Director of the Royal Gardens at Kew.

PROF. KARL GUSSENBAUER, of Prague University, has been appointed to the chair of Surgery at Vienna, in succession to the late Prof. Billroth.

A REUTER telegram states that at a meeting of leading citizens held at Toronto on June 23, it was unanimously decided to invite the British Association to hold the meeting there next year.

THE Council of University College, Liverpool, have appointed Dr. A. M. Paterson to the "Derby" Professorship of Anatomy, and Prof. R. W. Boyce to the chair of Pathology recently endowed by Mr. George Holt.

DR. AUGUSTUS SCHLOESSER, assistant to Prof. Henderson in the chemical department of the Glasgow and West of Scotland Technical College, has been appointed to the Principalship of the Storey Institute, Lancaster, rendered vacant by the resignation of Dr. G. S. Turpin.

A KINDLY and appreciative letter, by Prof. Poulton, F.R.S., on some incidents in the life of the late Prof. Romanes, appeared in the *Times* of June 19. The July number of *Science Gossip* contains an obituary notice of the lamented investigator, together with his portrait.

THE Cracow Academy of Sciences have awarded the Copernicus Prize of five hundred florins, founded by the town of Cracow, to Prof. Louis Birkenmajer, for his work "Sur la temperature des lacs des Tatres." A prize of one thousand francs (Priz Majer) is offered for the best work on "La Climatologie des pays Polonais"; papers to be sent in before December 31, 1896.

A SEVERE earthquake disturbance was experienced at Oran, Algeria, at about one o'clock on the morning of the 19th inst. The duration of the shock is said to have been four seconds.

A SPECIAL meeting of the Chemical Society will be held this evening, at nine o'clock, at the Royal Institution, when Prof. Dewar will lecture on "Phosphorescence at very low temperatures."

THE meeting of the Museums Association, now being held in Dublin, was opened on Tuesday with an address by the President, Dr. Valentine Ball, C.B., F.R.S., on "The Museums of Dublin."

IN the House of Commons on Tuesday, Colonel Howard Vincent asked the Home Secretary whether he had decided to adopt in the Metropolitan and City Police districts, and in the provinces, the recommendations of the committee appointed to inquire into the system of identifying criminals by measurement, invented by M. Bertillon, of Paris, and the finger-print test of Mr. Francis Galton; and, in such case, if, in order to facilitate research into the judicial antecedents of international criminals, the registers of measurements would be kept on the same plan as that adopted with such success in France, as also in other continental countries. In reply, Mr. Asquith said that the recommendations of the committee had been adopted, including the recommendations as to the mode of keeping the register.

IN connection with the Antwerp Exposition, a Congress has been arranged, under the auspices of the Sociéte Royale de Geographie d'Anvers, having for its object the discussion of matters relating to the atmosphere. The Congress will be held on August 16, 17, and 18. The papers will be classified into two sections, one dealing with atmospheric movements, while the other is concerned with aerodynamics. The former section is divided into four parts as follows:—(1) General theory of atmospheric currents and the causes which affect them. (2) Methods of observation at different altitudes. (3) Instruments of observation and for automatic registration. (4) Maps of permanent and of variable atmospheric currents, and a comparison of them with ocean currents. In the aerodynamic section the subjects dealt with will be:—(1) The measurement of the velocity of wind. The action of wind on a plane normal surface and on an inclined surface will be considered, and the friction of air. Experimental apparatus is also included in this division, and the effects of wind on buildings, bridges, towers, &c. Aeroplanes, windmills, and turbines are classified under the motive power of wind, while transport by land, sea, and air are arranged in a sub-group of questions relating to the resisting power of air. The subjects of the second part of the second section are the special application to aerial navigation of data on the resistance of air, and the development of the motors required to render such means of transport an accomplished fact. From this summary it will be seen that the Congress has been organised not only with the idea of bringing together those who are working at the problem of aerial navigation, but also meteorologists, naval architects, and all whose experiences may help to elucidate the matter. The President of the Congress is Lieut.-General Wauwermans, and the General Secretary, Chevalier Le Clement de Saint Marcq, Rue du petit Chien, 16, Antwerp. M. Lancaster, of the Brussels Observatory, is the President of Section I., and Captain M. van den Borren, the President of Section II.

EVERYONE will agree that the Marine Biological Association of the United Kingdom has, since the opening of the Laboratory, six years ago, carried out the intentions of its original supporters, which were "to promote researches leading to the improvement of zoological and botanical science, and to an increase of our knowledge as regards the food, life, conditions, and habits of British food-fishes and molluscs." Scientific research, however, is not often generously endowed, hence the Association, like many similar institutions for investigation, has its activity greatly restricted by the need for further financial support. With the idea of showing the truly national importance of the work carried on in the Laboratory at Plymouth, the Association has issued a pamphlet, in which its aims are briefly stated, and a few of the many practical and purely scientific investigations carried out under its auspices are described. It is hoped that this statement will quicken interest in marine biology, and induce benefactors to science to give their support to its representative Association, not only because their assistance will help to extend scientific knowledge, but also because they will be assisting in the development of our sea-fisheries. The following extract from the pamphlet referred to shows how small are the funds of the Association in comparison with those of other establishments having similar objects:—"The income of the Association is derived partly from a grant by the Treasury, partly from the voluntary generosity of public companies and private individuals. The Fishmongers' Company contribute £400 a year to the Association, whilst Her Majesty's Government have given £500 a year in the years 1888-9, 1889-90, 1890-91, and £1000 a year in the years 1891-2, 1892-3, and 1893-4. The total income unfortunately falls considerably short of the amount necessary to place the Laboratory on a properly efficient footing. The purchase and maintenance of a sea-going steam-vessel, by means of which fishery investigations can be extended to other parts of the coast than the immediate neighbourhood of Plymouth, is a most pressing need. The admirable Marine Biological Laboratory at Naples, founded and directed by Dr. Dohrn, and devoted purely to zoology and botany, has cost about £20,000, including steam-launches, &c., whilst it has an annual budget of £7000. The United States Fish Commission receives from its Government more than £70,000 a year, and possesses a perfect fleet of vessels. Its work almost exclusively relates to fisheries. The Scottish Fishery Board is credited in the estimates for 1893-4 with £21,858, which (with the exception of £3000 for pier and harbour works) is granted for fresh and salt water fishery work. The Marine Biological Association, with the twofold aim of promoting pure zoology and scientific fishery investigation, received in 1892-3 only £2199 in all." We trust that the appeal of the Association will result in a large extension of the list of subscribers, so that biological science and the fishing industry may both be benefited.

A RECENT number of the *Comptes Rendus* contains a note, by M. Birkeland, on some recent work done in the late Prof. Hertz's laboratory. It is well known that Hertzian waves when they travel along an iron wire magnetise it transversely, although they only penetrate a very short distance below the surface of the wire. This being so, it was an interesting problem to investigate whether it would be possible to observe in such a wire nodes and loops in the magnetisation. Experimenting in this direction M. Birkeland was led to a negative result, which he attributed to the electrical conductivity of the wire, and hence he was led to experiment, not on cylinders of iron, but on mixtures of finely divided iron and paraffin. He uses a square resonator having each side 60 c.m. long, the opposite side to the spark micrometer being formed into a coil of twelve turns, well insulated from each other. If a cylinder of soft iron is introduced into this coil, the spark length is not changed; a fact which previous experimenters have shown to be due to the screening effect of the induced currents in the superficial layer of the mass of metal. When, however, a cylinder of the mixture of iron and paraffin is introduced into the coil, the spark length may be reduced from 9 m.m. to 0·05 m.m. or to 1/180th of its original value. The effects observed increase as the electrical conductivity of the cylinders diminish, so that the magnetic action of the iron becomes less masked by the conductivity effects. This is well shown by surrounding the cylinder with tin-foil, when the spark regains its original length. When a hollow cylinder of the mixture of iron and paraffin is introduced into the coil, the spark length is much shortened, but the effect is much enhanced when the hollow cylinder is filled by a solid rod. Thus the author finds that the magnetic action is felt through a thickness of 5 m.m. when the mixture contains 25 per cent. of iron, and through 7 m.m. when it contains 10 per cent of iron.

THE Central Meteorological Office of France has just published its *Annales* for the year 1892, consisting of three large quarto volumes. Vol. i. contains a number of memoirs on special subjects, among which, as usual, there is one by M. Fron, on thunderstorms in France during the year. These summaries have been continued for thirty years, and furnish useful data for determining the laws which underlie the formation and propagation of those phenomena. M. Moureaux discusses the observations on terrestrial magnetism at the Parc Saint Maur, and gives curves from the self-recording instruments of the most remarkable disturbances, which were considerable during that year. He also contributes a paper on the magnetic conditions at 100 stations; there are altogether 428 such stations in France; those not yet dealt with will be discussed in subsequent years. The results of phenological observations and the migrations of birds during the years 1881-90 are discussed by M. Angot; this is one of the most comprehensive and complete papers of the kind hitherto published. He also contributes a valuable paper on the results of M. Vallot's first series of observations on the summit of Mont Blanc, made in 1887, and a comparison of the simultaneous observations made at the central office in Paris and on the Eiffel Tower, which confirm the principal results obtained in previous years. Finally, M. Durand-Gréville gives a detailed investigation of the connection between squalls and thunderstorms, and has determined some of the phenomena which regularly accompany the formation and propagation of the latter. Vols. ii. and iii. deal respectively with the ordinary observations and with rainfall values at a large number of stations. An important addition to this branch of the work has been made by the publication of the observations made in Senegal, among those referring to stations for various foreign places.

AT the joint meeting of Cornish scientific societies, held at Penzance on June 15, Mr. Howard Fox, the president of the Royal Geological Society of Cornwall, read a paper on "Some Fossils from the Coast Sections in the Parishes of Padstow and St. Mervyn," in which he showed that a hitherto unexamined portion of the North Cornish Coast is Upper Devonian. Mr. G. L. Crick, of the British Museum, recognised amongst the fossils found, Orthoceras, Bactrites, and Goniatites, and determined two species, *Bactrites Budesheimensis* and *Goniatites Simplex.* Both these species occur in Germany in Lower Beds of the Upper Devonian, and both forms are likewise present at a corresponding horizon in the red shales of Saltern Cove, near Torquay. In the same horizon at Trevone several specimens were found of the small bivalve shell *Cardiola retrostriata* (*Cardium palmatum*), also found at Saltern Cove and in the Upper Devonian beds of Budesheim. The occurrence of these characteristic fossils in the Trevone rocks leads to the conclusion that the beds are on the same geological horizon of the lower portion of the Upper Devonian as the Budesheim strata. A portion of a plate of a ganoid fish imbedded in the blue shale of Trevone was recognised by Mr. Smith Woodward as undoubtedly Devonian and belonging to a genus not yet described, distinct from the *Steganodictyum* of Ray Lankester. Remains of Trilobites, apparently species of Phacops, with several corals, viz. Favosites, Amplexus, and Pachypora, were found in the friable cliffs, which also yielded two bivalves not determinable, and a small brachipod, with a minute punctate structure, closely similar to that of the Devonian genera *Centronella* and *Cryptonella.* In the foreshores of the northern part of Constantine Bay a palmate form of coral was found, from which a section was made, and determined by Dr. Hinde to belong to the genus *Pachypora*, but the particular species could not be identified. The fossil which most distinctly characterises this foreshore is a species of Conularia. In surface markings this form, according to Dr. Hinde, differs from all other known species from the Devonian rocks of America and Germany, principally in the marked fineness of the transverse lines, and it probably belongs to a new species.

NEW bread and the hot morning roll, though difficult of digestion, may have some advantages. According to the *British Medical Journal*, Dr. Troitzki, writing in the Russian medical periodical *Vratch*, states that he has found that new and uncut bread contains no micro-organisms, as the heat necessary to bake the bread is sufficient to kill them all. As soon, however, as the bread is cut and is allowed to lie about uncovered, not only harmless but also pathogenic microbes find in it an excellent nutrient medium. White or wheatmeal bread is a better medium than black or rye bread, as the latter contains a greater percentage of acidity. Dr. Troitzki's experiments with pathogenic bacteria gave the following results:—*Streptococcus pyogenes aureus* retains its vitality on the crumb of wheatmeal bread for twenty-eight to thirty-one days, on the crust for twenty to twenty-three days; the bacillus of anthrax (without spores) remains alive on the crumb for thirty to thirty-seven days, and on the crust for thirty-one to thirty-three days; the typhoid bacillus remains active twenty-five to thirty days on the crumb, and twenty-six to twenty-eight on the crust; whilst the bacillus of cholera lives twenty-three to twenty-five or twenty-seven days on both.

A RECENT number of the *Arbeiten a.d. Kaiserlichen Ges undheitsamte* contains an interesting paper, by Dr. Dunbar, on the detection of cholera vibrios in river-water. As many as 1100 samples in all were examined, 855 being abstracted from the river Elbe alone, whilst samples from the Rhine, Weser, Oder, and other rivers were also submitted to the special tests necessary for the isolation of cholera vibrios. The investigations were begun at the beginning of last August, and were continued until the middle of December. Only those vibrios which gave the cholera red reaction were submitted to further cultivation and examination. Dr. Dunbar exercises great caution in the classification of the numerous vibrios he has isolated, and although in all important respects it was impossible to distinguish them from undoubted cholera vibrios, yet he prefers to describe those obtained from the river Elbe as Elbevibrios, those from the river Rhine as Rhinevibrios, those from the river Oder as Odervibrios and those from the river Amstel as Amstelvibrios. Some of these vibrios when cultivated in ordinary peptone broth in the presence of air and at a suitable temperature, gave rise to phosphorescence, a phenomenon which was never obtained with the cholera vibrio; but even this failed to serve as a mark of distinction, for out of 68 cultures in which this characteristic appearance was exhibited, 38 only gave it occasionally, losing this power in some instances and exhibiting it in others. Elbevibrios were detected in the vicinity of Hamburg from July 19 down to November 4; after that date, although samples were daily examined, none were found. But whereas these cholera-like vibrios were not found after November 4 in the running water, they were found more than a month later, on December 19, in the mud at the bottom of the river; the latter, remarks Dr. Dunbar, probably offering them an opportunity of remaining in a dormant condition for considerable periods of time until chance and suitable circumstance enable them to become again redistributed in the stream itself. These Elbevibrios were found on 21 occasions in the tap-water as delivered to the city, and once in this water after passing through a Berkefeld cylinder, which was investigated on 50 successive days.

WE have received part iii. of the *Proceedings* of the Academy of Natural Science of Philadelphia, extending from October to December 1893.

MESSRS. J. WHELDON AND CO., Great Queen Street, W.C., have issued a catalogue of books and papers on microscopic zoology and botany they offer for sale.

THE June number of the *Journal* of the Royal Microscopical Society, just issued, contains the sixth part of Mr. A. D. Michael's "Notes on the Uropodinæ," in addition to the useful summary of current researches relating to zoology, botany, microscopy, &c.

THE "Beginner's Guide to Photography" (Perken, Son and Rayment) is in its fortieth thousand. Evidently the purchasers (and their name is legion) of the cheap cameras with which the market is glutted, appreciate this guide to the methods of the "black art."

To the third edition of his "Epitome of the Synthetic Philosophy" (Williams and Norgate), Mr. F. Howard Collins has added an abridgement of the "Principles of Ethics." The volume thus presents, in a condensed form, the whole of Mr. Spencer's philosophical principles, so far as they have been published.

THE volume of *Proceedings* of the Liverpool Naturalists' Field Club for the year 1893 has been issued. It contains an interesting address by the President, Mr. G. H. Morton, on museums of the past, the present, and the future, accounts of the excursions and evening meetings of the Society, and summaries of the botanical and entomological work done. We regret to note that this Society, like many others in the provinces, is not flourishing, the number of members this year being forty less than last year.

THE Alembic Club Reprints, published by Mr. W. F. Clay, Edinburgh, are handy little volumes enabling a retrospective view to be obtained of scientific researches that have become classical. In No. 6, a copy of which is before us, we have the Bakerian Lecture delivered by Davy before the Royal Society in 1807, and a part of a paper communicated by him to the

Society in the following year. The papers, as is well known, deal with "The Decomposition of the Fixed Alkalies and Alkaline Earths." Priestley's experiments in 1775, which led to the discovery of oxygen, will be reprinted in No. 7, and Scheele's work of 1777 in the same direction will form the contents of No. 8. No. 9 will be made up of reprints of Davy's papers on the elementary nature of chlorine. These three volumes of the series are in the press.

THERE is a certain amount of satisfaction in identifying wild flowers gathered during country rambles. To assist amateur botanists in and near Edinburgh to carry out this kind of determination, Mr. C. O. Sonntag has prepared a little book of handy size, viz. "A Pocket Flora of Edinburgh and the Surrounding Country," and Messrs. Williams and Norgate have published it. Therein will be found, to quote the sub-title, "a collection and full description of all Phanerogamic and the principal Cryptogamic plants, classified after the natural system, with an artificial key and a glossary of botanical terms." It may be doubted whether a student derives any great advantage from the dictionary method of classifying specimens, nevertheless he may be led through such work to higher studies. Another local flora of which we have received a copy is a "Vade-mecum to the Alpine Flora," by L. Schröter and Prof. C. Schröter (London: David Nutt). This book is in its fourth edition. It contains one hundred and seventy coloured representations of Alpine flowers, so that every bit of bloom which beautifies the Swiss mountain-side can be easily identified by tourists without any botanical knowledge whatever. No attempt is made to describe or classify the plants in a systematic manner. Unlike Mr. Sonntag's book, that by Prof. Schröter appeals to the curious tourist rather than the investigating student. The text is in English, French, and German.

THE first edition of Quain's renowned "Dictionary of Medicine" was published in 1882; the second edition was issued by Messrs. Longmans, Green, and Co. last week. For twelve years Sir Richard Quain's comprehensive work has been the standard dictionary of medical knowledge, and the practitioner, teacher, and student alike have put their trust in it. The fact that more than 33,000 copies of this work of reference have been issued in this country and America suffices to show the manner in which the labours of the editor and his eminent staff are appreciated. To bring the book up to the present state of knowledge was a laborious task, for, since the first edition was published, the science and practice of medicine have made enormous progress, and many new developments have occurred. The work had, in fact, to be completely revised, and a large number of new articles had to be prepared. The result of these expansions is that the Dictionary now consists of two volumes, entirely reprinted, while the number of pages have been increased from 1834 to 2518. The editor, and his assistants, Drs. F. T. Roberts and J. Mitchell Bruce, are to be congratulated upon the accomplishment of their task. With the co-operation of numerous members of the medical profession, they have launched their treatise for a second time. We do not doubt that its future career will be as successful as its past.

UNDER the title "Proof Spirit and Fiscal Hydrometry," Mr. John Heywood has published a small book by Dr. B. Derham. The author arraigns the legal definition of proof-spirit, because it depends upon the indications of a certain Sykes' hydrometer. This instrument, and the tables for use with it, are shown to be open to objection. According to Dr. Derham, the proper allowances for variations of the temperature of the hydrometer, and of the spirit stored in bonded warehouses, are not made. Accepting this, it is shown that the Revenue suffers a considerable loss of duty on proof-spirits. In fact, it is asserted that the Revenue estimate, for the yea 1892-93, of the total quantity of proof-spirit, fell short of the true estimate by 186,542 proof-gallons; and that, consequently, the loss sustained was £93,271. And, it may be added, since the funds for technical education came from the wine and spirit duties, Dr. Derham's book would seem to show that the moneys available are less than they ought to be. Thus it appears that the progress of technical instruction is dependent upon the graduations of Sykes' hydrometer, a connection that reminds us of Darwin's story of the relation between cats and clover. Having pointed out the seeming defects in Sykes' system, Dr. Derham develops a new system of hydrometry, and describes a new form of hydrometer for carrying it into effect. His suggestions may be worth the consideration of those responsible for the proof standard.

THE hitherto unknown dimethyl arsine, $(CH_3)_2AsH$, has been isolated by Dr. Palmer in the laboratory of the University of Illinois, and is described by him in the current *Berichte*. It was obtained by the reduction of cacodyl chloride. The most advantageous mode of preparing it is as follows:—Granulated zinc is first slightly platinised, then covered with absolute alcohol, and sufficient hydrochloric acid added to produce a rapid current of hydrogen. A mixture of cacodyl chloride, hydrochloric acid, and alcohol is then allowed to fall into the flask from a dropping funnel; a reaction immediately commences, and copious vapours of the reduction product are carried away by the escaping excess of hydrogen. The vapours are conducted first through water contained in a couple of U-tubes, then dried by passage through a calcium chloride tube, and eventually led into a suitable receiver immersed in a freezing mixture of ice and salt. The dimethyl arsine rapidly condenses in the receiver to a colourless mobile liquid which boils at 36°. It is endowed with the characteristic cacodylic odour, and spontaneously inflames with some violence in contact with the air. When air is admitted to the mixture of its vapour with hydrogen a dense white cloud is produced, which rapidly settles upon the walls of the vessel in the form of a crystalline deposit, which is very soluble in water. Dimethyl arsine is completely absorbed by silver nitrate from the mixture of its vapour with hydrogen, with formation of a precipitate of metallic silver and an acid substance which appears to be cacodylic acid. The reaction which occurs in its preparation may be represented by the equation:

$$(CH_3)_2AsCl + H_2 = (CH_3)_2AsH + HCl.$$

If the cacodyl chloride is allowed to enter the reaction vessel too rapidly, or if there is an insufficient supply of acid present, the chief product of the reaction is cacodyl itself, $(CH_3)_4As_2$. Owing to the high boiling point of cacodyl, however, it is either retained entirely in the reaction vessel or in the washing tubes, so that the purity of the escaping dimethyl arsine is not appreciably affected, although its amount is considerably diminished. Dr. Palmer expects shortly to have a further communication to make concerning the remaining unknown organo-arsenic compound, monomethyl arsine, CH_3AsH_2, experiments being now in progress with a view to its isolation.

THE additions to the Zoological Society's Gardens during the past week include a Black-headed Lemur (*Lemur brunneus*, ♂) from Madagascar, presented by the Hon. Mrs. Fellowes; a Green Monkey (*Cercopithecus callitrichus*, ♀) from West Africa, presented by Mrs. Flowers; a Leonine Monkey (*Macacus leoninus*, ♂) from Burmah, presented by Mr. J. W. Hunter; a Brown Capuchin (*Cebus fatuellus*, ♀) from Guiana, presented by Mrs. J. L. Johnson; a —— Mangabey (*Cercocebus*, sp. inc. ♂) from Ujiji, Lake Tanganyika, a Yellow Baboon (*Cynocephalus babouin*, ♀), a Duyker-bok (*Cephalophus mergens*,

♀), an Æthiopian Wart Hog (*Phacochœrus æthiopicus*, ♂), a Banded Ichneumon (*Herpestes fasciatus*), a Milky Eagle Owl (*Bubo lacteus*), a Black-crested Eagle (*Lophoætus occipitalis*), a Marabou Stork, (*Leptoptilus crumeniferus*), two Green-necked Touracous (*Corythaix chlorochlamys*), two White-crested Touracous (*Corythaix albo-cristatus*), a Bell's Cinixys (*Cinixys belliana*) from British Central Africa, presented by Mr. H. H. Johnston; a Black-faced Kangaroo (*Macropus melanops*, ♂) from Australia, presented by Dr. G. Lindsay Johnson; a Black-headed Conure (*Conurus nanday*) from Paraguay, presented by Mr. A. Harrison; a Golden Eagle (*Aquila chrysaëtos*) from Scotland, presented by the Maclaine of Lochbine; a Stump-tailed Lizard (*Trachydosaurus rugosus*) from Australia, presented by Capt. Jamieson; a Maholi Galago (*Galago maholi*) from South Africa, an Arabian Gazelle (*Gazella arabica*, ♂) from Arabia, an Indian Gazelle (*Gazella bennetti*, ♀) from Persia, a Lioness (*Felis leo*) from East Africa, a Military Macaw (*Ara militaris*) from South America, deposited; a White-tailed Gnu (*Connochœtes gnu*), three Ypecaha Rails (*Aramides ypecaha*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE NATIVE CALENDAR OF CENTRAL AMERICA AND MEXICO.—The native races of Mexico and Central America used a calendar differing completely from those employed by the ancient nations of the Old World to reckon time. Many explanations of the origin of the calendar have been suggested, some referring it to series of recurring events in nature, others to astronomical phenomena, while a third section of inquirers regard it as purely mythical and terrestrial. Dr. D. G. Brinton has lately studied the peculiar calendar from the point of view of linguistics and symbolism, and his results are given in the *Proceedings* of the American Philosophical Society, vol. xxxi. p. 258, 1893. As the calendar system investigated is not widely known on this side of the Atlantic, it may be well to give an outline of it. "The basis is a so-called 'month' of twenty days. Each day is designated by a name of some object, animate or inanimate, and besides its name, each day is numbered, but not from one to twenty, but only from one to thirteen, when the numbering begins again at the unit. The result of this combination evidently is, that a day bearing both the same name and the same number will not recur until thirteen of the 'months' have elapsed. This gives a period or cycle of 260 days, and this anomalous period is at the foundation of the native calendar." Dr. Brinton's linguistic analysis of the names of the twenty days in the Maya, Tzental, and Quiche-Cakchiquel dialects, and in the Zapotec and Nahuatl languages, shows that they are all identical in signification, and therefore must have had one and the same origin. By arranging the symbols represented by the day-names in order from one to twenty, it is found that they exhibit a sequence covering the career of human life, from the time of birth until death at an old age. Thus, in all the five languages and dialects, the name of the first day signified birth or beginning, that of the tenth day, success (through hardship and suffering); of the eleventh, difficulties surmounted; of the thirteenth, advancing years; of the eighteenth, war and death; of the twentieth, the sun, or house of the soul. It appears, therefore, that the calendar conveyed a philosophical conception of life; which may or may not, however, have originated contemporaneously with it. The period of twenty days was doubtless derived from the vigesimal system of counting in use among the tribes employing the calendar. This number 20 is based on finger-and-toe counting, and Dr. Brinton points out that in the languages investigated its name has the signification "completed" or "filled up." "In this way," he thinks, "the number came to represent symbolically the whole of man, his complete nature and destiny, and mystically to shadow forth and embody all the unseen potenesis which make or mar his fortunes and his life." Each of the twenty signs in the primitive calendar had 13 numbers, and also 13 names, or rather 13 varieties of the same name. Apparently the ancient seers of Mexico and Central America believed that by assigning thirteen modes of activity to each of the twenty headings under which the agencies that influence human life were arranged, they had taken into account the thirteen possible relations of each to both the material and immaterial worlds; and the fact that the result of 20 × 13 days is 260 days or approximately nine months, that is, the period from conception to birth, would, according to Dr. Brinton, have appeared to confirm the mystic potenesis of these cardinal numbers. But whatever theory is accepted to account for the adoption of the factor 13, there is little doubt that this period was posterior and secondary to the 20-day period.

THE APPEARANCE OF THE HELIUM LINE.—M. A. Bélopolsky contributes to the *Memorie delle Società degli Spettroscopisti Italiani* for May an account of some observations made by him on the apparent reversal of the Helium line, D_3. He noticed, while observing solar prominences, that this bright line frequently appeared double and contained a dark line, not running down its middle, but nearer to one edge than the other. A close investigation on several occasions showed that the one-sided appearance was not produced by instrumental defects. And since it was found that the line was sometimes visible, while at other times it could not be detected, M. Bélopolsky concluded that it was produced by absorption in the earth's atmosphere. The fact that the line did not split D_3 in halves, and that a second similar line could sometimes be seen, indicated that the appearance was not merely one of reversal. To locate the positions of these dark lines, the third order of a spectrum produced by a Rowland grating having 14,438 lines to the inch was employed. It was then found that the bright badge of Helium was almost exactly in the middle of two fine lines, of which the one near the redward side was double. Their telluric origin was evidenced by their absence on one occasion when the air was very dry and the temperature −4° C. At other times, when the atmosphere was full of moisture, and the temperature comparatively high, the lines were perfectly seen. With a spectroscope of small dispersive power, the double line on the red edge of D_3 appears as a single line stronger than the really single line on the violet side, which can only be seen under good observing conditions. M. Bélopolsky gives the following wave-lengths of the lines, on the Potsdam scale: 587·65 (double), 587·60 (D_3), 587·58.

EPHEMERIS FOR TEMPEL'S COMET.—In continuation of the ephemeris for Tempel's periodic comet, given in these columns on May 31, the following ephemeris for Paris Midnight (from *Astr. Nach.* 3229) shows the positions of the comet until the middle of August:—

1894.	R.A. h. m. s.	Decl. ° ′
July 1	2 16 48	3 15
5	2 26 5	3 34
9	2 35 2	3 50
13	2 43 39	4 3
17	2 51 55	4 14
29	3 14 34	4 30
Aug. 2	3 21 20	4 29
6	3 27 41	4 26
10	3 33 36	4 21
14	3 39 4	4 13

The comet is in Cetus, and is moving towards Taurus. It will pass about a degree to the north of α Ceti in the middle of July.

THE RECENT DISCOVERY OF FOSSIL REMAINS AT LAKE CALLABONNA, SOUTH AUSTRALIA.[1]

II.

GEOLOGY.

FOR what I have to say under this head I must express my obligations to my colleague, Prof. Tate, whose observations in Australia have now extended over many years. He has recently summarised the whole history of its geological progress in a very able presidential address to the Australasian Association for the Advancement of Science, and I have had no hesitation in quoting freely from this and from other writings of so competent an observer.

There appears to be no doubt, both from geological and

[1] By Dr. E. C. Stirling, F.R.S., C.M.G., Hon. Director, South Australian Museum. (Continued from page 188.)

biological reasoning, that in the Lower Cretaceous period a great part of Central Australia was covered by a sea which extended from the Gulf of Carpentaria to the Great Bight, and so divided the continent into an eastern and western moiety. Following this, an upheaval of the sea-covered area took place, succeeded by a denudation of the cretaceous deposits. Unequal movements of depression then brought about lacustrine conditions on portions of the now uplifted bottom of the old sea strait and, in other portions, permitted of the admission of the waters of the ocean. Finally a general upheaval, followed by utter desiccation, placed the deposits of the period just concluded in nearly the condition as that in which we now find them.

The systems of existing lakes, which have been mentioned in an earlier part of this paper, are evidently the shrunken remnants of the much larger lacustrine area of Pliocene times —a condition which demanded for its existence a much greater rainfall than now exists, and was contemporaneous with that which gave rise to the glacial phenomena at places in more southern latitudes in Australia. The region of Lake Eyre was then, as now, the centre of the inland continental drainage. Towards this depression are directed many dry water-courses, of which those of the Macumba, Finke, Cooper, and Diamantina are the chief. For miles around extends an area of sand-hills, separated by loamy interspaces, which are littoral sand-banks marking the successive changes in the contraction of the waters. Within its basin the Pliocene sands and loams have yielded further proof of its lacustrine origin in the remains of Diprotodon, Turtle, Crocodile, and Ceratodus.

In Prof. Tate's opinion, Lake Torrens may have belonged to a lacustrine area distinct from that of Lake Eyre, as with the existing contour of the country a submergence of at least four hundred feet would be necessary before the two systems could be connected.

Such a submergence would also unite in a vast inland sea the whole of the lake region around Lake Eyre and to the westward of Lake Torrens. A very much less considerable submergence would connect Lake Eyre with Lake Frome and the lakes to the north of it. Much of the Murray Desert to the eastward of Overland Corner, and perhaps the whole Riverine region, was at this time a lacustrine area, though probably disconnected from those of Lakes Eyre and Torrens.

The following table, based on Mr. Hurst's report, and revised by Prof. Tate, represents approximately the classification of the formations of the district:—

Recent.—Loose sand generally forming low ridges, sand-hills, or dunes overlying in places the Pliocene beds.

Pliocene.—Lake Callabonna; fossiliferous formation.
Bands of unctuous blue clay containing abundant quantities of saline minerals and concretions of carbonate of lime; thin seams of sand; inflorescent deposit of salts upon the surface. Fossils: Extinct Mammals, Birds, a fresh-water Mollusk (*Potamopyrgus*, sp.), Entomostracans, and a few plants of living species (*Charæ* and *Callitris robusta*).

Mesozoic.—(*A*) "Desert Sandstone" or Upper Cretaceous (hard quartzites or porcellanized sandstone, gritty sandstones, and conglomerates). Fossils: Dicotyledonous leaves. (*B*) "Rolling Downs" formation or Lower Cretaceous; shales with fossiliferous limestone bands.

Azoic.—Metamorphic schists.
Clay slates, mica, talc, and hornblende slates, metamorphic and intrusive granite and greenstone.

The Pliocene formation in which the extinct Marsupials occur does not appear to be restricted to the present boundaries of the lake, since wells, sunk a considerable distance from the present shore, have yielded fragments of bone in exactly the same formation, thereby showing that the lacustrine area, in Pliocene times, occupied a larger area than at present.

The Mesozoic formation is limited upon the surface to a line of outcrops along the eastern slope of the Flinders Range. At Parabana, Pepegoona, Hamilton and Paralana Creeks, these beds occur as the edges of an immense mesozoic basin which underlies Lakes Frome and Callabonna. The detritus of this formation forms the stony table-lands and plains of the country, and the, so-called, stony deserts of the early explorers have their origin in the same formation.

The Azoic rocks are restricted to the Flinders Range, and are of doubtful age. These rocks were pierced by the Government boring party at Lake Frome several years ago, while boring through the Post-tertiary and Mesozoic formations in search of artesian water.

FOSSILIFEROUS AREA.

The area that has been more or less well explored, is not more than a mile long by about half to three-quarters of a mile wide, but this forms but a small portion of the fossiliferous ground. Bones were dug up at the springs lying in the lake bed eight miles to the north of the camp, and were observed on the surface in a very weathered condition all along the track thither. In fact Mr. Zietz informs me that traces of bones and teeth exist on the surface in almost every part of the lake he examined. Nor, as has been said, are they restricted to the present boundaries of the lake.

SURFACE SKELETONS.

One very remarkable feature is the existence of surface skeletons, indicated by the presence of concretionary limestone, or travertine, which has formed for the bones a sort of cast, elevated a few inches above the surrounding level. In some cases the relative position of the bones has been preserved to such an extent that the limestone mass presents a striking outline of the form of the skeleton. Usually in such cases the animal is lying on its side with the head and limbs plainly visible and more or less extended. The actual osseous substance has, in many of the bones of these surface skeletons, completely disappeared, but not however, in all cases, some of them, usually the limb-bones, are more or less imperfectly preserved and devoid of concretion. Several of these surface skeletons existed near the camp at the time of my visit, but Mr. Zietz informs me that after the drying up of the rain which then fell they were no longer visible, having been covered up by the general saline encrustation which has previously been spoken of.

CONDITION OF THE BONES.

The condition of the bones varied very much; some were so friable that they crumbled into powder and could not be removed; others, usually in moist places, were wet, soft, and of the consistency of putty. Curiously enough, for reasons which are not clear, some bones from wet places were firm and hard, while others from ground that was comparatively dry were soft. As a rule, those in best condition came from localities which, without being too wet, were moderately damp. The bones, thus varying in condition and consistency, required very different methods of treatment. The greatest difficulty was undoubtedly due to the circumstance that the bones were saturated with what was practically a concentrated saline solution. In fact, all their cavities were so filled with this fluid that it was necessary to allow a considerable time for it to drain away. In other cases the bones were encrusted and impregnated with gypsum crystals. From such causes the bones became in dry weather brittle and liable to break or crack, and in damp weather difficult to dry. Very careful and patient methods of treatment had consequently to be adopted, and will still be necessary until the salt is removed.

When dry, the fractured surfaces adhere strongly to the tongue, and an approximate chemical examination, by Mr. Turner, of a clean piece of Diprotodon bone gave the following composition:—

Substance dissolves almost entirely in dilute hydrochloric or nitric acids. Contains—

Moisture	3·76 per cent.
Organic matter	7·4 ,,
Inorganic matter, mainly phosphate of lime with some carbonate	88·84 ,,
Total	100

POSITION AND ATTITUDE OF SKELETONS.

The heads were pointed towards all directions, and the remains of different animals frequently much mixed. Where, however, the bones of an individual were lying in juxtaposition they preserved fairly constant relations to one another. The vertebræ, for instance, often formed a more or less continuous series or were broken up into segments, of which the constituents were in such close apposition that they could be removed entire. These bones and the head, which was often much flattened laterally, as if by pressure, were usually lying either in their proper position with the dorsal surfaces uppermost, or were turned over on their sides. The pelvis was usually horizontal; of the ribs, some were *in situ*, others either widely separated from their fellows, or several firmly welded together. The limbs, almost invariably at a greater depth than the rest of the skeleton, had their various segments greatly flexed. The feet were deepest of all. This attitude, together with the frequent approximation of the bones of individual skeletons, is, as has been observed, strongly suggestive of death *in situ* after being bogged. A very similar attitude was assumed by the camels on the occasions when they got bogged in crossing from the sand islets to the main land.

The four Birds whose remains were found close to the camp had their heads all pointing to the south-west, that is towards the part of the lake-bed considered to be the deepest, but their bones, especially the ribs and short bones, were much broken and mixed together. The larger bones, however, were well preserved, and in one skeleton the cervical and dorsal vertebræ formed a continuous series. It was, unfortunately, only possible to secure two heads, and these, though apparently entire, were so soft and fragile that they had to be set immediately in a half-mould of plaster of Paris.

determined by Prof. Tate to be *C. robusta*, a species now living, were found embedded in the same blue clay, and some fructifications of *Charæ* were washed out of it.

FOOD REMAINS.

Associated with the skeletons of Diprotodon, in a relative position which corresponded with that of the abdominal cavity, were occasionally found loosely aggregated globular masses of what I judge to be the leaves, stalks, and smaller twigs of some herbaceous or arboreal plants. The fragments are very uniform in length, thickness and character, rarely exceeding an inch in length or a line in thickness. They are solid, often irregularly branched, frequently retaining portions of the bark, and have their ends often frayed or crushed as if by the action of teeth. Microscopic examination showed the structure of the sclerenchyma tissue to be well preserved, and gave clear indication of the existence of dotted ducts, but I could find no trace of leaves that might have indicated a diagnosis. Judging from this entire

Femur.

FIG. 2.—Head of Diprotodon. (Lying in clay matrix which has been partially removed.)

The position of the Bird-remains were here, as elsewhere, indicated by the presence of circular surface patches of "gizzard-stones," consisting of fine and coarse sand and small siliceous pebbles not exceeding three-quarters of an inch in diameter, the surfaces of which were smooth and worn as if by attrition.

The stones comprised in one entire patch weigh fourteen ounces, and include examples of siliceous sandstone, jasper, claystone, blackened on the outside, black quartz, clear quartz, chalcedony, together with a few fragments of blue brittle clay with worn edges. Such stones are not now found on the Flinders Range, but are characteristic of the great Central Australian plain formation, which extends from the Lake Eyre basin across the continent to the Gulf of Carpentaria.

Such pebbles occurred either scattered or in groups at various places in the lake, and were the only stones of any kind to be found anywhere on its surface. The only shell found in the clay matrix of the bones was a minute fresh-water Mollusk (*Potamopyrgus* sp.). Three fruits, however, of a *Callitris*

absence of leaves and from the degree of maceration, or entire absence of the bark, these masses probably represent the contents of the intestines. No traces of coprolites were anywhere met with.

I have submitted a sample of these food remains to Baron von Mueller, who recommends that it should be sent to Prof. Radlkofer, of Munich, whose special investigations in xylography may enable a more accurate determination to be made.

MATERIAL OBTAINED.

At the present time it is impossible to give more than a very bare outline of the extent of material obtained. In the first place, more than a third (and that the best) of it has not yet reached Adelaide, nor can do so for another month, and the unpacking of what has already arrived has only just been completed. On the field itself there was no time or means for careful examination and comparison, Mr. Zietz very rightly understanding his duty to be that of gathering in and of preserving as much material as possible while conditions, which might at any time alter, were favourable for work. In this and in the all-important work of careful labelling and packing, his time was fully occupied as long as daylight lasted, and as soon as the bones were sufficiently hardened they were packed up so as to be out of harm's way; consequently, the opportunity has never yet occurred of examining the collection in the aggregate.

Mr. Zietz is, however, confident that he has one fine skeleton of the large *Diprotodon australis* complete, and a second nearly so. The indications afforded by differences in the shape of the skull and other bones, together with the great variation in size, shape and section of the great upper incisors, render it probable that, even among the moiety of specimens already unpacked, there are at least three or four species of large Diprotodontoids represented.

We have nearly a dozen heads in good or fair condition, either intact or in pieces which can be put together; a very extensive series of limb bones, including some perfect feet removed entire with their envelope of clay, which, in some cases, will be found to show the impressions of the soles.

Of the feet, in which from our previous ignorance of their constitution much interest is centred, I prefer not saying much at present. Among the first consignment of bones brought down by Mr. Hurst, were the supposed bones of a fore and hind foot, but a careful examination of them satisfied me that they were not only incomplete, but that the assigned constituent bones did not all belong to the same individual, or possibly even to the same species. When at Lake Callabonna I made a further attempt to ascertain their structure from apparently untouched and entire specimens, but the wet weather had made the bones so exceedingly soft and fragile, that they collapsed under the gentlest handling, and I was consequently unwilling to risk further damage. Several of those we have were removed without disturbance of the enveloping clay, and are presumably complete, but the clay has now, with exposure, become so hard that they require for development more time than we have been able to devote to them under our present great pressure of work. Besides, there are many other bones the condition of which demands more immediate attention, so that I fear the feet must wait. There are hundreds of separate carpal, tarsal, metacarpal and phalangeal bones, many ribs, several more or less perfect pelves, and a very few marsupial bones. The vertebræ are the weakest point in the collection, as these are usually in bad condition or broken, and, in all cases, they were very difficult to remove and to prepare without further damage. Several small bones, which are almost certainly those of a very young Diprotodon, were found by Mr. George Hurst in such a position relative to the pelvis of an adult animal as to suggest that the parent had died with a young one in its pouch. Other such bones were found by one of Mr. Zietz's party. Of an apparently smaller species of Diprotodon, possibly *D. minor*, we have several heads and many other bones.

How many separate individuals of Diprotodon have been met with it is difficult to say with accuracy, on account of the way in which they were often scattered and mixed, and the fact that the work of Mr. Zietz overlapped that of his successor, but it would probably be safe to say that there was some indication or other of the existence of at least 100 distinct animals.

Remains of a large Wombat, which appears without doubt to be *Phascolomys gigas*, were very scarce; most of the bones of the appendages, however, are represented more or less perfectly, as are also the marsupial bones. Unfortunately we have only fragments of two skulls, of which one can be made fairly complete when the pieces are put together. There appears no doubt but that the adze-like teeth, described by Sir R. Owen as those of *Sceparnodon*, belong really to this animal, as anticipated by Mr. Lydekker ("British Museum Catalogue of Fossil Mammalia," part v.). The name, however, is a misleading one, as the animal could not have exceeded three feet in height, though the bones are very massive.

Of fossil Kangaroos we have one small but very complete skeleton, and a large series of separate bones of several larger kinds, including a fairly complete skull, which has a length of 33·5 cm.

Femur.

Lower jaw.

Humerus.

FIG. 3.—Diprotodon bones partially excavated.

Of *Nototherium*, so far as we are aware, no remains have been met with, unless, perhaps, some teeth which differ from the ordinary type of those of Diprotodon may prove to be referable to this animal.

Besides the above, which constitute the bulk of the mammalian specimens, there are old bones and fragments of bones belonging to some, as yet, undetermined small animals.

Of the great Birds which appear to be all of one species, and of nearly one size, we have, as stated, two skulls of extraordinary size, in passable condition; but as these have not yet been developed, it is not possible to give their characters or exact measurements. They, however, certainly exceed eleven inches, and possibly reach twelve inches, in length. There are besides three pelves, one sternum, a whole vertebral series, including the tail, several ribs, two partially complete sets of wing bones, and a dozen or more legs complete, so that the collection probably comprises nearly all the bones of the skeleton. The femur is of the same massive build as that of *Dromornis australis*, and even exceeds it in size. Moreover, so far as can be judged from description and plates, it differs from it in contour and section, which is greatly compressed antero-posteriorly, and in some other particulars. The differences between the two tibiæ are also considerable, especially in respect of the existence in the new fossil of a bony ridge across the precondylar groove. The proximal end of the femur differs also from the fragment assigned by Mr. De Vis to *Dinornis queenslandiæ*, but not accepted as such by Captain Hutton. Apart from the vast differences of proportion, the leg-bones of the new fossil have many points of resemblance to those of *Dromæus* in the disposition of salient anatomi al features, a similarity which has been noted by Sir R. Owen in the case of *Dromornis*. The foot (relatively small, when compared to that of *Dinornis elephantopus*) is tridactyl, the outer toe appearing to possess only four phalangeal segments.

The following measurements present, roughly, a comparison between the dimensions (reduced to the metric system) of the femur of Owen's *Dromornis*, as stated by him (*Trans. Zool. Soc.* vol. viii. p. 381), and one of the largest of the femora of the Lake Callabonna fossil.

—	Extreme length.	Lat. diameter at middle-third.	Antero-posterior diameter.
	cm.	cm.	cm.
Dromornis australis .	29·2	6·4	4·0
Lake Callabonna bird .	35·1	7·9	6·2

A further idea, also, of the comparative proportions of the various segments of the leg may be gained by reference to the subjoined table, in which the comparison is made between the legs of a *Dinornis elephantopus* in the South Australian Museum, the Lake Callabonna fossil, and a large Emeu (*Dromæus novæ hollandiæ*):—

—	Femur.		Tibiç-Tarsus.		Tarso-Metatarsus.		Middle toe.
	Extreme length.	Girth at mid-point.	Length.	Girth.	Length.	Girth.	Total length.
	cm.	cm.	cm.	cm.	cm.	cm.	cm.
Dinornis elephantopus . . .	30·8	16·5	51·2	14·6	22·2	14·0	18·3
Lake Callabonna Fossil . . .	35·1	23·3	61·3	17·2	37·8	12·8	15·3
Dromæus novæ hollandiæ . .	21·2	9·8	43·6	8·0	37·4	7 5	14·6

The combined lengths of the three principal segments in the Callabonna fossil thus exceed those of the Emeu by more than a foot, and those of *D elephantopus* by about the same amount.

Of the wing we fortunately possess two examples, one wanting only in the phalangeal portion, the other more imperfect. Comparing it with this appendage of the same Emeu, whose humeral and radio-ulnar segments are respectively 10 cm. and 7·5 cm in length, I find that the corresponding segments of the fossil bird are 8·9 cm. and 10 cm. and considerably thicker.

The remaining bird-bones are in the collection which has yet to reach Adelaide, and I can therefore give no particulars of them from personal observation. There can, however, I think, be no doubt, even from the above limited observations, that these bird-remains indicate the former existence of a large extinct struthious bird distinct from either *Dromornis* or the *Dinornis queenslandiæ* of De Vis.

It is estimated that altogether about three to four tons net weight of bones have been, so far, obtained.

Although the most careful search was constantly made, no traces whatever of *Thylacoleo* were discovered, which, under the circumstances, is rather remarkable if the habits of this beast were as predatory as is believed by some. Its remains have, however, been found in other parts of South Australia, associated with those of Diprotodon. Nor were there any signs of the contemporaneous presence of man.

Meteorological.

Arriving at the camp on August 16, the party experienced fine weather, but very cold nights for about a week. Strong winds, mostly south-easterly but veering in all directions and increasing in strength for about twenty four hours and eventually subsiding, then became of frequent occurrence. Later on, towards the end of October, these gales, now usually from northerly quarters, increased in force and frequency, beginning at any time in the day and lasting twelve to eighteen hours, carried dense clouds of fine sand from the dunes, and pulverised saline matter from the lake, and were most irritating to the eyes.

In November these gales blew almost continuously and with still greater force, raising sand-storms so dense that it was impossible to see more than a few yards, and work was consequently impossible. Empty cases, and even the bones laid out to dry, were blown about the camp, sometimes to a distance of a hundred yards. The nights were intensely dark. Heavy clouds to the northwards seemed to threaten rain, but none came for some days. These clouds appeared to separate at the nor hern end of the lake, to travel southwards on each side of it, and then to unite again. Mr. Ragless, at Callabonna, was convinced that in some way or another the lake bed was an obstacle which the rain clouds from the west did not readily pass. During the day the heat was often intense, the thermometer in the tent rising frequently to 110° F. or not unfrequently even to 120°, but the nights were still comparatively cool. Innumerable flies were, in the day-time, a constant and maddening source of annoyance to man and beast, and so tortured the camels that the margin of their eyelids became quite raw. About the middle of November there was heavy rain for eighteen hours, and a week later a severe sand-storm from the west, bringing a sharp thunder-shower, in which an inch fell in a quarter of an hour, and its impact on the surface of the lake was so heavy that it could be heard at Callabonna Station six miles distant. A fortnight later a second severe sand-storm from the west was followed by another heavy shower. Just previous to the latter rain large flocks of the Australian Swift, *Cypselus australis*, locally called rain-birds, and considered to be a sure sign of heavy rain, passed over the lake. On one night only was there a fog, which was of such peculiar denseness that the candle in the tent threw hardly any light, and its flame appeared surrounded by a yellow halo.

Previous to heavy weather immense numbers of nocturnal insects came round the camp fire at night, and a large collection of them was made.

Rabbits.

During November the camp became almost unbearable from the stench produced by the dead carcases of rabbits which came to drink of the waters of a very brackish, in fact salt, spring at the base of the sand-hill, about a hundred yards from camp. Round this they died after drinking, or else perished after crawling for shelter into the tents and empty boxes. It became part of the routine of the camp to bury upwards of fifty bodies every night, but still the nuisance was hardly lessened. The rabbits also caused many bones to be broken by crawling under them in search of little pools of salt water which dripped from them as they were laid out to dry. In their frantic search for water they gnawed holes in the water-bags in camp, and on the mainland bit through the stems and roots of the "needle-bush," a species of *Hakea*. In one night at Callabonna Mr. Ragless killed 1400 with poisoned water, and what with drought and the ravages of these pests, which stripped the scanty bushes of every green leaf till they were nothing more than bundles of bare sticks, the surrounding country presented an appearance of desolation that defies description.

Under such circumstances of heat, sand and effluvia, it is not surprising that the health of the party suffered eventually from ophthalmia and gastro-intestinal complants, and, indeed, it was chiefly this which led to the breaking up of the camp at the end of November for the time being.

It would be an unworthy omission if I were not finally to acknowlege the cheerfulness and skill with which Mr. Zietz performed his duties under somewhat arduous and depressing circumstances; indeed, whatever satisfactory results may have been achieved by this expedition they are most chiefly due to his indefatigable zeal in the interests of palæontology and of his museum. To the Messrs. Ragless our best thanks are due for their kindness and hospitality to members of the party at various times, and for many necessary articles supplied, sometimes, I fear, at their own inconvenience. Our great obligation to the Government of South Australia for the loan of camels, granted through the mediation of Mr. Goyder, the Surveyor General, I have already acknowledged.

For the preceding notes I can only claim that they comprise but a rough and imperfect epitome of the physical features of the fossiliferous area, and of the conduct of the Museum party's operations up to the present time. As has been already stated, until the whole of the specimens have been unpacked, cleaned, mended, examined and compared, no accurate summary of the palæontological results can be given. It must further be remembered, that the South Australian Museum has recently shared in a general retrenchment imposed upon all Government institutions by the financial exigencies of the day, and that at this very time when the limited museum staff is called upon to deal with, for it, an unprecedented mass of material, it is also called upon to remove and re-arrange, with expedition, the whole of its collection in a new and more commodious building. I mention these facts as a plea for some indulgence for the delay that must inevitably take place, even with such collaboration as we may hope to secure, before the full scientific results can be made known.

Recognising the extreme promise of this discovery at Lake Callabonna, no hesitation was felt by the Museum Committee in subordinating all other work for a time to its vigorous prosecution. But for reasons, to which I have just alluded, excavations could only have been continued for a very limited time, had it not been for the very timely, generous, and unconditional assistance afforded by Sir Thomas Elder, G.C.M.G., a gentleman who stands conspicuous amongst Australian colonists for the liberal support he has so frequently and so munificently displayed in the interests of education and exploration in South Australia. This latest benefaction has enabled much to be done under undoubted difficulties, but much yet remains to be done, and it is hoped that, at a more favourable season, the work now for a time suspended may be resumed, to yield results still more favourable than those hitherto achieved. In the meantime the area comprising the lake has been reserved by the Government for the purposes of further exploration to be carried on under the authority and direction of the South Australian Museum.

KAFIRISTAN.

THE concluding meeting of the Royal Geographical Society for the present session was held on June 25, when a paper on Kafiristan was read by Surgeon-Major G. S. Robertson. Kafiristan is the least known part of Asia, and Dr. Robertson is the first European who has succeeded in penetrating its remote valleys, and making the acquaintance of the primitive tribes who dwell there.

Kafiristan is a geographical expression used to designate the country of those non-Mahomedan tribes who inhabit that space left blank in our maps, which is bounded on the east by Chitral and the Kunar valley, on the south-east by the Kunar valley, on the west by Afghanistan, and on the north by the Hindu Kush and by Badakhshan. Politically speaking, the whole region is bounded on the east by Chitral and the debatable land of the Kunar valley, and on all other sides by Afghan territory. All the rivers of Kafiristan drain into the Kabul river. The parts of this country explored during a year's stay included the Bashgul valley and many of its subsidiary valleys, from the head of which a passage was made to the Minjan valley of Badakhshan. The Kunar valley was also visited, and the valley known as Viron by the Mahomedans, and Presun by the Kafirs, was finally reached and found to be the most sacred part of this well-secluded country and the most interesting. Tribal jealousy made progress very difficult, but Dr. Robertson's journey and sojourn did not cost a single life, a very remarkable fact in a country where homicide is not regarded as criminal. All the passes leading into Kafiristan from Badakhshan are more than 15,000 feet in elevation, and internal communication between valley and valley is completely cut off in winter, when the various tribes live in absolute seclusion, each in its own district. The tracks which take the place of roads are narrow and difficult, running along the river valleys in many parts; they can only be traversed by experienced men; dogs cannot pass some of the difficult points without assistance.

The origin of the people is unknown. Classifying the tribes according to speech, there are, first, the Siah-Posh; secondly, the Wai, including probably the Ashkun; thirdly, the Presun. The Presun are certainly unlike all other Kafirs; they are possibly an aboriginal race. Dr. Robertson could never learn to repeat nor could remember one single word of their language; indeed, at their religious functions the sounds uttered by the officiating priests seemed more like a soft musical mewing than anything else.

Their customs are very peculiar and extremely primitive. One of the most curious is that a chief on his appointment, or anyone who excels in athletic exercise, does not receive tribute or reward, but is expected to feast all his neighbours as a thanksgiving for his exceptional distinction. The physique of the people was splendid, perfect muscular development being the rule, and fat men were quite unknown amongst them. They are great dancers, and have many ceremonial dances of much complexity. Funeral ceremonials are elaborate, and last a long time; but marriage is performed with the minimum of ceremony, the only essential being the payment of purchase-money to the bride's parents. The people were boastful, and at first it was impossible to get them to speak the truth on any subject; but they are brave to the last degree, and have maintained their independence for centuries against all comers.

A short paper was read at the same meeting by Mr. F. G. Jackson, describing the equipment of the Jackson-Harmsworth polar expedition and its proposed route.

SCIENTIFIC EDUCATION AND RESEARCH.[1]

ENGLISH boys and girls at the present day are the victims of excessive lesson learning, and are also falling a prey, in increasing numbers year by year, to the examination-demon, which threatens to become by far the most ruthless monster the world has ever known either in fact or in fable. Ask any teacher who has to do with students fresh from school his opinion of them: he will say that in the great majority of cases they have little if any power of helping themselves, little desire to learn about things, little if any observing power, little desire to reason on what they see or are called on to witness; that they are destitute of the sense of accuracy, and satisfied with any performance however slovenly; that, in short, they are neither inquisitive nor acquisitive, and as they too often are idle as well, the opportunities offered to them are blindly sacrificed. A considerable proportion undoubtedly are by nature mentally very feeble; but the larger number are by no means without ability, and are, in fact, victims of an acquired disease. We *must* find a remedy for this state of things, or perish in the face of the terrific competition now setting in. Boys and girls at school must be taught from the very earliest moment to *do* and to *appreciate*. It is of no use our teaching them merely *about* things, however interesting—no facts must be taught *without their use* being taught simultaneously; and, as far as possible, they must be led to discover the facts for themselves. Instead of our placing condensed summaries in their hands, we must lead them to use works of reference and acquire the habit of finding out; they must always be at work applying their knowledge and solving problems. It is a libel on the human race to say, as many do, that children cannot think and reason, and that they can only be taught facts; early childhood is the time at which these faculties are most apparent, and it is probably through failure to

[1] Extracted from the Presidential address delivered by Dr. H. E. Armstrong, F.R.S., at the Chemical Society, on March 22.

exercise them then that they suffer atrophy. The so-called science introduced into a few schools in answer to the persistent demands of its advocates has been in most cases a shallow fraud, of no value whatever educationally. Boys see oxygen made and things burnt in it, which gives them much pleasure; but, after all, this is but the old lesson learning in an interesting shape, and has no superior *educational* effect. I would here repeat what I have recently urged elsewhere, that in the future *all subjects* must be taught *scientifically* at school, in order to inculcate those habits of mind which are termed scientific habits; the teaching of *scientific method*—not the mere shibboleths of some branch of natural science—must be insisted on. No doubt some branch of chemistry, with a due modicum of physics, &c., is the subject by means of which we may best instil the scientific habits associated with experimental studies, but it must be the true chemistry of the discoverer, not the cookery-book-receipt pseudo-form which has so long usurped its place. Whatever be taught, let me repeat that mere repetition work and lesson learning *must* give place to a system of allowing children to *do* things themselves. Should we succeed in infusing the research spirit into our teaching generally, then there will be hope that, in the course of a generation or so, we shall cease to be the Philistines we are at the present time; the education given in our schools will be worthy of being named a "*liberal education*," which it never will be so long as we worship the old world classical fetish, and allow our schools to be controlled by those who reverence this alone, having never been instructed in a wider faith.

As regards our college courses, I see no reason to modify the views expressed in my address to the chemical section of the British Association at Aberdeen in 1885; on the contrary, the experience I have since gained as a teacher and examiner has served only to strengthen them and to convince me of the paramount necessity of a very radical change in our system of instruction, and I rejoice at the increasing evidence of a state of unrest both at home and abroad. The "thorough" course of qualitative analysis which it has long been customary to impose at a very early period of the student's career must, I venture to think, be relegated to near its close; this course certainly has not the effect of producing competent analysts, and but too often reduces those who toil through it to the dead level of machines; in hundreds of cases I have seen students, as it were, hang up their intelligence on the clothes-peg outside and enter the examination room masked with a set of analytical tables, through which alone they allow themselves to be actuated, and to which they render the blindest obedience. Qualitative analysis actually requires the fullest exercise of the mental faculties as well as considerable manipulative skill. By introducing this branch of study at too early a period we force our students to act as machines, inasmuch as they do not, and cannot, know enough to work intelligently; we are but trying to make them run before they have learnt to walk. Even when the interactions on which qualitative analysis is based are fully studied, and the equations relating thereto are conscientiously written out, the result is not much better, owing to the slight importance of so many of the interactions apart from their technical application in analysis, and especially on account of our ignorance of the precise nature of many of the interchanges of which we avail ourselves: the persistent misrepresentation of facts which such a course encourages is, in my opinion, one of its worst features.

I believe that in the near future our students will first be set to solve problems, each in its way a little research, and involving much simple quantitative work; they will thus be taught chemical method, or, in other words, *the art of discovery*. They will then be taken through a course of quantitative exercises with the object of making them acquainted, by direct contact with the facts, with the fundamental principles of our science, which are but too rarely appreciated at the present day. After this, they will seek to acquire proficiency in quantitative analysis and in the art of making preparations; and subsequently they will give sufficient attention to the study of physical properties to enable them to appreciate the physico-chemical methods of inquiry which are now of such importance. The study of qualitative analysis in detail will be left to the last, as being an eminently technical subject. Meanwhile, by attendance at lectures, by reading carefully chosen works of a kind altogether different from the soul-destroying text-books we now possess, and especially by the study of classical models in chemical literature, they will have acquired what is commonly spoken of as theoretical knowledge, but too often regarded by us as of secondary importance, and which it is so difficult to make Englishmen realise means a proper understanding of the subject. Students so trained—imbued from the outset, even from early school days, with the research spirit—will at all times be observant and critical, nay, even logical; dogmatic teaching will cease to have any charm for them: they will actually take deep interest in their studies—a result devoutedly to be hoped for, as nothing is more galling to the teacher at the present day than the crass indifference of the average student and his refusal to give attention to anything unless it will pay in an examination. At the close of such a course, the student will be thoroughly prepared to undertake original investigation, distinctly with the object of exhibiting his individuality and originality, and not, as at present, with the object of acquiring for the first time an insight into the methods of the investigator; he will thus be spared the unpleasant discovery which the advanced student now too often makes that his early training has unfitted him, rather than prepared him, for the task of original inquiry.

But to attain to this happy state it will be necessary that school education be "rationalised" and improved, as I have already ndicated; that the material placed at our disposal be of far higher average quality than heretofore; and that the period of study be lengthened.

As it offers but few prizes and unfortunately has no sinecures —which, however objectionable from an abstract point of view, are actually of the greatest service to many causes—chemistry has hitherto failed to attract much ability. Very many commence its study because they have an idea that chemists are always making interesting experiments of the firework order such as the conventional lecturer shows to a popular audience, and when the drudgery of actual practice is discovered by the young worker to be something very different from the rosy picture which such displays had excited in his mind, it often turns out that a mistake has been made in the choice of a career; such mistakes will occur less frequently when our schools are so conducted that we shall be able to find out what our boys and girls are fit for. Too often those who take up the study of chemistry are destitute of the mental ability required to comprehend so difficult and wide a subject, even if possessed of considerable manipulative skill; very many of these never can rise to the dignity of chemists, and it is clear that in the future some distinction must be made between cultured chemists and those who are but mere skilled workmen in some special branch of the subject; even "analyst" is too broad a term, in many cases; "tester" might, perhaps, be coined for the purpose. When we teachers are in a position to advise a parent that his son has not the making of a chemist in him, but that he would do well as a food tester, manure tester, or iron tester, for example—and the advice is understood and appreciated—we shall be relieved of much anxiety. We have to bear in mind Huxley's remark—that the future of the country depends, in industries as in everything else, on getting our capacities to the top and, if possible, sending our incapacities to the bottom. Infinite mischief has been done in this country by the intrusion into our industries of large numbers of men dubbed chemists, who have no right whatever to the name—from no fault of their own, but owing to their imperfect training, and more especially the ignorance of employers. Experience has shown only too fully that no one has derived any real advantage from this state of affairs. We may hope for better things in the future, especially if our colleges generally are led to impose an entrance examination. I am satisfied, from the experience that we have had at the City and Guilds of London Central Technical College, that it is of utmost importance that those who are to study chemistry should at least have acquired a sound elementary knowledge of mathematics; that those who prove to be satisfactory students of chemistry are almost invariably those who are fairly proficient in mathematics, and *vice versa*. "It is almost impossible to become a chemist in less than three or four years of constant application." (Author's preface to Lavoisier's "Elements of Chemistry," English translation by Kerr, 5th ed. 1802.) Such being the opinion nigh on a century ago, what must our view now be? And yet there is a strange illusion abroad that a *three years' course* suffices to make a lad who has had no previous training whatever in scientific method a "full blown" chemist, worthy of considerable hire! It is often heart-rending to the teacher to see lads of great promise forced out into the world, largely by this prejudice, just at the most critical period of their career, when they are on the very verge of acquiring real understanding of their subject, and of developing originality, as well as the power of working independently: abandoning their studies in this way, they too often degenerate into mere machines, capable of doing what they are told, but rarely more. And the manufacturer, who is too short-sighted to discriminate, then complains that he gets very little help from his "chemist," and seeks for a superior article abroad.

If we consider what a chemist, to be worthy of the name, must know in these days, it is clear that public opinion as to the duration and nature of his studies needs much emendation. He must be both artificer and artist. By constant practice and persevering application, he must acquire the manual dexterity, manipulative skill and neatness required of the analyst, while, at the same time, he must gradually become imbued with that high sense of accuracy, without which his labours will ever be untrustworthy; he must also acquire manipulative skill of an entirely different order by preparing a variety of typical substances, so that he may understand how to set to work when he subsequently engages in original labours involving the preparation both of materials already known and of new ones; and he must be practised in the more important methods of determining physical constants. While thus engaged in the laboratory, he must also be studying hard, constantly reading and *occasionally* attending lectures. To be a chemist it is necessary, moreover, to know much besides the practice and theory of chemistry proper: no slight amount of mathematical knowledge is also requisite for the proper understanding of the fundamental problems of our science, and no mere acquaintance with the first principles of physics, especially electricity, suffices; some acquaintance with biological science is indispensable, if we are to understand the manifold applications of our science in agriculture and in medicine, or are to assist in unfolding the nature of physiological processes generally; without some knowledge of mechanical drawing it is impossible to deal with machinery or to understand the language in which machinery is described; and it is necessary to read French and German fluently, the latter especially, in order merely to follow with intelligence what is being done by chemists. All this cannot be compressed into three years, and be it remembered I have said no word as to the necessity of every student who aspires to rank as a chemist undertaking some research work in order that he may acquire independence and the ability to solve problems and to progress.

So long as it is commonly supposed that it is but necessary to learn how to "analyse" in order to become a chemist, there will be but little progress; but when it is realised that chemistry is an exceedingly difficult subject to master, requiring a high order of intellect and breadth of mind, combined with extreme patience and perseverance and much mechanical dexterity, other views will prevail, and we may hope that we shall then count as of us very many who will rank high as artists and designers, and statesmen even—instead of being for the most part mere bricklayers, carpenters and joiners, capable only of working to order.

I have great hope that in the near future there will be many inducements held out to capable students to prolong their period of study to a satisfactory extent. At present, scholarships are mostly given to lads on their leaving school and commencing their technical training; the method by which such lads are selected is, in too many cases, an unsatisfactory one, the award being made on the result of an examination for which the candidates have been carefully prepared and crammed beforehand: the result too often affords but a proof of the power of lesson learning, and but little evidence of real ability. Serious injury is done at the Universities, owing to the stilted and artificial character of many of the college examinations, mere lads being required to answer questions of a highly technical character, far beyond the standard of school knowledge of the subject; those who are successful are more often than not overtrained—purely artificial products, whose mental digestion has been impaired, if not altogether ruined, by skilful tutors up to the tricks of the examiners. Such a system is partly responsible, also, for the growing practice of keeping lads at school—and even establishing "technical" sides for their special benefit—far beyond the age at which school should be quitted; such lads usually acquire bad habits during the last year or two of their school career, growing lazy; they are more often than not very poor material when they come to college; and in cases in which they are successfully pushed through public examinations, such as those of the London University, not having enjoyed the advantages of college life and instruction, they are too frequently but provided with a varnish of knowledge. However, it will probably be thought necessary to offer such entrance scholarships in order to attract ability, and they will be regarded with favour by schools as they obviously afford a means of advertising—in fact, they are used as such; it is, therefore, all the more important that the conditions under which they are awarded should be such as to favour rational methods of teaching and which as nearly as may be correspond with the natural conditions of school life; especially should we guard against encouraging the tendency which undoubtedly exists in schools to lavish attention on those of great promise at the expense of those of average ability. Genius will ever take advantage of opportunities, while necessarily it will benefit from careful training; but it may be overtrained and dulled, or made priggish by undue specialisation at too early an age. Yet to make changes is difficult, as there are so many rivals interested; and although the evils of our system are recognised, no one is willing to take the first step, fearing that this may entail individual sacrifice.

It has long been my opinion that scholarships would be of most use if given to those who have gone through a systematic course of training—lasting say about three years—and who are on the verge of learning to become capable independent workers; an additional two years spent in acquiring the power of undertaking investigations will render such students highly competent. But most parents can ill afford the necessary outlay, and it is astonishing how little at this stage lads themselves realise how extraordinarily important it is for them to continue their studies; that, in fact, they are worth very little to anybody. A limited number of such scholarships are available in some of our provincial colleges, and those given by the 1851 Exhibition Commissioners are also of this kind. In London, however, there has long been a strange deficiency in this respect, but I rejoice to say that this is on the eve of being remedied by the enlightened action of the Salters Company, by whom not only has a scholarship of £150 per annum been offered to my Institute for the encouragement of higher research in chemistry, but also one of £100 tenable in the research laboratory of the Pharmaceutical Society, as well as one of like amount to aid in the investigation of the more medical aspects of pharmacology, tenable in the school attached to St. Thomas's Hospital. The influence of the example thus set will, I trust, be widely felt—may our sore needs be met ere it is too late!

In my address at Aberdeen I dwelt much on the necessity of creating *an atmosphere of research in our colleges*, and to-day I am but repeating much that I said then; I regret to say that meanwhile no great progress has been made, although indications are not wanting that the foundation is being laid on which, if conditions become more favourable, we shall be able to build extensively. I venture to think that the time is come when we must appeal to our senior students to help us: hitherto the majority of these have gone to Germany to complete their education, Liebig's magnetic influence being in no wise exhausted—for it was he who gave direction to the stream which ever since has steadily flowed in one direction, and deep beyond description is the debt we owe to his memory in consequence. Time was when it was necessary to take passage on this stream, but this is no longer the case, or need not be if advanced students will but collect around us in sufficient numbers to enable us likewise to form schools of original workers—for we, like the ancient Egyptians, cannot make bricks without straw, and to be condemned always to teach the rudiments, more often than not to unwilling ears, takes the very life and soul out of those among us who by nature have any higher aspirations. There are undoubtedly advantages to be gained from a residence abroad—no one can recognise this more fully than I do; but I believe the case to be one of such gravity that some sacrifice must be made, and that if national interests are not to be put aside as of altogether secondary importance, individual preferences must, for a time at least, be subordinated to higher considerations. It is not accounted necessary in Germany to study abroad, and severance from apron strings is effected when desirable by visiting a university away from home. Why should not English students in like manner pass from college to college in this country, and thus help us to help them?

But we want help also from another quarter—or rather, let me say, that there is another section, and that a very large one, of the community *must help us* far more than they have hitherto done *to help them;* I mean *our manufacturers* generally. Let me remind you that the Chemical Society *was established for the general advancement of chemical science as intimately connected with the prosperity of the manufactures of the United Kingdom:* these very words form part of our charter. Yet to how small an extent is it recognised that chemistry is of service—that many of our manufactures, in the words of our charter, mainly depend upon the application of chemical principles and discoveries for their beneficial development? It is of no use to manufacture goods if you cannot sell them, and that is too often our position. Every teacher of any standing in Germany can count on placing his students so soon as he is in a position to state that they are fully capable and worth a trial; but here there is no such relationship established between the schools and the works; no proper opportunity is given to young men to prove their fitness for an industrial career. It is not even recognised that the discipline afforded by the study of our subject is an admirable preparation for an industrial career. Take the brewing industry, which in this country has availed itself far more than any other of our services—the brewer is called on to conduct operations involving chemical changes of a most complex and delicate character, subject to variation if the slightest departure be made from a very limited range of conditions, and this too with a material subject to constant fluctuation in composition and character, requiring the most vigilant and appreciative watching. Every brewer ought consequently to have received a chemical training; yet those who enter this industry are, with very rare exceptions, pitchforked into it as raw lads from school, without any preliminary training whatsoever, having received their position through the influence of a friend and from no merit of their own. The same might be said of the dyeing industry, of that of gas manufacture, and of many others. Some of you may have seen the list of subscriptions to the proposed Schorlemmer laboratory at the Owens College, Manchester, and may have marked with sorrow, as I have done, how few and small are the contributions from those connected with the local industries, and how large and numerous relatively are those from friends and admirers of the deceased chemist and from members of the college staff. Contrast with this the great number of subscriptions towards the erection of the Hofmann-Haus in Berlin. Although the comparison is not quite a fair one, perhaps, yet it illustrates my meaning, the reception accorded to the Manchester scheme being sufficiently indicative of the absence of appreciation of the real value of chemical science to industry in one of our chief industrial strongholds. . . .

The proposed Teaching University in London and the Commission on Secondary Education may help in an extraordinary degree to improve our position. But it is to be feared that our subject will not attain to its proper condition unless some action be taken which will consolidate the teaching—which will lead to the centralisation of students of chemistry proper, so they may enjoy the inestimable advantage of intercourse, and have at their disposal a complete staff of competent teachers, each one of whom thoroughly represents some special branch of the subject; so long as students are distributed about the town in half-dozens and each chief teacher is called on to cut himself up into any number of small pieces, so as to deal with the subject of chemistry as a whole, true higher teaching is impossible.

Much to be feared, also, is the tendency to over-estimate the value of examinations, and the great work of the future will be so to improve these that they shall have no prejudicial influence on the student's work and in no way check the development of original methods of teaching; we must fix our attention mainly on the influences to which the student is to be subjected during his career; the competent teacher will ever study his students while they are at work, and do the best for them, provided he be not rendered powerless by the trammels of an examination system which heeds "results" only and not individuals.

Finally, let me say that, while sympathising most fully with those who advocate a complete course of study, I feel that it is very easy to demand too much—very easy to make it impossible for students to do justice to their work by imposing too many subjects. Our chief desire must always be that students shall acquire a knowledge of scientific method and the power of working independently. Certain subjects must be insisted on—for example, mathematics and drawing: if a knowledge of these be not acquired early it will never be acquired; but apart from these and a competent knowledge of the main subject, we probably may, as a rule, be satisfied with comparatively little. Those who have once learnt to work and acquired a knowledge of scientific method will of their own accord, in proportion to their intelligence, apply themselves also to the study of other subjects—as many among us have done; those who are not sufficiently intelligent to do this are not, as a rule, improved by being forced to pay attention to unpalatable studies; on the contrary, they are, more often than not, thereby hindered from acquiring a competent knowledge of some one subject which does appeal to them, and are spoilt for life in consequence.

SCIENTIFIC SERIALS.

Bulletin de l'Academie Royale de Belgique, No. 4.—On the hydrates of the alkyl-amines, by Louis Henry. It has been known for some time that ammoniacal bases form compounds with water, a typical example being $2CH_2 . 2NH_2 . H_2O$, ethylenic diamine. Their properties have not yet been fully investigated. The author distinguishes between hydrates whose bases are soluble, and such whose bases are insoluble in water. He deals with methyl, ethyl, propyl, butyl, and amyl compounds, with the aromatic series, and with nitriles and amides. Their density increases with the percentage of water contained in them, even if the molecular weight diminishes. Their power of combining with water increases with their solubility and their richness in hydrogen, whether this be contained in the nitrogen radicle or the hydrocarbon.—On the creation of an International Bureau of Bibliography, by M. Mourlon. M. F. Vander Haeghen had proposed to the literature class of the Academy to initiate a movement for the compilation of a universal catalogue of public libraries. This proposal coincides with that for the establishment of a comprehensive and international catalogue of scientific papers, brought forward by the Royal Society. M. Mourlon proposed the deputation of three delegates to confer with the other two classes of the Academy with a view towards co-operation with the Royal Society.—On the aurora borealis observed at Louvain on March 30, 1894, by F. Terby. The author points out the recurrence of the monthly period previously observed in the appearances of February 28 and March 30.—Vascular hyphæ of the mycelium of the Autobasidiomycetes, by Ch. van Bambeke. The mycelium in question always contains vascular hyphæ, varying in number, distribution, dimensions, and form according to the species of mycelium. They are larger than ordinary hyphæ, and are usually cylindrical, with occasional fusiform or claviform extensions. They consist of a thin, extensible, and elastic envelope containing a substance which is usually homogeneous and highly refracting, but sometimes granular. They may be considered as a conducting apparatus playing an important part in the distribution of nutritive materials.

Symons's Monthly Meteorological Magazine, June.—The May frost of 1894. M. Symons publishes minimum temperatures in the shade, obtained from forty-six counties in England and Wales, in which the thermometer fell below the freezing point between the 20th and 22nd May. In six counties minima of 25° or lower were recorded, while on the grass, readings of 18° in Nottingham, and 19° in Stafford were registered. The readings were not excessively low for May, which has always a cold period about the middle or latter part, for during a frost in May 1891 these low temperatures were exceeded by about 1°. Letters from correspondents show that the wide-spread disaster to vegetation was caused not so much by the lowness of the air temperature, as by the radiation, which was facilitated by the clearness of the sky, while owing to the mildness and dampness of the weather previously the vegetation was more forward and fuller of sap than usual, which froze and burst the cells by expansion. The frost was, as usual, most severe in the lowlands, near streams, and except in the north-east, where the temperature just touched 32°, none was recorded on the English sea-coast.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 31.—"Propagation of Magnetisation of Iron as affected by the Electric Currents in the Iron." By J. Hopkinson and E. Wilson.

Consider a solid, cylindrical electromagnet, it is well known that, in reversing the magnetising current, the induction does not instantly reverse, but a certain time elapses before it again attains its full value, that it reverses at a later time at the centre of the core than near its surface, and that the delay in reversal near the centre is due to the electric currents induced in the iron. The object of the present paper is to investigate these effects.

The magnet experimented upon had a diameter of 4 inches, and formed a closed magnetic circuit. Through a part of its length the cylinder of 4 inches diameter was formed of an iron core surrounded by two concentric, closely fitting tubes. Exploring coils of fine copper wire were bedded in the iron between the surfaces of the tubes. The currents induced in these exploring coils were observed when the current in the main coil of the magnet was reversed. These currents in some cases last for over half a minute.

Inferences can be drawn from these results as to the behaviour of other diameters than 4 inches. Comparing two cylinders of different diameters, similar events occur, but at times proportional to the squares of the diameters of the cylinders. From this consideration and the experiments, a judgment is formed as to the effects of local currents in the cores of transformers and of the armatures of dynamo machines.

June 14.—"The Effect of Mechanical Stress and of Magnetisation on the Physical Properties of Alloys of Iron and Nickel and of Manganese Steel." By Herbert Tomlinson, F.R.S.

Royal Meteorological Society, June 20.—Mr. R. Inwards, President, in the chair.—Mr. R. H. Scott, F.R.S., read a paper on fogs reported with strong winds during the fifteen years 1876–90 in the British isles. Out of a total of 135 fogs, 108 were associated with cyclonic, and twenty-seven with anticyclonic conditions. The majority of the fogs occurred with south-westerly winds and with temperatures very close to the maximum for the day.—Mr. R. H. Curtis read a paper on some characteristic features of gales and strong winds. After calling attention to the unsatisfactory state of anemometry, and after describing the "bridled" anemometer at Holyhead, Mr. Curtis stated that the greatest force of an individual gust which he had met with was registered in December 1891, and amounted to a rate of 111 miles per hour, which with the old factor would be equivalent to a rate of about 160 miles per hour. Gusts at a rate from 90 to 100 miles per hour have many times been recorded, but the usual limit for gusts may be taken to equal about 80 miles per hour, which on the old scale would be equivalent to about 120 miles per hour. Gales and strong winds differ in character very much; and as the result of a prolonged study of their general features, as recorded by the bridled anemometer, the author has been able to group them into three general classes. He then described those gales which are essentially squally in character, in which the gusts constitute the main feature of the gale. In an average gale the ordinary gusts follow each other at intervals of about ten to twenty seconds, while the extreme gusts occur at the rate of about one per minute. Another class of gales are those in which the velocity of the wind is tolerably steady. In the third class are gales which appear to be made up of two series of rapidly succeeding squalls: the one series at a comparatively low rate of velocity, the other at a much higher one, the wind-force shifting rapidly, and very frequently from one series to the other. Mr. Curtis also stated that, on looking carefully over the anemometer records, he had not unfrequently found very distinctly marked a prolonged pulsation in the wind-force, which recurs again and again with more or less regularity, of perhaps twenty minutes or half an hour in some cases, and in others at longer intervals of about an hour, more or less.

Physical Society, June 8.—Prof. A. W. Rücker, F.R.S., President, in the chair.—Prof. Ramsay, in opening the discussion on experiments on the relations of pressure, volume, and temperature of rarefied gases, by Mr. E. C. C. Baly and himself, recapitulated the chief points in the paper. Siljeström, in 1873, and Mendeléef, in 1875, he said, had both found that gases become less compressible than Boyle's law would give, as rarefaction proceeds. Amagat, in 1883, examined the subject, and concluded it was impossible to make measurements sufficiently accurate to decide the question one way or the other. In 1886 Bohr investigated the compressibility of oxygen, and found its behaviour abnormal about 0·7 m.m. pressure. Van der Wen's experiments (1889) led him to conclusions opposite to those of Siljeström and Mendeléef, and those of Melander (1892) gave support to Van der Wen's results. To decide the question at issue the authors took up the subject, and their results confirm the conclusions of Siljeström and Mendeléef. They also prove that oxygen behaves abnormally about 0·75 m.m., as found by Bohr. Prof. Perry said some of the terms used in the paper required alteration. The word "elasticity" was employed in several senses; sometimes being used to denote "$p\,v$," the product of pressure and volume, whilst at others its ordinary meaning was intended. He did not quite understand the connection between $p\,v$ and the thermal expansion, to which the authors refer at the end of their paper. Taking Ostwald's equation for gases $(p + a)\,v = Rt$, he proceeded to show that the coefficient of expansion would be constant whether $p\,v$ was constant or not. Dr. Burton said he had been accustomed to think as pressure was reduced gases approached the simple or "perfect" state. It was very desirable that similar experiments be made on other gases, to ascertain if any had constant coefficients of expansion. He failed to see why the internal energy should increase as the pressure decreases, unless, under these conditions, energy travels more by radiation than by conduction or convection. The President, speaking of the adhesion of gases to the surface of glass, suggested experiments on the effects produced by varying the ratio of the surface to the volume of the gas. On the subject of distribution of energy he was inclined to agree with Dr. Burton's view, rather than with the author's suggestion. One would not be led by *à priori* reasoning to expect that the internal energy would increase with decrease of pressure. Prof. Ramsay, in reply, said that in the experiments on oxygen at about 0·75 m.m. pressure, the greater part of the gas was sometimes found in one McLeod gauge and sometimes in the other. Only after standing seventy-eight hours did the quantities trapped in the two gauges become equal. The only explanation they could think of was that the temperatures of the gauges might not have been absolutely the same. Speaking of the suggested increase of internal energy with decrease of pressure, he said Prof. Dewar's experiments tend to show that there was little conduction through vacuous spaces. The President thought Dr. Bottomley's researches had shown that radiation also falls off rapidly as the pressures become very small.—Owing to the absence of Captain Abney, the exhibition of photographs of flames, which had been announced, was postponed. A paper on the isothermals of ether was read by Mr. Rose Innes. Taking the important linear law $p = b\,T - a$ connecting the pressure and temperature of substances (liquid and gaseous) at constant volume, given by Ramsay and Young (*Phil. Mag.* vol. xxiii. p. 436), and subsequently confirmed by Amagat and Tait, the author has endeavoured to express the constants b and a in terms of the volume v. Using the results of Ramsay and Young's experiments on ether, because they extended over a large range of volume (1·9 to 300), the following formulæ were found to give the best approximation, viz.

$$b = \frac{751 \cdot 9}{v - 0 \cdot 9173\, v^{\frac{1}{3}}} \quad \text{and} \quad a = \frac{23{,}300{,}000}{v^2 + 11 \cdot 05\, v^{\frac{1}{3}}}$$

Tables and curves accompany the paper showing that for volumes between 6 and 300 the agreement of calculated and observed values of p do not differ more than can be accounted for by errors of experiment. For volumes less than 5 the formula for p gives numbers quite wrong. In searching for a physical basis for the expressions for b and a the author puts l^3 for v in the above formula, l being the side of a cube whose volume is v. The expression for p then becomes

$$p = \frac{RT}{l^3 - cl^2} - \frac{A}{l^6 + kl^5} \quad . \; . \; . \; . \quad (3)$$

Writing the coefficient of T in the form $\frac{R}{l^3} \cdot \frac{l}{l - c}$, the author goes on to show that this form might be expected if the molecules had finite dimensions, for the number of impacts on the faces of a cube would be increased in the ratio $\frac{l}{l - c}$, where c is a quantity depending on the size of the molecules. Ingenious arguments suggested by Van der Waal's remark that his formula must not be pushed beyond the point where the actual volume is less than eight times the volume of the molecules, lead the author to infer that for ether this limiting volume is somewhat above 6. Hence he would not expect his (Mr. Rose Innes) formula to hold below this volume. The formula for a, the "internal pressure," is explained on the supposition that a "skin" effect exists between the matter in the vessel and the boundary layers. By clearing expression (3) of fractions the author shows that the shape of the isothermals are represented by an equation of the seventh degree in l, which cannot have more than three positive roots, and thence infers that isothermals are not necessarily represented by cubic equations, as is sometimes assumed. Prof. Ramsay said Mr. Rose Innes' formula was much more satisfactory than that of Van der Waal's, which was at best only a rough approximation. The President objected to the use made of the word "discontinuity" in the paper, as being quite different to its precise mathematical meaning. He also pointed out that the author's arguments respecting the effect of finite molecular dimensions was much less general than that of Van der Waal's. Although the new formula agreed with experiment over a longer range of volume than that of Van der Waal's, it would not be safe to argue beyond the range of the experiments it represented.

PARIS.

Academy of Sciences, June 18.—M. Lœwy in the chair.—On the satellite of Neptune, by M. F. Tisserand.—The principle of maximum work and entropy, by M. Berthelot. A general discussion of the theory of maximum work, treated under the heads—(1) Chemical action and the disengagement of heat; (2) the principle of maximum work; (3) entropy; (4) a comparison of the consequences of the principle of maximum work and those of entropy.—Note on *Phyllium pulchrifolium*, by M. Sappey. The author shows that *Phyllium pulchrifolium* exhibits only a superficial resemblance to leaves, and is a true insect in all essential particulars.—On the *Dyrosaurus thevestensis*, by M. A. Pomel. This fossil reptile is the same as that described by M. Phil. Thomas as *Crocodilus phosphaticus*. It is not a crocodile, and should perhaps be termed *Dyrosaurus phosphaticus*.—On the astronomical observations made at Abastouman by M. de Glasenapp, director of the St. Petersburg Imperial Observatory, by M. Lœwy.—A memoir was presented on a theoretical study of the elasticity of metals, by M. Felix Lucas.—Solar observations made during the first quarter of the year 1894, by M. P. Tacchini. A progressive diminution in spots and faculæ has been recorded.—Researches on continued fractions, by M. Stieltjes.—On four connected solutions of the problem of transformation relative to the elliptic function of the third order, by M. F. de Salvert.—The expression of the number of classes deduced from the transformation of elliptic functions, by P. de Seguier.—On the surfaces capable of forming, by a helicoidal displacement, a *famille de Lamé*, by M. Albert Petot.—On a system of chromato-diatonic gamuts, by M. Edmond de Polignac.—The detection of traces of chlorine, by MM. A. Villiers and M. Fayolle. The chlorine is liberated by permanganate in presence of sulphuric acid, and shows, even in small traces, a blue colouration becoming red violet when treated with the following reagent in excess: saturated aqueous solution of colourless aniline 100 cc., saturated aqueous solution of orthotoluidine 20 cc., and glacial acetic acid 30 cc.—On the emetics, by M. E. Maumené.—Preliminary notice on a meteorite of a type distinct from the ordinary stony meteorites, by M. G. Hinrichs.—On the influence of fluorine compounds on beer ferments, by M. J. Effront. It is shown that ferments which have gradually become inured to the action of fluorine compounds give more alcohol and less glycerine and succinic acid than ordinary yeast from a given quantity of glucose.—Anatomy of the digestive tube of Hymenoptera, by M. Bordas.—On the presence of a thread cell in the spores of Microsporidiæ, by M. P. Thélohan. The author concludes that the Microsporidiæ should belong to the group of the Myxosporidiæ, as their spores present the same characteristics.—On the structure of the plants of Spitzbergen and of the island of Jan Mayen, by M. Gaston Bonnier. The following conclusions have been formulated:—(1) Arctic plants as compared with Alpine plants of the same species are thicker and present a differentiated structure, and contain more numerous lacunæ; (2) the greater humidity of the air and the different character of the light play the principal part in this adaptation of Arctic plants.—The *gommose bacillaire* of vines, by MM. Prillieux and Delacroix.—On the presence of remains of Foraminiferæ in pre-Cambrian rocks of Brittany, by M. L. Cayeux.—Impermeability of healthy epithelium to drugs and poisons, by MM. Boyer and L. Guinard.—Regulation of thermogenesis by the cutaneous action of certain alkaloids, by MM. L. Guinard and Geley.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—A Text-Book of Ore and Stone-Mining: Dr. C. le Neve Foster (Griffin).—A Hand-book to the Flora of Ceylon: Dr. H. Trimen, Parts 1 and 2 and Plates (Dulau).—Practical Photo-Micrography: A. Pringle (Iliffe).—Travels amongst American Indians: Vice-Admiral L. Brine (S. Low).—Aspects of Modern Study (Macmillan).—Beginner's Guide to Photography, fifth edition (Perken).—Bodenphysikalische und Meteorologische Beobachtungen mit besonderer berücksichtigung des Nachtfrostphänomens: T. Homén (Berlin, Mayer).—Travels in a Tree-top: C. Abbott (Matthews).—The Tidal Streams of the North Sea: F. H. Collins (Potter).—A Monograph of the Bats of North America: Dr. H. Allen (Washington). Bulletin of the U.S. Fish Commission, Vol. xi. (Washington).

PAMPHLETS.—The Calming of Waves: Dr. M. M. Richter, translated (Hamburg, Porges).—On Blinding of the Retina by Direct Sunlight: Dr. G. Mackay (Churchill).—Johns Hopkins University of Baltimore Register for 1893-4 (Baltimore).—Carolina Pirates and Colonial Commerce, 1670-1740: S. C. Hughson (Baltimore).

SERIALS.—Sitzungsberichte der Physikalisch-Medicinischen Societät in Erlangen, 25 Heft, 1893 (Erlangen).—Zeitschrift für Wissenschaft-liche Zoologie, lvii. Band, 4 Heft (Leipzig, Engelmann).—Séances de la Société Française de Physique, July–December, 1893 (Paris).—Proceedings of the Liverpool Naturalists' Field Club, 1893 (Liverpool).—Economic Journal, June (Macmillan).—Good Words, July (Isbister).—Sunday Magazine, July (Isbister).—Longman's Magazine July (Longmans).—Bulletins de la Société d'Anthropologie de Paris, Avril (Paris).—Journal of the Royal Microscopical Society, June (Williams and Norgate).—Transactions of the Royal Irish Academy, Vol. xxx. Part xi.: On the Geology of Torres Straits: Profs. Haddon, Sollas, and Cole (Dublin).—Ditto, Vol. xxx. Part xii: On the Volcanic District of Carlingford and Slieve Gullion, Part I.: Prof. Sollas (Dublin).—Proceedings of the American Philosophical Society, January (Philadelphia).—Proceedings of the Academy of Natural Sciences of Philadelphia, 1893, Part 3 (Philadelphia).—Journal of the Academy of Natural Sciences of Philadelphia, 2nd series, Vol. x. Part 1 (Philadelphia).

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