THURSDAY, FEBRUARY 14, 1901.

DARWINISM AND LAMARCKISM, OLD AND NEW.

Four Lectures by Frederick Wollaston Hutton, F.R.S., &c. Pp. x + 171. (London: Duckworth and Co., 1899.)

THE first of the lectures printed in this volume is entitled "Darwinism," and it was delivered at the Philosophical Institute of Canterbury, New Zealand, in 1887; the second, delivered in 1898 to the same Institute, is upon "The New Darwinism"; the third, "Darwinism in Human Affairs," was given in 1882 to the students of Canterbury College, University of New Zealand; while the fourth and concluding lecture, "The New Lamarckism," has been added to render the "treatment of the subject more complete."

The author's object has been to make a clear statement of his subject, suitable for readers who are not specialists and "have no time to study more elaborate works." Throughout a large part of the work he has succeeded in this attempt, although there are passages the meaning of which is not carried on the surface. Thus, at the beginning of the Introduction, a quotation from Darwin is concluded with the words, "This, which was published in 1859, is strictly correct at the present day"; while the next sentence, opening the succeeding paragraph, reads, "In 1899 things are different." By reading on, and then turning back to the preceding page, the apparent confusion is removed, but this is hardly the way to make things easy. Similarly, on p. 9, the word "transmitted" is used in a context which seems to imply heredity, and when the conclusion has been assimilated, the next sentence informs us that the word is not used exclusively in this sense.

The author considers that the increased prominence given to isolation "is the only real advance that has been made since Darwin's death" (p. 5); but surely the question of the hereditary transmission of acquired characters is in a totally different position to-day from what it was in 1882; and the change as regards this subject from the old uncritical, somewhat slipshod attitude of the past must be counted as a very real advance. Although Lamarck receives generous treatment in the book, Buffon is altogether neglected, his suggested causes of change in the direct influence of the environment being set down to the later zoologist.

Romanes' term, "physiological selection," is criticised because, "except in the bacteria, species are not founded on physiological characters." The suggested cause of evolution is more than doubtful, but the phrase is certainly a descriptive and appropriate one to express the idea that physiological incompatibility between the germ-cells of certain individuals and those of the rest of the species may be an agency which determines the splitting of a single species into two. The suggested substitution of the phrase "progressive infertility" (p. 12) by no means expresses Romanes' idea; for he conceived of the infertility arising, ready-made and complete, as the result of spontaneous variation. When the author states that species are not founded on physiological characters he forgets (although he himself recognises it elsewhere) that the physiological characters of fertility *inter se* and of infertility with other species have been very widely looked upon as among the most important attributes of a species. Thus Huxley's criticism of the evidence for the acceptance of natural selection may be summed up in the words of his letter to Charles Kingsley:

". . . if Carrier and Tumbler *e.g.* were physiological species equivalent to Horse and Ass, their progeny ought to be sterile or semi-sterile. So far as experience has gone, on the contrary, it is perfectly fertile. . . It has been obvious to me that this is the weak point of Darwin's doctrine. He *has* shown that selective breeding is a *vera causa* for morphological species; he has not shown it a *vera causa* for physiological species." ("Life and Letters," 1900, vol. i. p. 239.)

This quotation is introduced merely to show that there is good warrant for Romanes' use of the term "physiological" in this connection, not because the present writer believes that the suggested difficulty is insuperable.

One of the reasons given for the inference "that the object of physiological evolution was the development of man" seems to be very far-fetched, viz. the existence of a number of elements

"in the world which appear to be of no use except to man: for example, gold, silver, lead, zinc, &c. . . . Not only were these made for man, but they appear to have been made as rewards for the exercise of his intellect. There are other substances, such as the rarer elements, of which no use seems ever likely to be made except the important one of stimulating enquiry" (p. 19).

A similar conviction as to the meaning of the beauty and variety of organic forms is expressed on p. 107.

In the first lecture, "Darwinism," the interesting history of the author's personal experience of evolution is recorded. He had read the "Origin" on its first appearance with avidity, and could detect no flaw in it, but thought that this must be due to his own ignorance. He was soon afterwards convinced by Sir Andrew Ramsay, with whom he went on a geological excursion to the Isle of Wight. In 1861 he wrote an article on the "Origin" in the *Geologist*, and received an extremely kind and interesting letter from Darwin (p. 34).

In criticising Darwin's statement that he owed the idea of natural selection to Malthus, a very interesting passage from the "Journal of a Naturalist" is quoted, apparently proving that the fundamental ideas about natural "checks" and "constant food supply" were clearly fixed in his mind at a very early period (pp. 40–41). The reference is not given, but the important passage should be compared in the different editions of the "Journal."

The statement that Darwin abandoned his hypothesis of pangenesis, "or thought lightly of it" (p. 51), is erroneous. The great "Life and Letters" shows clearly enough that he retained considerable confidence in it even when friends whose opinion he valued very highly did not agree with him. The chief experimental difficulties which oppose it are not alluded to (pp. 59–60), viz. the fact that mutilations, even when continued for a long series of generations, are not inherited, and that transfusion of blood and transplantation of tissue do not produce any hereditary influence.

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The second lecture, "The New Darwinism," contains at the outset (p. 63) an entirely new and erroneous definition of the term "Neo-Darwinian." "The Neo-Darwinians, as we are sometimes called, accept Darwin's teaching, and supplement the theory of natural selection with *methods of isolation*" (italics the author's). As is well known, the term was really applied to those who accepted only that part of Darwin's teachings which was originated by him, and excluded that small but distinct element of Lamarckian doctrine which he incorporated with his own. The history of the use of this term and "Neo-Lamarckian" is as follows. A school of Lamarckian evolutionists grew up in the United States, and reached its maximum about the time that the question of the hereditary transmission of acquired characters became acute, viz., 1887 and the following years. It consisted of Cope, Hyatt, Ryder and several other naturalists; W. B. Scott and H. F. Osborn belonged to it in those days. The members of the school chiefly looked at evolution from the point of view of palæontology. They called themselves Neo-Lamarckians, because they rejected Lamarck's more extravagant suggestions, but believed that in the remainder they had found a satisfactory basis for evolution. When, owing to Weismann's writings, the scope of heredity began to be rigidly investigated, many naturalists quickly recognised that grave doubt was thrown upon the whole of Buffon's and Lamarck's suggestions as to the causes of evolution, and they took their stand on natural selection alone among all hypotheses as yet proposed. In this they followed Weismann and Wallace, and they were called by those who did not agree with them "Weismannians" or "Neo-Darwinians," the term "Darwinian" being reserved for those who believed the whole of Darwin's teaching—the extrinsic element as well as that peculiar to him. This at any rate, was the attempted achievement of the labellers. The naturalists in question had never selected the label which it was sought to affix to them, nor were they pleased with it, as were the Neo-Lamarckians with their invention. They, or at any rate many of them, protested against the term "Darwinism" being used necessarily to include an element extraneous to Darwin, although accepted by him, of very doubtful validity, and liable, if entirely abandoned, to drag down with it the historic title derived from the name of the great English naturalist. "Darwinism," applied, as Wallace applies it, to the hypothesis which was originated by Darwin, is liable to no such objection, and these naturalists maintained that it is in every way appropriate to thus describe natural selection, the one and only suggested cause of evolution which seemed to them to possess any significance or value. The history of the whole controversy is to be found in letters and articles printed in this journal for several years following 1887.

In this second lecture many examples are given of what are believed to be useless specific characters (p. 69–73). The exigencies of space prevent any detailed criticism, but it may be generally stated that many of the cases cited are extremely unconvincing. The question of incipient variations is briefly alluded to without any reference to Dohrn's principle of "change of function," which offers so probable an explanation of many difficulties.

One of the best features of the book is the use made of the natural history of New Zealand and the southern seas (as on pp. 87, 90, 91, &c.).

In the third lecture, "Darwinism in Human Affairs," there is a clear statement of the way in which selection acts on a group of competing individuals distinguished by variation (pp. 110, 111). The concluding sentence of the lecture, on p. 133, is distinctly out of place in a work of this kind. Those who have written on the relations of religious thought and doctrine to the teachings of science have always been welcomed by a large body of readers. But it is unwise, and, fortunately, rare, for the two sets of ideas to be jumbled together haphazard, so that in a professedly scientific work we are suddenly brought up with a shock by some short sentence expressing a religious conviction. The object which the author probably has in view is not advanced by such a method.

The concluding lecture, on "The New Lamarckism," contains much cautious and interesting reasoning upon various instances which are believed to prove the existence of the Lamarckian factors of evolution; although the part which the nervous system probably plays in many of the changes, such as those of pupæ (p. 141) and of mammalian hair (p. 142), is neglected. The opinion that retrogression follows as a natural result of the cessation of selection is rejected by the author (p. 157), as we might expect, seeing that he does not allude to the conception of a condition of unprogressive equilibrium still requiring the unremitting aid of selection for its support. In this lecture, too, there is a further dogmatic statement as to the uselessness of certain structures or features. Among these the white under-side of flat fishes is instanced as probably due to disuse-inheritance (p. 160); but Abbott H. Thayer's interpretation of white under-sides generally may very probably be applied (as, indeed, Mr. Thayer believes) during the movements of these fish. The statement that "the thickness of the legs of the moas was of no advantage to them. On the contrary, it was distinctly a disadvantage" (p. 160), is an example of dogmatism concerning conditions of life of which we are extremely ignorant.

The author is inclined to believe in certain examples of "disuse-inheritance," although he generally criticises the evidence for "use-inheritance." He forgets that passive structures which are useful, but not physiologically altered by their own utility, degenerate when they cease to be useful, no less than the active structures which are modified by their own use. This argument, *mutatis mutandis*, affects equally the supposed use-inheritance.

In the case of certain New Zealand alpine plants, it is contended that there is good evidence for the transmission of an acquired character. *Olearia nummularifolia*, var. *cymbifolia*, produces leaves characteristic of the local alpine plants, but "the leaves on new shoots revert to the ordinary form if the plant is removed to the low land; thus showing that the peculiar shaped leaf is an acquired character and not inherited." On the other hand, the alpine *Veronica lycopodioides*, having a leaf similar to that of the *Olearia*, does not change when grown at a low level, "and we must, therefore, assume that an acquired character has here become congenital" (p. 165). The probable explanation is that natural selection has rendered the former species susceptible to the influences of two very different sets of conditions, while the latter has been led by it to a single fixed form suitable to a single set of conditions. This is only a suggestion, and might require modification after a special study of the circumstances of the two species; but it is sufficient to show that we require far more evidence before it can be conceded that such transmission had been made in any way probable.

The book is well and clearly printed. A portrait of Lamarck forms the frontispiece. E. B. P.

THE RATIONAL TEACHING OF MATHEMATICS.

The Teaching of Elementary Mathematics. By David Eugene Smith, Principal of the State Normal School at Brockport, New York. Teachers' Professional Library. P. xv + 312. (New York: The Macmillan Company. London: Macmillan and Co., Ltd., 1900.)

IN many training colleges for primary school teachers there are elaborate courses of study on psychology and ethics. Surely a knowledge of morals and of the mental machinery of boys and girls would be more certainly and more easily acquired incidentally during other studies, such as the natural sciences; but at these colleges there is seldom any attempt to educate through the natural sciences. We have, though not to the same degree, the same feeling about courses of instruction in mathematics. There is a cold-blooded formality about the mere name which tells all children truly that they are being offered stones for educational bread. But if there must, unfortunately, be separate courses of instruction in mathematics, we should, if we were children, dearly love to be taught by Mr. Smith. He is well read in his subject, and teachers who are also well read will take pleasure in seeing the best views so clearly put forward; teachers who are not learned in the subject will benefit greatly by reading this book. Short sketches of the histories of arithmetic, algebra and geometry are woven into the text in such a pleasant fashion that one reads and understands without much effort. The merits and demerits of various systems of teaching mathematics to very young children are clearly stated, but we cannot help thinking that too much is made of the philosophy of the numerous German exponents of pedagogy. There is no system which will give good results in the hands of a fool; there are many systems which will work fairly well in the hands of the average teacher; a thoughtful man who is in sympathy with his pupils will succeed with any method that he is likely to adopt.

Philosophers are too fond of distinguishing between teaching for *utility* and teaching for *culture*. We take it that even if we teach mathematics for its "bread-and-butter-value," if we teach so that a pupil really understands what he does, then we are really training his logical powers and giving him help in his ethical, religious and philosophical ways of thinking. The more we try to teach merely for culture the more do we make the reasoning obscure and difficult. As if a good teacher could possibly give sordid notions to his pupils! What we really want is that all teachers shall know their business, and then, however quickly they may make their children cover the ground of elementary mathematics, and we say the quicker the better, the children will be taught as rational beings. Much of the arithmetic taught in schools is really the teaching of a trade. A particular rule like *Practice* is merely the application of arithmetic to the trade of a grocer. So also rules like *Interest* or *Discount* are labour-saving rules, useful when one has thousands of calculations of the same kind to make, easily learnable by a boy after he leaves school if he has a knowledge of simple arithmetic and if his common sense has had a fair chance of development. Children may be kept for years at "rules" of arithmetic which they never understand, by an unscientific teacher, and this is what the philosophers condemn as utilitarian teaching. There is as little *utility* about such teaching as there is *culture* in that of the equally unscientific follower of the greatest psychologist. Of the two, however, the unscientific utilitarian does least harm, for he makes least pretence; he only stupefies the brain, the other destroys the soul.

Indeed, the man who aims exclusively at culture always hurts the soul of his pupil, for he teaches that what is useful must be low, and that the study of it must lead to sordid thought. We can no longer afford to laugh when men assure us that they scorn the results of their studies when these results prove to have useful applications. So long as these men were few in number they might be laughed with; we laughed because they were paradoxical and because we did not fear that the utility of a study could really be lost sight of. We are always grateful to philosophers who discover new truths, whatever their notions as to their utility may be. But when the stupid admirers of these men erect their paradoxes into articles of belief; when headmasters with much capital invested in teaching machinery find that such articles of belief give a fictitious value to their invested capital; when as a result, 98 per cent. of the boys leaving school at seventeen to nineteen years of age know no mathematics, although they are supposed to have been studying mathematics for many years; when we have overwhelming proof from the fields of war and commerce and manufacture that the best race of men in the world is held by want of education, as if by enchantment, from exercising its natural powers—then we feel that the time has come when a crusade ought to be preached against the pestilent heresy.

We are very glad to think that Mr. Smith gives great weight to the opinions of Profs. Henrici and Minchin about mensuration and geometrical teaching. Lacroix expressed them clearly, so did Clairaut and Voltaire and Hoüel and Spencer and Langley, and many another educationist. Laisant says, "But just as there must be a preliminary preparation for arithmetic—namely, practical calculation—so theoretical geometry should be preceded by the practice of drawing." Rousseau said that for young pupils "geometry is merely the art of handling the rule and compasses." Mr. Smith describes the use of shears and cardboard, and he suggests how to follow Galileo's experimental and inductive methods in mensuration, even with boys of intermediate grades. As for demonstrative geometry, Mr. Smith says that in America it usually begins in the tenth or eleventh school year.

"To begin a work of the difficulty of Euclid any earlier than this will hardly be sanctioned by American teachers; the hard Euclidean method must change, or the subject must remain thus late in the curriculum. If the object were, as seems to be the case in England, to cram the memory for an examination, it could be attained here as easily as there. But the considerable personal experience of the writer, as well as the far more extended researches of others, convinces him that as a valuable training in logic, as a stimulus to mathematical study, and as a foundation for future research, the study of Euclid as undertaken in England is not a success."

He then quotes Prof. Minchin, who says:—

"Why then is it that the teacher, when he comes to the teaching of Euclid, is confronted with such great difficulties that his belief in the rationality of human beings almost disappears with the last vestiges of that good temper which he himself once possessed? The reason is simply that Euclid's book is not suitable to the understanding of young boys."

We wish that Prof. Minchin had gone further and said that whereas every boy and man takes an interest in experimental science, including geometry and mensuration, only a few ever take an interest in demonstrative geometry; and it is both wrong and foolish to insist on its being learnt by boys whom it stupefies, whatever their age may be. All educationists are agreed that the English system of insisting on all young boys learning demonstrative geometry is quite wrong. Certainly, we know of no educationist who has a word to say in favour of the system prevailing in all English schools. We take it that the system is maintained because it does not "pay" the pupil in any sense whatever. Prof. Hudson is quoted as saying, "To pursue an intellectual study because it 'pays' indicates a sordid spirit." Working at geometry indicates no sordid spirit in our boys, but we are not so sure as to what it indicates in the masters of English schools. It "pays" them very well indeed.

Give the brains of an average English boy a chance of development, and he is full of common sense and self-reliance and scientific method; and yet the average boy leaves our schools uneducated, with no knowledge, and with the belief that he is stupid. Even Pythagoras did not think that more than a very few men were capable of the study of geometry; hardly one legislator or ruler or warrior from the time of Pythagoras to that of Pappus made a study of geometry, although this was a time when there were few kinds of intellectual study.

Mr. Smith's statements as to the history of the subject are fairly acceptable, as he keeps clear of debatable matter.[1] Throughout, he is unwilling to give Semites much credit, and I presume that it is in consequence of this that, in describing the work of Diophantus, the Alexandrian beginner in what we now call algebra, he forgets to mention that in all probability all the early life of Diophantus was spent among Asiatic peoples. Algebra, as we know it, dates from the time of Haroun of the "Arabian Nights." No doubt it comes altogether from the Semites of thousands of years before—the Semites who gave us all religions and the usages of older civilisations, without being able to give us their own subtler instincts; who taught Homer the decoration of a shield and Pericles how to beautify Athens; who gave Greece all its geometry through Pythagoras the Tyrian; who allowed Thales and Herodotus and other peripatetic students to absorb their science; who taught the doctrine of humanity to Socrates, and who did not mind taking to themselves Aryan names either in Troy or Alexandria or London.

The earnest reader of Mr. Smith's book will probably be led by it to think things out for himself. It is not important that he should subscribe to the author's opinions. Indeed, these opinions are rather in opposition to one another, for Mr. Smith is able to see that there is much to be said in favour of the views of almost all the writers whom he quotes. He gives many hints which will be found very suggestive by a thoughtful teacher of arithmetic and algebra who is not himself a good mathematician. They may, however, lead a common man to obscure the minds of his pupils, giving them, for example, all the historical methods of solving quadratics before they know much about quadratics. When one clears an equation of fractions by multiplying all across by some function of the unknown, the resulting equation contains other roots than the original one—yes, but it is not wise to trouble beginners with too much of this. One may philosophise deeply over our very simplest notions, but "Sartor Resartus" ought only to be read by grown-up people.

JOHN PERRY.

[1] As this notice was getting too long, we have cut out much of what we had written. We have here cut out some remarks as to the claim of Napier of Merchiston to the invention of the use of decimals. But it is rather important to re-write an observation made long ago by Prof. Ayrton:—"The units ought to be symmetrical with regard to tens and tenths, and it would be more scientific to write 1500·0032 as $150\bar{0}0032$ or $150\dot{0}0032$, or in some other way which shows its symmetry. It is astonishing what trouble is given by the difference in rules between finding the logarithm of a number like 500 and a number like 0·05. If they were written $50\dot{0}$ and $\dot{0}05$ we should have the same rule for both. If we must retain the present unscientific method, let writers who wish to avoid printers' errors avoid ·05 and always write 0·05."

HUMAN ORIGINS.

In the Beginning (*Les Origines*). By J. Guibert, S.S. Translated from the French by G. S. Whitmarsh. Pp. xvi + 379. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1900.)

THE author of this book is the Superior of the Institute Catholique in Paris, but when he wrote it he was professor of natural science at Issy. The book is the outcome of an endeavour to train young ecclesiastics who, in the future, would have to propagate and defend the faith. It is rightly insisted as most essential that young clerics should be wanting in no knowledge concerning humanity; and it is pointed out that two perils of equal danger have to be avoided—an ill-founded compliance with the theories in favour amongst the learned, and a blind attachment to certain ideas which have no firm foundations, but which some men erroneously consider as identical with the faith. The author imposes on himself the three following obligations: (1) honestly to explain systems, (2) assert with firmness what is well established, (3) leave the questions open which have not yet received a solution; and he concludes his preface thus:

"If, as science advances, it should illuminate some doubtful point, or show the fallacy of some solution which I had looked upon as finally settled, I should not hesitate to yield myself to these indications. And if the Church, in whose infallibility I firmly believe, should deliver a judgment contrary to my assertions, I am ready, in advance, to accept her teaching."

It is interesting to note how this very earnest and conscientious teacher treats his subject, as he evidently endeavours to present the main results of scientific research to his readers so that they may be prepared for the shock of a possible future meeting with scientific doctrines which might imperil their faith.

The "Church" has, very wisely, not pronounced definitely on many scientific problems, and concerning these it is open to an intelligent Roman Catholic to hold fairly advanced views; for example, the cosmogony of the Bible is one of these, and the reader is permitted to take his choice of the three main interpretations of this account. The most, too, is made of our ignorance concerning the origin of life and the actual precursors of man. The author regards himself as an evolutionist, but he is not a thoroughgoing one, as he distinctly affirms that the theory of evolution can neither be applied to the origin of life nor to man. He asserts that

"evolution, even had it realised the progression which unites all animals in one nature, could not have produced that new creation which is known as an intelligent and free man."

The author admits that the volume has no scientific pretensions, and he goes on to say "were it judged with the utmost rigour it would not disturb me." All the same, the book would have been less open to criticism if it had been looked over by specialists, as there are many statements of theories or facts that, to say the least, it would have been much better to have put differently, and there are many errors of nomenclature and misprints that should have been avoided. For example, Noctiluca is called a "jelly fish" (p. 75), *Aurelia oecrita* (*sic*) is termed a Madusa (p. 82). As examples of errors of fact may be instanced, the Australians are credited with a "wide head" (p. 368); the Bushmen are degenerate Hottentots, and these, according to "eminent ethnologists," are "emigrant Egyptians, debased and deformed by misery" (p. 372).

We have given this book as much space as it deserves as a popular exposition of human origins; but nevertheless it is probable that it will be of service, as it should make some religious people think on subjects that they too often ignore, and, at all events, it will indicate to "good Catholics" that certain of their own religious teachers do not entirely repudiate modern science or entirely reject the theory of evolution.

OUR BOOK SHELF.

Atti della Fondazione scientifica Cagnola. Vol. xvii. Pp. xxvi + 355. (Milan: Tip Bernardoni di C. Rebeschini, e c., 1900.)

UNDER the Cagnola foundation, two prizes are annually awarded for essays on subjects proposed by the founder, and one prize of about 100*l.*, with a gold medal of the value of 20*l.*, are awarded on a subject chosen by the Reale Istituto Lombardo. The theme for 1898 was a critical exposition of the theory of electrical dissociation, and the successful memoir by Profs. Angelo Battelli and Annibale Stefanini forms the subject of the present volume.

Among the various theories of solution, that of van 't Hoff, which regards the dissolved substance in a dilute solution as existing in the gaseous state, has found much favour; but determinations of molecular weight derived by this hypothesis do not agree, especially in the case of electrolytes, with those obtained by other methods or deduced from the chemical formulæ. This circumstance, coupled with the fact that the least electromotive force suffices to generate a current in an electrolyte, had already led Clausius to replace the hypothesis of Grotthus by other theories; and Arrhenius, observing that the anomalies in the osmotic pressure and the freezing-points occur exclusively in solutions of electrolytes, was led to the hypothesis that these contain the acids and salts in a state of dissociation, increasing with the dilution.

This hypothesis of electrolytic dissociation has been put by the authors to a variety of tests in connection with the mechanical phenomena of osmotic pressure, optic phenomena, thermal phenomena connected with freezing- and boiling-point determinations, and, lastly, electric phenomena; and while many of the results favour the hypothesis of the existence of free ions in solutions, others are difficult to reconcile with this theory. Thus the degree of dissociation required to account for optic phenomena does not always agree with that deduced from cryoscopic or ebullioscopic observations, or from electric conductivity. Moreover, the authors do not consider it conclusively proved that there is no inferior limit to the electromotive force sufficient to set up a current in an electrolyte.

It will be thus seen that Profs. Battelli and Stefanini have opened up a wide field of discussion in connection with electrolytic theories, and that their work, both theoretical and experimental, will be of no small assistance to chemists and physicists interested in researches in this subject.

An Elementary Treatise on Qualitative Chemical Analysis. By Prof. T. F. Sellers, A.M. Pp. 160. (Boston: Ginn and Co., 1900.)

THE author justifies his contribution to the long list of analytical works by pointing to the inevitable gap. The gap no doubt exists. The question is whether it is desirable to fill it. We have analytical books which mean business, and, being written for analysts and not for students, are crowded with practical details. Then there are the countless examination cram books, which by tabular and other devices direct the student by the shortest cuts to his ultimate goal—the discovery of the constituents of salts, simple and complex. The present little volume is to fill the gap which lies between these two extremes, and its advantages are set forth in the preface under six principal heads and eight subsidiary ones. Without transcribing literally these manifold recommendations, it may suffice to say that the book opens with the principles of analytical chemistry by introducing the theory of solution, osmotic pressure and electrolytic dissociation, and proceeds with the usual series of qualitative tests for bases and acids and their methods of separation.

However desirable it may be for even an elementary student to gain some knowledge of analytical chemistry based upon the modern theory of solution, a beginner should first be confronted with his experimental facts. A reversal of the present order might therefore be adopted with advantage. An advantage, too, would be derived from the introduction of a few illustrations, descriptive of the apparatus mentioned in the text.

As to whether a student, such as the author contemplates, who does not intend to specialise in chemistry, gains very much from the detailed study of analytical operations, is open to question.

The study of qualitative analysis as a substantial part of elementary practical chemistry has been determined largely by tradition, partly, too, by the exigencies of examination, to which it readily lends itself; but it is worth consideration whether the emphasis laid upon it on these grounds is not exaggerated, and whether a student who studies chemistry for one year could not fill his time with practical problems of greater value.

J. B. C.

Microbes et Distillerie. Par Lucien Lévy. Pp. vi + 323. Paris : Carré et Naud, 1900.)

THIS book, which deals with the micro-organisms connected with distilling operations, supplies a good illustration of the rapid progress that is being made in the study of technical mycology. M. Lévy confines himself strictly to his subject, and does not wander into the details of practice, and yet the three hundred and twenty odd pages of his book are none too many for a very brief *résumé* of much that is known concerning the relations of micro-organisms to the distilling industry. But brief and condensed though it is, it is accurate and very fairly complete, and, moreover, possesses that charm of simple rendering which is so characteristic of the best class of French scientific literature.

The book will be useful to all interested in the technology of the fermentation industries; but we are inclined to go farther, and also recommend it to the notice of students of pathogenic micro-organisms. There appears to be some little danger of too wide a separation of this branch of bacteriology from the science as a whole, and any such artificial division can only work for harm. Probably much of the knowledge gained concerning the micro-organisms of fermentation and their actions has some bearing on pathological bacteriology, and for this reason we recommend M. Lévy's book to pathological bacteriologists as a concise and suggestive *résumé* of another branch of their science. Doubtless it reflects more especially the work and views of the French school, but then it is published in the land of Pasteur.

A. J. B.

The Fifth Report upon the Fauna of Liverpool Bay and the Neighbouring Seas. Edited by Prof. W. A. Herdman, F.R.S. Pp. ix + 336. Twelve plates. (Liverpool Marine Biology Committee, 1900.)

THE reports and other publications of the Liverpool school of naturalists have provided material for many paragraphs in our "Notes" columns, the latest "Memoir" published by the Liverpool Marine Biology Committee having been noticed quite recently (p. 330). The present volume contains reprints of the annual reports of the Committee, from the ninth to the thirteenth inclusive, papers communicated to the Biological Society of Liverpool on Copepoda, Hydromedusæ, Turbellaria, Actinia, and an abnormal Echinus, and a list of the marine fauna and flora of the Irish Sea. The record of the L.M.B.C. is brought down to the end of its sixteenth year, and observations extending over several years, referring to the marine biology of Liverpool Bay and the Irish Sea, are rendered available in a convenient form. The volume stands as substantial evidence of what valuable work a few good naturalists can do, even when the financial resources are limited.

Analytical Tables for Complex Inorganic Mixtures. Arranged by F. E. Thompson, A.R.C.S. Pp. 7. (Stafford : *Chronicle* Office.) Post free, 1*s.* 7*d.*

A SERIES of tables suitable for use in chemical laboratories where students are working at qualitative chemistry, with an examination like that of the advanced stage of practical inorganic chemistry of the Board of Education in view. The tables show how to conduct a preliminary examination of a substance in the dry way, and in the wet way for metals; and they describe the usual treatment of group precipitates and filtrates. There are also tables for examination for acids and giving confirmatory tests for acids.

LETTERS TO THE EDITOR.

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Mathematics and Physics in Public Schools.

A WELL-ATTENDED conference of science masters in public schools was held last month at the University of London, and among the many interesting papers read was one by Mr. W. D. Eggar, of Eton, on the coordination of mathematics and physics in our public schools.

In answer to that paper I endeavoured to point out at the time that the present want of cohesion between these studies was due, not to the incapacity of the instructors in these subjects, but to the illiberality of the system still prevailing, not only in the Universities to which many of the boys eventually go, but also to an equal degree in these public schools themselves.

I will here take the opportunity of thanking the editor of NATURE for his courtesy in inviting me to express my views at greater length. This letter is a plea for a change in the order of teaching mathematics in the older public schools, and contains a suggestion as to how such a change could be effected.

The points I wish to call attention to in this letter are that (1) the hands of mathematical teachers in these schools are tied by the conditions of the University examinations; (2) in arithmetic more attention should be paid to the decimal system; (3) the Euclid should be curtailed and some of it put into algebraical form; (4) too much time is given to artificial questions in algebra; (5) trigonometry ought to be begun earlier; (6) more hours might be allotted in the week to mathematics and physics; and (7) the classics are given an abnormal and unjustifiable preponderance in an ordinary boy's education.

I am quite aware that the difficulties to be overcome in effecting any rational common-sense change in the methods and order of teaching elementary mathematics will be very great, but let us hope they will not prove insurmountable.

To begin with, the public schools for boys of average ability are bound to more or less base their scheme of work on the pass requirements of the Universities, though perhaps at Eton this may be less the case than at many other schools. After those requirements have been satisfied the teaching does not by any means always shape itself in the direction of the work a boy may afterwards follow while at the University or in after life. As things are, what is the present condition of the average boy at our older public schools?

In arithmetic he gains a certain amount of proficiency in those fractions known as vulgar, he learns the artificial rules for extracting square and cube roots, he works out problems involving questions of time and work, or of time and distance, or of areas, he becomes quite proficient in the ordinary matters of compound interest, discount, stocks and shares, and he even gains an idea of what a stockbroker is. I am not prepared to say that all this has not its educational, and even its commercial, value later on, for it certainly has; but what I maintain is that we do not go far enough. There is not enough chance, our pass examinations being what they are, of boys seeing the value and importance of the decimal system as applied to physical measurements and problems. They are often apt to imagine that a result must be absolutely correct to its last decimal place, or it is valueless; and the methods of approximation are often excluded from their course altogether, either as being not sufficiently accurate or not required for the University entrance or pass examinations.

Let us turn now to the question of Euclid. Geometry is an excellent form of mental gymnastics when it is taught in the proper way, but the manner in which it is presented to the boy in our editions of the great geometer is antiquated and out of date. Far too much in this abstract science is left to the imagination, a quality which the ordinary boy frequently lacks; and ocular demonstration is but little resorted to in order to give him, by means of figures and models cut out of cardboard, a clearer idea of what he is required to prove. I also venture to think that the Euclid, such as we know it, is spun out to an excessive length, and too often the patience and courage of the average boy is well-nigh spent before he gets to the end of it.

I am fully aware of the existence of that useful body known as the Association for the Improvement of Geometrical Teaching, or, as it is now called, the Mathematical Association, of which I have the honour to be a member, but it is a large problem which it has to face, and it is to be hoped that its publication will not fall too much into the way of merely publishing solutions of interesting and sometimes recondite conundrums.

I should like to see a more rational form of geometrical text-book in common use, in which many of the propositions of the second and fifth books are merely translated into algebraical language, and ratios and symbols more widely employed in the sixth book to shorten many of the propositions.

Again, no doubt, trigonometry is postponed till too late a date, and in many cases it is not begun at school at all. Why should not every one gain a reasonable notion of the sines, cosines and tangents of angles at a much earlier stage in order to supplement his knowledge of geometry? I would not recommend a beginner to employ himself for hours, as is often the case, in proving long, and to him cumbrous, identities, but leave such work to the professed mathematician. It would be more profitable for the boy to plot out graphs of the simpler functions on squared paper and thereby gain an early notion of coordinates. He should also be taught much earlier a practical working of logarithms, and not postpone it until perhaps he has got beyond the binomial and experimental theorems.

What do we find, too, in the teaching of elementary algebra? There seem to be the same unpractical methods at work here. Boys spend considerable time over the ordinary rules in the early part of their text-books, and often no suggestion is made to them that algebra is but a convenient method of expressing general ideas in a shorthand form. The fundamental notions of ratio, proportion or variation are kept from them because, if you please, the chapters on them are printed somewhat late in their text-books! Too frequently the average question merely involves a bristling array of letters and brackets which have to be simply eliminated or removed. Seldom is an appeal made to a boy's faculties of sight and touch, and seldom is any apparatus for measurement placed in his way. The present order of things may not do much harm to the boy of mathematical ability, if he means to make a special study of the subject; but for the rank and file it is wrong, if they are to coordinate their mathematics with a good working knowledge of the calculus of experimental science.

Here I must make mention of a very valuable article by Prof. Perry in NATURE of August 2, 1900, and I only regret that, as I was away at the time, I was not aware earlier of its existence. I need only say that I am heartily in accord with him in advocating some such scheme as he there proposes. To turn now to what I hope may prove a practical suggestion. It would not be possible to change abruptly from the present arrangement to such a scheme; but the process could certainly be gradual, and a larger, gradually increasing, proportion of hours for experimental work might well be introduced into the curriculum. Surely the University of Cambridge might lead the way and bring into its previous examination some form of physical science, theoretical and practical, in order that all young men may obtain some idea of the practical applications of mathematics. Why is it that so many young men at Cambridge find the subject of physics so difficult, and are sometimes induced to abandon it for some other form of science? My answer is that their previous mathematical education has often been conducted on the wrong lines, and their knowledge is not of that kind which is required of them in the laboratories.

The University of Oxford is, however, a far worse offender in its mathematical papers for responsions and matriculation. The arithmetical papers set are thoroughly on the orthodox lines, and this is very well as far as it goes; but there is no hint of any application of arithmetic to practical work. The rest of the mathematics required is truly ridiculous; a candidate may either take an elementary algebra paper, carrying him about half-way through the subject, or a paper on the first two books of Euclid, and the latter alternative is strongly recommended by the authorities. Note that he must not take *both* subjects, so that the candidate is given to understand that these two subjects are divided off into separate compartments, and may have no more relation to one another than biology has to Greek iambics. Moreover, from what I understood in a speech at the Conference of Science Masters, a young man who would offer physics for a scholarship does not always meet with the encouragement he deserves from the authorities at certain colleges, and *a fortiori* no pass candidate is expected to even trouble himself about the subject.

With these difficulties in our way it cannot be expected that very much towards realising Prof. Perry's ideal has yet been achieved; but, in addition to what I have said, there is no doubt that the number of hours given to the study of mathematics or physics at our older public schools is woefully inadequate. It is useless to say that so much money is spent on these subjects. Unless more time is given to them for each individual boy, satisfactory results cannot be produced, much less can an advance be made towards coordinating the two subjects.

A great debt of gratitude is due to men like the late Prof. Huxley in furthering the cause of science in the public schools, but we do not want to stay where we are. An answer to the practical question of how we are to fit more time into the working day involves the removal of compulsory Greek and an alteration of the classical scheme. Education is very much in the air just now, and when Lord Rosebery, Sir John Williams and others, in the last few months, speak publicly upon this subject, it is greatly to be hoped that reforms will be brought about.

The old theory is, that it does not much matter what a boy is taught at school provided he is made to work. This, to my mind, is a most mischievous doctrine. The average boy has only a limited capacity and a limited time for learning to fit himself for his life's work, and it must be discouraging to him to find, when he leaves school, that he knows absolutely nothing about the work by which he may be going to earn his bread. Not every boy is capable of becoming a classical scholar with a fine critical instinct; let those who are by all means be encouraged in every possible way. But it is for the average boy that I plead, and I ask why so much of the old studies should be thrust down his throat when modern life will require of him a knowledge of a great deal besides.

I do not desire to enter into a long discussion of the merits of a classical education, but in the older public schools some change must be brought about if we are to devote more time to modern subjects, and it is for this reason that I have introduced the question here. A spirit of quasi-mediævalism still seems to be numbing the existence and warping the educational growth of these schools. Far better would it be if a change came about from within; but will anything short of another Royal Commission bring about the necessary reforms?

Athletics fill a large part of school life, and it is natural that they should appear important on a healthy boy's horizon. It is, therefore, all the more necessary he should be properly guided in his work before the time comes when he can judge for himself. Perhaps too much time may be given to sports; be that as it may, a boy in each day cannot work more than a certain number of hours, but while he is at work, for heaven's sake let us teach him more of the things which are likely to stand by him afterwards. I have too much respect for the older public schools to wish to see them left behind in the race by vigorous younger sisters; but we, who are concerned with such schools, cannot shut our ears to the peremptory demands for a more rational education, if our national life and character are to play the same part in the future that they have done in the past.

G. H. J. HURST.

Eton College, Windsor, February 12.

The Use of Mosquito Curtains as Protection against Malaria.

IN your issue of December 20, 1900, is described the use of mosquito curtains against malaria in Egypt. It is, I suppose, generally known that in India they have been used for many years in a similar fashion. Between 1872 and 1883 I travelled and camped in some of the most malarious jungles in India. Sometimes I had to travel, like a Boer, in light marching order; but mosquito curtains, I can well remember, were the last things to be left behind. Their efficacy in those days was attributed to a filtering action; and, following out this idea, I used (especially in very feverish districts) to employ curtains composed of thin porous sheeting. I can still recollect the various stories of the efficacy of mosquito curtains against malaria.

There seems to be an opinion amongst men who go north into the malarial districts of Rhodesia, &c., that Dr. Ross's splendid discovery does not cover quite the whole ground. One can recollect how, in certain countries, certain winds (apart from mosquitoes) inevitably bring attacks of fever, even in those who are apparently free at the time from infection. On the Nilgiris, in Southern India, between 6000 and 7000 feet high, malarial fever is unknown on the spot, but a man may turn over the ground in certain marshy localities and get fever certainly whenever he does so. It was common experience in India that the drinking of certain water, such as that from the highly malarious Western Ghaut forests, would inevitably cause malarial fever.

In many malarious localities, especially parts of China, it is sufficient to turn the ground over to apparently poison the atmosphere and induce malaria in those who are near. There is a medically authenticated case of fever being contracted from newly turned-up earth carried in baskets by coolies past a window. When this and other cases come to be re-examined they may be found traceable to mosquito-born Hæmamœbidæ; but it is difficult to account for them all in this way, and, as I mentioned, there seems to be an opinion amongst Northern men here that all cases of malarial fever cannot be attributed to Anopheles infection. D. E. HUTCHINS.

Conservator of Forests, Cape Town, January 19.

Audibility of the Sound of Firing on February 1.

I ENCLOSE a record of the sound of the guns heard at Eastbourne, commencing at 3h. 14m. and ending at 3h. 57m. As you will see, the sounds came with great regularity every minute, but the period which the sound covered in each minute gradually fell off from eleven to about five seconds. My observations were checked by a friend, and we were stationed on the summit of a down some 500 feet above sea level with a clear sea horizon out to Newhaven. The distance to the Solent is about sixty-five miles, and there was a slight wind from the North-West. I should like to try to describe the sounds which, though faint, were perfectly distinct—er-er-er-pup-er-er-pup-pup, the detonation sound being more marked towards the end of each period. I need not say that the sounds were indescribably mournful to listen to. H. D. G.

Audibility of the Sound of Firing on February 1st.

Sound commenced at h. m. s.	Sound ended at h. m. s.	Duration of sound s.
3 14 7	3 14 18	11
3 15 8	3 15 19	11
3 16 8	3 16 18	10
3 17 8	3 17 19	11
3 18 8	3 18 19	11
3 19 8	3 19 19	11
Observations interrupted by the rumbling of the wheels of a cart about a quarter of a mile distant.		
3 23 11	3 23 19	8
3 24 12	3 24 19	7
Observations again broken by sounds of a distant cart.		
3 27 13	3 27 19	6
3 28 13	3 28 18	5
3 29 11	3 29 17	6
3 30 11	3 30 16	5
3 31 12	3 31 16	4
3 32 12	3 32 13 (?)	1
3 33 12	3 33 16	4
3 34 11	3 34 15	4
3 35 11	3 35 15	4
3 36 11	3 36 15	4
3 37 11	3 37 15	4
3 38 10	3 38 16	6
3 39 10	3 39 17	7
3 40 11	3 40 15	4
3 41 10	3 41 15	5
3 42 10	3 42 15	5
3 43 10	3 43 15	5
3 44 10	3 44 15	5
Observations again interrupted.		
3 46 11	3 46 14	3
3 47 10	3 47 16	6
3 48 9	3 48 15	6
3 49 9	3 49 15	6
3 50 10	3 50 15	5
Failed to hear sound—reports growing fewer and very faint.		
3 52 13	3 52 16	3
3 53 10	3 53 15	5
3 54 11	3 54 14	3
Reports continued until 3 57—but impossible to time—so very faint.		

Sensational Newspaper Reports as to Physiological Action of Common Salt.

IN the interest of the dignity of scientific research I venture to hope you will print the following statement. Some American papers have recently published sensational and absurd reports of physiological theories and experiments whose authorship they attributed to me. These reports, which in America nobody takes seriously, were reprinted and discussed in European papers. I hardly need to state that I am in no way responsible for the journalistic idiosyncrasies of newspaper reporters and that for the publication of my experiments or views I choose scientific journals and not the daily Press. JACQUES LOEB.

The University of Chicago, Physiological Laboratory, January 16.

The Publication of Books without Dates.

Is it not time that men of science should raise a protest against the publication of books without a date on their title-page? This is a practice which has been common to maps and a certain class of books of reference, and it comes, to my mind, very near to being a deliberate fraud, as it seeks to pass off as new that which is more or less obsolete. We should surely do our utmost to prevent this habit from spreading to scientific books, such as the translation of van 't Hoff's "Physical Chemistry," which is reviewed in NATURE of February 7. O. HENRICI.

Central Institution, Exhibition Road, February 9.

Optical Illusion.

IT seems to me certain that the phenomenon illustrated in NATURE of February 7 (p. 353) is due to (1) *fatigue*, the cause of the reversed image seen when one looks away from the diagram on to white paper, combined with (2) *involuntary and incessant slight movements of the eye*.

Of course the reversed image, white squares and black lines, when one looks away on to white paper, is well known. With me it does not appear to occur at once, but after an interval; and it is intermittent, fading and recurring several times.

Now, when one gazes at the diagram, the eye moves incessantly to a slight extent; and so it is only the central part of the images of the white spaces that fall always on parts of the retina continually fatigued; the edges, near the black squares, fall on parts of the retina that have, on the whole, a good deal of rest owing to the fact that they are occupied for half the time (or so) by the images of the black squares. I do, in fact, see dark lines along the central portions of the white spaces, and the dark patches spoken of are where these dark lines cross.

I can make the horizontal dark lines disappear by purposely giving my eyes a more than slight movement up and down the vertical white spaces. Then the vertical shadowy lines, in the middle of these spaces, remain; the horizontal dark lines vanish, as should be the case.

As regards the "vanishing" of a patch looked at, I do not find this to be a correct account of what I observe. I notice that when I suddenly gaze at any one crossing, the crossing dark lines and dark patch at that place take longer to appear; but they do appear in time. Perhaps the "yellow spot" is slower in action than the rest of the retina in questions of fatigue? But these phenomena are difficult to observe, as the eyes soon tire. A very noticeable phenomenon, I suppose an extreme case of fatigue, is the following. When I gaze for a long time, white spaces here and there disappear altogether in a fitful manner, the squares concerned for the time blending. This occurs with monocular vision as well as binocular, as do all the phenomena mentioned. But I think the eyes must be very tired for this to occur.

As regards the question of spacing, I imagine that the steadier the eye-muscles, and so the less the involuntary movements, the narrower might be the white spaces. I have noticed a violet margin round an orange on snow, due to the same causes. It increased when the orange was rolled. The explanation is obvious if the view taken above is right. W. LARDEN.

R.N.E. College, Devonport.

Some Animals Exterminated during the Nineteenth Century.

Re the very interesting article published under the above-mentioned title by Mr. R. Lydekker (p. 252, January 10), may I indicate and correct an error? *Camptolaemus labradorius* is certainly exterminated on the North Atlantic coast of America, as Mr. Lydekker says; but this breed still exists not very far off, but in a somewhat out-of-the-way place, in the island of Anticosti, where M. Paul Combes saw it recently, as he states the fact in his "Exploration de l'Ile d'Anticosti," 1896 (J. André, publisher, Paris). HENRY DE VARIGNY.

Paris.

IN reference to the foregoing letter, it may be mentioned that the duck in question is entered as extinct in the "A.O.U. Check-list of North American Birds," 2nd ed. p. 56 (1895), and no information has subsequently reached this country as to its alleged survival in Anticosti. R. L.

THE PRESERVATION OF PHOTOGRAPHIC RECORDS.

AFTER the article by Dr. W. J. S. Lockyer on the disappearance of photographic images (p. 278) and other references that have been made to this subject, there is no need to dilate upon the importance of the preservation of the vast number of photographic records now being produced in our observatories and laboratories. I would, however, venture to express surprise that the fact established by Dr. Isaac Roberts as to the want of permanence of a silver photographic image appears to have been unexpected, bearing in mind the general procedure that appears to be the rule in the production of such photographs.

Photographic procedure is based chiefly, practically speaking, indeed, entirely, upon "rule of thumb," and if each modification requires a ten years' trial of it to establish its advantage or otherwise, it is at least desirable that more attention should be paid to the principles which govern the production and the permanency of photographs. It is well known that metallic silver is liable to change, yet we cannot get away from the use of silver salts, and these, of course, give silver images. *But silver ought never under any circumstances to be relied on.* The questions that present themselves, therefore, are: (1) how best to preserve the original silver image, and (2) how best to copy it.

It has been suggested to give up gelatine and go back to collodion. But this suggestion appears to be founded on nothing better than the quite insufficient evidence of general experience, and partly, also, on false inference. Metallic silver, we know, is affected by the air, and in a wet collodion plate the silver lies chiefly on the surface of the film, while in the ordinary dry plates it is buried in the gelatine. Moreover, experienced photographers tell us that the image on wet collodion plates gets denser with age. If it does so the image is unstable, and change, however it manifests itself, must be avoided if the photograph is to be accepted as trustworthy. The coarser grains and crystalline character of the image produced on wet collodion would account for its superior resisting power to outside influences, but this alleged superiority has not yet been proved. We cannot go back to collodion, but under any circumstances there appears to be no good reason for expecting any gain in that direction. Gelatine is the medium of to-day, and no evidence of its unfitness has been adduced.

Metallic silver is soluble in such reagents as dissolve silver oxide, if air or an oxidiser is present. Ammonia, potassium cyanide and sodium thiosulphate readily dissolve silver in the presence of air. The oxidation products of developers act as oxidising agents. Ferric oxalate, the product of development with ferrous oxalate, is particularly active in attacking silver, and is practically used for the purpose of thinning silver images. And the coloured products of oxidation of alkaline developers are well known to retard the reduction of silver salts, though apparently they have not been shown to be able to directly attack the metal itself. But it must be remembered that that which produces no appreciable effect in a few months, or even years, may have a disastrous action in a generation, so that the only safe course is to eliminate or exclude every suspicious substance. In short, the photographic film should consist of pure silver in clean gelatine, for anything more than this that is likely to be present will, in all probability, prove deleterious.

There is no difficulty in banishing at once ammonia, ferrous oxalate and potassium cyanide. The ammonia in the developer is replaced by sodium carbonate, an exchange in every way advantageous, the ferrous oxalate by alkaline developers, a change which has already met with general approval, and potassium cyanide as a fixing reagent is practically obsolete. The two great dangers that are not sufficiently appreciated by many photographers are the presence of thiosulphate from the fixing bath and oxidation products from the developer. To remove the first, the usual half-hour of washing is not sufficient, however the water may be applied. There is no particular virtue in running water or in washing contrivances; it is the prolonged soaking in clean water that is wanted. However the washing is done, it is easy to remove the greater part of the thiosulphate; it is the last traces that are hardly, if at all, susceptible to detection by any of the ordinary methods that need attention. If after half an hour it is not possible to detect any thiosulphate in the wash water, a further soaking for an hour and a half, with suitable changing of the water, would not be excessive treatment.

The same washing that gets rid of the fixing reagent washes out the developer and its oxidation products, if the work has been carefully and successfully done. But to ensure this the developer must have sufficient sulphite (sodium sulphite) in it to prevent its discoloration or the staining of the film. The deposition of staining matter should be prevented, as removal is tedious and troublesome. Many published formulæ for developers prescribe an insufficiency of sulphite, and it is not possible to state definitely how much is required, because that will depend on the time taken for development and the amount of sodium carbonate present. But generally, if not always, and certainly when using pyrogallol, the sulphite should be proportioned to the bulk of developer—that is, to the water; it is unsafe to dilute the prepared developer without adding the further quantity of sulphite to maintain its due proportion.

The method generally adopted at the present time to get rid of stains is founded, like so many other photographic methods, on a false basis. The idea is that if a stain disappears, it has gone. The appearance, truly, has gone, but the matter that constituted the stain may remain, and perhaps in a more dangerous form than it was at first. In almost all cases the effect of acids on stains due to oxidised developers is to lighten the colour of the staining matter and to render it insoluble. The action of alkalies is to darken its colour and to render it soluble. Alkaline solutions are, therefore, true clearing reagents, while acids are actually prejudicial, although they appear to effect improvement. It is desirable to carefully avoid the use of any acid solution whatever, and by doing so it will be found that cleaner and chemically purer plates are produced. After developing in an alkaline solution and rinsing the plate, it should be fixed in a solution of sodium thiosulphate made alkaline with sodium carbonate, and then well washed. The washing may be done with plain water, but if there is the slightest trace of colour due to stain, it will be found of advantage to add a little carbonate of soda or a very little caustic soda to the first wash waters. Acid fixing baths should be absolutely eschewed. The very grave risk that accompanies their use is not appreciated, or they would never be recommended.

Having thus obtained a really clean (that is, chemically pure) plate, the exposed surface of the film must be protected in some way to keep the image as much as possible from the air, and also to prevent contamination by the acid perspiration from fingers when handling it.

For this purpose a celluloid varnish will be found a better protection than the ordinary lac varnishes, but whatever is used it is desirable that the gelatine be dried before it is applied. By warming the plate until it is as hot as the hand can bear, and then allowing it to cool to the desirable temperature for varnishing, even though the varnish may have to be applied to the cold plate, the film is probably effectively dried. But what seems to be a much more effective method of preserving the film from outside influences is to cement on to it a cover-glass by means of Canada balsam, and this is not difficult to do after a little practice.

By thus securing, as far as possible, an image of pure silver in a clean gelatine film, drying it and sealing it up, the photographer will have taken what appear to me to be the best steps possible to preserve the photograph. It may be a little more trouble than the ordinary routine, but hardly so much trouble as is involved in the practice of other photographic methods, such as wet collodion or daguerreotype. But whatever the trouble, nothing short of such treatment as has been indicated will give the photographer the satisfaction of knowing that he has done his best to preserve his plates. I have not referred to toning, although so great an authority as Sir William Crookes has recently referred to it, because a toning process gives a more complex image, and therefore a more difficult one to deal with, but also, and chiefly, because toning is an incomplete operation, and so gives an image of varying composition, and can hardly, by the nature of the action, produce a proportional change throughout the whole image. The fainter detail will be proportionately more affected than the denser parts. Measurements of the effects of the light are thus rendered impossible, or at least doubtful, and so useless.

But whatever care is taken to secure the preservation of the original plate, if it is valuable or likely to become valuable, it alone should not be trusted as the only record of the result it bears. Within a comparatively short time of its production, say within a few months, one or two prints should be obtained from the plate. These prints should be produced in the most simple manner possible in order to avoid personal bias or other possible errors consequent on a multiplicity of manipulations. They should be of the nature of printed-out prints, because a developed print (such as one on bromide paper) allows much scope for variation. Obviously the prints must be permanent. Platinum and carbon prints are the only ones that fulfil these conditions. Both are stated to require "development," but this is a misapplication of the word, or a different application from that which refers to the development of gelatino-bromide plates. The point is that the full chemical effect in both platinum and carbon prints is produced by exposure to light alone, the after treatment only utilising the change. A platinum print is probably more trustworthy as to permanency than a carbon print. The paper used must be of excellent quality, or the sensitive coating would be interfered with, and there appears to be nothing whatever that will affect a platinum image, unless, indeed, it is treated with chemicals that disintegrate the paper at the same time. Platinum prints, however, are not the best agents for showing fine detail or very small differences of density. In this respect they may be improved and much additional brilliancy imparted to them by applying any of the waxing preparations made for waxing prints. For rendering delicate tones, doubtless a carbon transparency would be superior to a platinum print. But if a photographic plate is of such a character that it is desired to preserve its record as nearly as possible for ever, it would not be an undue precaution or an excessive trouble to make two or three platinum prints as well as a carbon transparency from it. If the original plate is to be preserved by sealing it up with Canada balsam, then it should be varnished with a lac or similar varnish for getting the prints. The varnish could then be easily removed, if necessary, before the sealing up of the plate, or a varnish might be used that would be unaffected by the balsam. But on no account whatever must an unprotected film be touched by any platinum paper, carbon tissue, or any paper upon which a printed-out image can be produced, because all such papers contain soluble substances that prejudicially affect the image.

By working on the lines indicated, I think that it would be difficult to set a probable maximum limit to the duration of photographic records. We know how few years are sufficient to produce a measurable deterioration in many of the photographs as at present produced.

CHAPMAN JONES.

A LANCASHIRE COLLEGE.[1]

MR. HARTOG and the authorities of the Owens College are to be congratulated on their work, which owes its origin in part, to quote the words of the preface, "To a request from the committee of the Education Exhibition, held in London in January last, that the authorities of the college should furnish an account of the institution for that Exhibition and for the Paris Exhibition, to which it was preliminary, in part to the desire of the authorities of the college for a record of its development and present condition in celebration of its jubilee."

The introductory chapters deal with the history of the college and its buildings, its government and finance, and its relation to the Victoria University. Then follow details of the classes and lectures, with particulars of the special departments and of other allied institutions, lists of fellowships and prizes, and, lastly, a striking record of original publications by members of the college.

It appears that the earliest attempt to establish a University in Manchester was made in 1640, when Henry Fairfax presented a petition to Parliament in favour of this course. The opposition of the city of York killed the project; the next similar attempt was made in 1877, but the opposition of the city of Leeds led to the establishment of the Victoria University.

Between these dates various efforts were made to promote a college for higher education in the city; none of these, however, met with marked success until, in 1851, the Owens College was founded in accordance with the will of John Owens, a Manchester merchant and spinner.

The first chairman of the Owens trustees was George Faulkner, the friend and partner of the founder, who, it is said on good authority, refused to become Owens's heir, and persuaded him to found a college. Owens's bequest realised about 90,000*l.*, and, in accordance with the founder's decision, the income from this was spent mainly on the provision from the first of an adequate teaching staff. To this Mr. Hartog with justice attributes a great share in the ultimate rise of the college. The histories of Owens College and of University College, Liverpool, a sister member of the Victoria University, teach the same truth. Owens College began in a hired house; University College in a disused lunatic asylum; but in both cases the devotion and splendid energy of the staff won in time the confidence of large-hearted men and women in their respective towns, and though the equipment of neither college is yet complete, the laboratories and class rooms, museums and libraries bear striking testimony to the wisdom of those who moulded the institutions in their early days.

Owens College began with five professors and two teachers. To-day its staff consists of thirty professors, thirty-four independent lecturers, and thirty-nine assistant lecturers and demonstrators.

But success did not come at once; the number of day students, which at first was sixty-two, in 1857 dropped to thirty-three; the local newspapers pronounced the scheme to be a mortifying failure. The trustees and the staff, however, held their course, and from 1858 onward the numbers have gone on increasing until, during last session, they reached the total of 1002. A building fund,

[1] "The Owens College, Manchester, founded 1851. A brief History of the College and Description of its various Departments." Edited by P. J. Hartog, B.Sc. Pp. viii + 260. (Manchester: Cornish, 1900.)

which ultimately realised 106,000*l*., was started in 1867, and the first permanent buildings were opened in 1873.

About the same time a fundamental change took place in the government of the college, which passed from the trustees constituted by the founder's will to the governors, council and senate appointed under the Owens College Act.

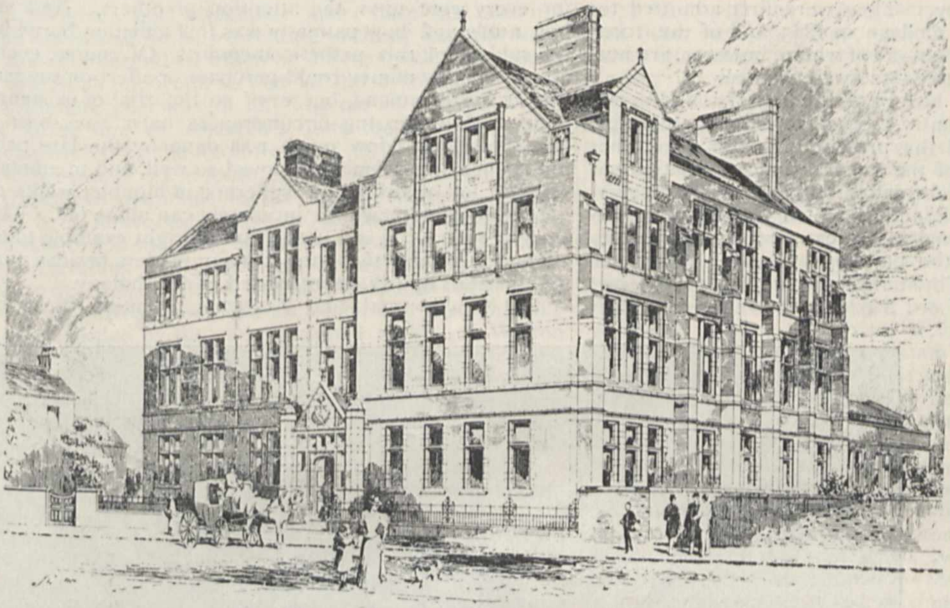
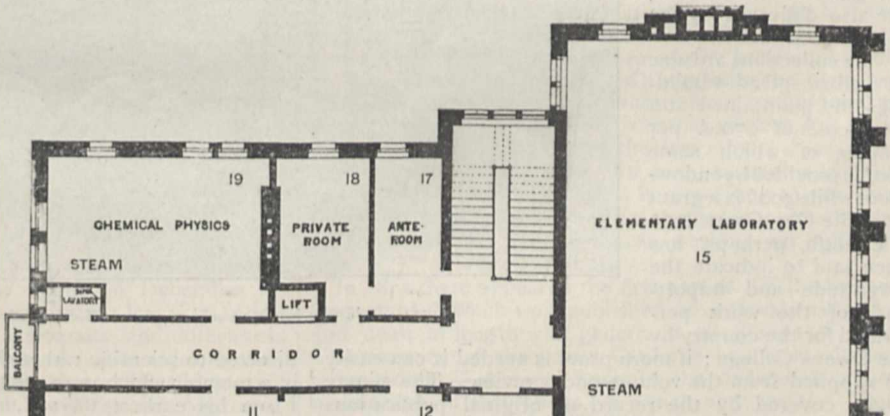


FIG. 1.—Physical Laboratories, Owens College.

The funds of the college were largely increased by the Clifton bequest of 21,500*l*. for the engineering department and the Beyer bequest of over 100,000*l*., received between 1876 and 1887. Since that date the legatees of Sir Joseph Whitworth have given about 120,000*l*. The capital is now 866,000*l*., of which 418,000*l*. is sunk in land buildings and appliances; almost the whole of this sum is due to private benefactions. The income for the session 1898–99 was 39,000*l*., and of this about 17,000*l*. was derived from students' fees, 12,700*l*. from special endowments, and 4,500*l*. from Government and other public funds.

These figures give some idea of the magnitude of the work done by the college, though in spite of the efforts made there is a continually recurring deficit. Increase in the number of students means a disproportionate increase in laboratories and teaching appliances, which cannot be met by an increase in fees; each extension of buildings involves increased cost in maintenance, rates and establishment. While private generosity has done much, the number of donors is not very large, and the amount received from public funds bears no proper proportion to the work which the college is doing for the city and county. In 1898, the Manchester Corporation contributed 700*l*. for technical instruction and 400*l*. for the museum, while the Lancashire County Council gave 250*l*., to be raised to 500*l*. in the following year.

One other striking event in the history of the college must be noted. In 1877 a memorial, largely supported, was sent to the Privy Council praying for a charter to convert Owens College into the University of Manchester. This was followed by a memorial from the Yorkshire College asking that a charter should not be given to Owens College, but "to a new Corporation, with powers to incorporate the Owens College and such other institutions as may now or hereafter be able to fulfill the conditions of incorporation." This petition proved successful, and the Victoria University received its charter in 1880.



FIRST FLOOR PLAN

FIG. 2.

Owens College became by the terms of the charter the first college of the University; in 1884 University College, Liverpool, founded in 1881, and in 1887 the Yorkshire College, Leeds, founded 1874, were associated with it as constituent colleges of the University. By its charter women are admitted to all the degrees of the Victoria University. They were first admitted to lectures of the Owens College in 1883, and of the 1002 registered students in 1899—all of whom, however, are not students of the University—126 were women.

Such is, in brief, the history of the first of the University Colleges of the country. Space forbids any attempt at a description of all the present buildings, or of the interior organisation of the college and its relation to the University; much information on these points may be obtained from the book, and the plan and illustrations, which have been prepared with great care and skill, give an admirable idea of the buildings. Among these the most recent are the Christie Library and the physical laboratory, opened by Lord Rayleigh in June last. The Manchester Museum, however, must have a special mention. The nucleus of the collection consists of the specimens belonging to the Manchester Natural History Society and the Manchester Geological Society, transferred to the college with some endowments in 1872. The college is bound to maintain the collections and give the public access to them, free of charge, on certain days. The public lectures, which have become well recognised institutions, are also delivered by the staff and others.

The collections are now housed in splendid buildings and maintained at a total cost of 2700*l.* per annum, of which some 900*l.* is provided by endowment while 400*l.* is a grant from the City Council.

Enough, perhaps, has been said to indicate the magnitude and importance of the work performed for the country by the Owens College; if more proof is needed it can easily be supplied from the volume under review. The ninety pages covered by the record of original publications contain the names of many who have made their mark in literature and science, together with the titles of numerous papers universally recognised as of the highest merit. The authorities of the college did good service to the cause of university education in the country when they prepared a volume such as this for exhibition at Paris. R. T. G.

LORD LILFORD'S LIFE.[1]

THE scientific aspect of the late Lord Lilford's career is, we are informed in the preface to the present volume, to be written by another hand. The task of his sister has been, in the main, to set before the world the character and every-day life of her brother. And a noble theme, admirably carried out, the author has had before her. To a man fond of field sports and an enthusiastic observer of nature, scarcely any more terrible affliction, save loss of sight, can be conceived than to be stricken down in the prime of life by a malady which rendered him for the rest of his days a helpless cripple dependent for every want upon the attention of others. And yet how nobly and how patiently was this affliction borne by the subject of this pathetic memoir! Of course, every alleviation that money could purchase or affection suggest was at his command, but even so the trial of existence under such distressing circumstances must have been a heavy burden. How much was done by the late peer to advance the science he loved so well, and to ameliorate the lot of his fellow sufferers in humbler walks of life, those who knew him intimately can alone tell. The story of such a life is a lesson and a bright example to us all, and it should thus attract many readers besides personal friends and those interested in ornithology.

But in a journal like NATURE, attention must be directed to scientific rather than to moral attributes, even in a memoir which purports to treat chiefly of the latter. From his earliest days Lord Lilford appears to have displayed a remarkable fondness for animals, and throughout his life the observation of their habits seems to have afforded him the most intense delight. To those who are not endued with this love of living creatures it is difficult to realise how strong is its development in others. Although in earlier days a keen sportsman, Lord Lilford states he experienced more delight in watching the movements of wild birds than in shooting them; and in the collection at Lilford it was his aim that the feathered captives should enjoy as much liberty and space as was compatible with deprivation of complete freedom. The sight of a captive eagle moping in a cramped cage, with draggled feathers and unclean surroundings, was absolutely hateful to his sensitive nature; and the collection of eagles and other birds of prey at Lilford afforded an example, as regards mode of treatment, to the menageries of the world. But cranes were the birds which formed the great specialité of the Lilford collection, and only a

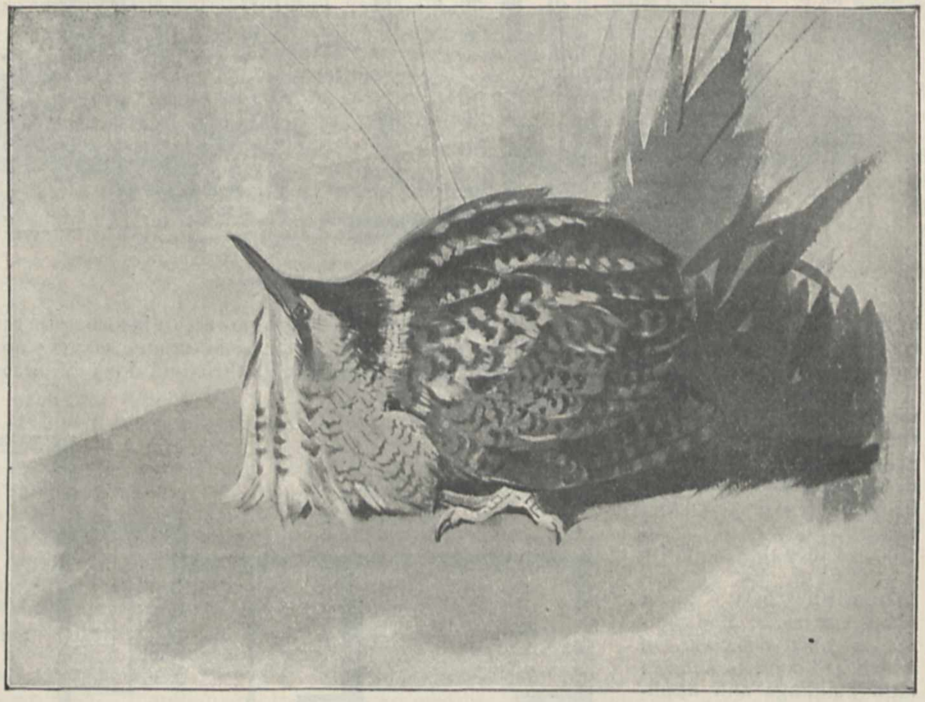


FIG. 1.—A bittern in the crouching attitude (from "Lord Lilford's Life").

[1] "Lord Lilford, Thomas Littleton, Fourth Baron." A Memoir by his sister, with an Introduction by the Bishop of London. Pp. xxiii + 290. (London: Smith, Elder and Co., 1900.) Price 10*s.* 6*d.*

bird lover can fully realise the joy of the owner at the completion of the series, in 1894, by the arrival of a specimen of the wattled species.

Lord Lilford, in his published letters, constantly deprecates his own claims to be regarded as a scientific ornithologist; but, altogether apart from his beautiful work on British birds, we venture to think that the work of the field-naturalist, which he did so much to advance, is at least as important as that of the systematist. Not that the late peer was in any way out of sympathy with the latter line of research; quite the contrary, as is demonstrated by the letter from Mr. O. Thomas, referring to his generous aid in assisting to complete the collection of European mammals in the British Museum with a view to a future exhaustive work on the subject. In addition to his energetic efforts on behalf of bird protection (including the prohibition of indiscriminate egg-collecting), Lord Lilford displayed especial interest in the fauna of Spain—an interest which has been happily commemorated by the name assigned by Mr. de Winton to the Spanish hare, which has been recently found entitled to specific distinction.

In the main the letters which the author of the memoir has selected for publication help in forming a true estimate of the character of their writer; but, in our opinion, some of those to artists and taxidermists referring to minute details in their works might advantageously have been omitted. One of the most interesting portions of the volume is the concluding chapter, which is made up by extracts from Lord Lilford's notes on his own collection of living birds and other animals. And the interest of this is much enhanced by the beautiful sketches of birds in the collection from the talented pencil of Mr. Thorburn, one of which we are enabled to reproduce. One of the objects dear to Lord Lilford's heart was to obtain portraits of birds in their natural and characteristic attitudes, and thus to improve the system of mounting specimens in museums, where it was formerly the exception to find a species in anything approaching a natural pose.

Apart from the noble example of his life to mankind in general, the loss to natural history of a man like Lord Lilford is one that will not easily be replaced, as, unfortunately, but few of those endowed with wealth and leisure display any inclination to follow in his footsteps.

R. L.

PROF. J. G. AGARDH.

JACOB GEORG AGARDH, the great Swedish phycologist, was born at Lund on December 13, 1813. His father was the celebrated Dr. Carl Adolf Agardh, professor at Lund University, and afterwards bishop in the diocese of Karlstad. The elder Agardh was the author of the "Synopsis Algarum Scandinaviæ," the "Systema Algarum" and the "Species Algarum," which laid the foundation for the brilliant work accomplished by his son.

Jacob Agardh entered as a student in the University of Lund in the year 1826, became doctor of philosophy in 1832, docent in 1834 and demonstrator of botany in 1836. In 1847 he became extraordinary professor, and in 1854 he was made ordinary professor, which post he held till 1879, when he retired.

His first paper, on Pilularia, was published in 1833 and was followed by several others on botanical subjects, mainly systematic. In 1836 appeared his first paper on algæ, and from that time till shortly before his death he continued with unfailing activity to publish papers and books on marine botany. The greatest work of his life was the "Species, Genera et Ordines Algarum," in which he laid down for the first time the lines of a natural system of classification in algæ. The English phycologists, Greville and Harvey, had helped to pave the way for this monumental work, and the elder Agardh had prepared some of the ground in his "Species Algarum" already mentioned. Dr. Kützing in Germany had already begun, in 1845, his "Tabulæ Phycologicæ, but it remained for Jacob Agardh to bring into order the many genera of marine algæ which had been left untouched, and to divide up the whole group into series, orders and genera. It is difficult for a worker in these days to realise the chaos in which the whole subject of algæ was involved when Prof. Agardh began his great work. Records were scattered throughout botanical literature, and it is no marvel that a species was described more than once through ignorance of an already existing diagnosis. The "Species, Genera et Ordines" brought together all the hitherto described species and added many new ones. These were arranged according to a natural system, and their synonymy, literature and geographical distribution were appended. From that time all work on algæ was straightforward, and although in time this book of Prof. Agardh may be superseded, it will long remain the ground plan of systematic phycology. The first volume dealt only with Phæophyceæ, and was published in 1848. Four volumes on Florideæ followed, of which the last is a revision and enlargement of the first part. The Corallineæ were worked out by Prof. Areschoug and included in the third volume of the work. In the introduction to the last volume, published in 1876, the author states that he has treated of "the disposition and description of forms" rather than "of the organs which have been considered of the greatest importance"—the trichogyne and antheridia, and the functions of these organs. This statement is specially interesting in regard to the classification of Prof. Schmitz, which is now so largely followed. There the differences which form the groundwork of the classification consist in the various forms of development in the carpogonium after fertilisation has taken place, thus forming a system which, however correct scientifically, is wholly unpractical for systematic workers. (It is, however, only fair to add that in this respect the system was perhaps only left incomplete through the premature death of its author.) In Prof. Agardh's system the algæ are classified according to their mature form, and indeed, as is only natural, the whole of his earlier work makes more of macroscopic, or at least of the less minute characters, than is usual in these days. In some cases this led him into error, but, on the whole, it is interesting to see how much his work is confirmed in the main points by the investigations of later botanists working on different lines.

In 1872 there appeared the first part of "Till Algernes Systematik," which was published at intervals till 1890, and dealt at length with genera in all groups of algæ. The treatment of the genus Caulerpa has been alluded to by Mdme. Weber van Bosse in the dedication of her monograph of this genus, in which she declares Prof. Agardh to be the first to give a natural system to Caulerpa and to open the road for a special study of these algæ. These words apply to many another genus as well. In 1879 an important work, "Florideernes Morphologi," appeared, followed by "Species Sargassorum Australiæ" in 1889; and in 1892, when in his eightieth year, a new work was undertaken entitled "Analecta Algologica." Parts were issued at intervals, and, although it was supposed a few years ago that the aged botanist had finished his work, and that the "Analecta" had come to an end, he still continued writing, and even published a part so late as last year. The work of these years cannot be ranked so highly as that of his middle life; but nothing can ever detract from the brilliancy and lasting worth of his work in earlier years.

Prof. Agardh was referee to Kew for algæ, and many specimens in that herbarium bear their names in his handwriting. In later life he received much material from Australia, where Miss Hussey and others collected for him. The herbarium of the late Mr. Bracebridge Wilson, which was bought by the British Museum in 1896, had been referred to Prof. Agardh, and some of his notes are found in Mr. Wilson's handwriting copied on the sheets.

Of the kindness of the late professor it is possible to speak from personal experience. He was always ready to help and advise any student of algæ; he would examine a plant sent to him and endeavour to identify it, and, when the circumstances warranted the risk, he would send his own valuable type-specimens for examination. Never did Prof. Agardh fail to give of his best, though from his position in the world of phycology requests must sometimes have been numerous, and leisure uncommon. So late as December of last year it was my privilege to receive from him on loan a type-specimen of one of his species of Siphoneæ, and for the first time there was in his letter a strong vein of anxiety concerning the alga, and an urgent request that it might be speedily and carefully returned. The whole letter showed most markedly the advance of age, and the evident relief when the alga reached him safely on its return was almost touching. Quite shortly afterwards came the news of his death on January 17 of this year.

His knowledge of English was excellent, and he wrote it well and idiomatically.

His herbarium was given by him some years ago to Lund University, the home of his own work and of his father before him.

Medals and honours came to him from all sides. He was member of the Vetenskaps Academy, honorary member ot the Göteborg Scientific and Literary Society, as well as of the Scientific Society of Upsala and the Agricultural Academy and Physiographical Society in Lund. In 1862 he was appointed to confer the degree of Ph.D. at Lund, in 1879, at the jubilee of the Copenhagen University, he received the honorary title of doctor of medicine, and in 1883 he became a "jubeldoktor" of philosophy. In 1893 he was decorated with the Grand Cross of the Nordstjern Order, in 1886 the Vetenskaps Academy presented him with the Letterstedt prize for original work, and in 1897 he received the gold medal of the Linnean Society. He was also knight of the Prussian Order Pour le Mérite.

As delegate for the University of Lund he attended the two last sessions of the Ecclesiastical Council, and after the change in the representation he was member for the town of Lund in the second Chamber from 1867-1869 and from 1870-1872. He was also member of the Mint Committee of 1872.

He married, in 1848, Margareta Helena Sofia Meck, who survives him; and he leaves two sons, one of whom continues the family tradition of being attached to the University of Lund. E. S. B.

PROF. ELISHA GRAY.

It is with great regret that we learn of the death of Prof. Elisha Gray on January 21. Prof. Gray was born at Barnesville, Ohio, in 1835; he was apprenticed to a carpenter, and during the time of his apprenticeship he studied physical science. At the age of twenty-one he went to Oberlin College, where he worked for five years, and at which he afterwards became professor. Prof. Gray first turned his attention to electrical invention when at the age of about thirty; he then invented a self-adjusting telegraphic relay. This was soon followed by other inventions of telegraphic apparatus. In all he took out about fifty patents, mostly dealing with telegraphy and telephony; one of the latest of these, and one of the best known, was the telautograph, a telegraphic apparatus for transmitting handwriting to a distance. At the time of his death he was engaged in carrying out experiments on a method of marine signalling with electric bells by which the sounds could be transmitted several miles through the water. In the course of these experiments, we understand from an American contemporary, he caught a chill which caused his sudden death.

Prof. Gray's name will be perhaps best known and remembered in connection with the invention of the telephone. On February 14, 1876, he lodged a caveat with the American patent office for the invention of a telephone. On the same day, but a little later, Graham Bell lodged a caveat for his similar invention. Bell was, however, the first to perfect his instrument, and in consequence Gray yielded to him in the dispute as to priority which arose, and the matter was compromised by the purchase of both patents by the same company. In later years, in the course of legal cases which arose in connection with the Bell patents, disclosures were made by which Gray was led to believe that his caveat had been betrayed to Bell by one of the patent examiners. Whether this actually was true or not seems to be uncertain, but in any case Gray firmly believed in its truth, and his later years are said to have been embittered by the thought that he had been cheated out of the money and credit he deserved. In 1878 his work in connection with the telephone was recognised at the Paris Exhibition, and he was decorated with the Legion of Honour. In 1893 he was Chairman of the International Congress of Electricians at the World's Fair at Chicago. He was the author of a popular book on electricity, and also of several papers communicated to scientific societies.

THE INDIAN ENGINEERING COLLEGE, COOPERS HILL.

A DEPUTATION waited on Lord George Hamilton on Tuesday last with respect to the recent dismissals from Coopers Hill College, and in support of the following memorial, with 374 signatures attached, including the names of the principal leaders of science in the country. The deputation was introduced by Lord Kelvin, and there were present Lord Lister, Lord Rayleigh, Sir H. Roscoe, Prof. Armstrong, and Dr. G. J. Stoney, who spoke in relation to the question; Sir F. Bramwell, Sir F. Abel, Sir Norman Lockyer, Sir William Crookes, Prof. Carey Foster, Prof. Meldola, Prof. Le Neve Foster, Prof. Everett, Prof. Perry, Prof. Poynting, Dr. G. Johnston, and many others.

Memorial to the Right Honourable the Secretary of State for India.

The correspondence regarding Coopers Hill College which has been published in the *Times* of January 3, 1901, which includes Sir Horace Walpole's letter to Colonel Ottley of December 14, 1900, and Colonel Ottley's letter of December 17, 1900, has caused a painful shock to those engaged in higher education throughout the United Kingdom, and to all who are interested in the training of engineers.

This correspondence relates to the sudden and arbitrary dismissal of able and distinguished scientific teachers, who have been doing duty in the College for periods of from nine to thirty years, and the value of whose past services is at the same time officially recognised.

Such arbitrary dismissal is likely to affect adversely the cause of scientific teaching in the United Kingdom. It cannot fail to injure the future of the College. During the correspondence which has ensued it has become apparent that the teaching staff have no voice in the educational policy of the College, and are not consulted when any change in the curriculum is contemplated. We wish to draw the attention of the Secretary of State to this unsatisfactory st ite of affairs, which must militate against the success of the College as an educational centre.

The sudden dismissal is action of a kind which we were not prepared to expect in any institution under the control of the British Government; and we think that the seven members of the staff who are required to retire at three months' notice are justified in asking for the inquiry into the working of the College, for which they have petitioned in their memorial of Dec. 27, 1900.

We therefore desire to express our hope that the Secretary of State for India will see his way to grant their request, and to suspend proceedings until an adequate inquiry by competent persons shall have been held.

Lord Kelvin, as reported in the *Times*, said he represented 374 signatures with respect to the seven dismissals from the Engineering College. He had received letters of apology from Sir Batty Tuke, who expressed the conviction that a great injustice had been done; from Sir Richard Jebb, who expressed the opinion that the dismissals were harsh and derogatory to science and deterrent to good men; from Col. Milward, from Prof. Oliver Lodge, who said the professors had been treated like pawns; Sir Douglas Fox wrote as an ex-governor of the college who had received no notice of this proposed "drastic change." Sir Douglas Fox said that certain changes had been suggested to the board of visitors, and among these the supersession of two out of the staff; but he was astonished to find seven men dismissed.

Lord George Hamilton said that all who were present signed the report. Sir D. Fox was wrong.

Lord Kelvin said he had read in the *Standard* that the board of visitors were unanimous. But the letter of November 2—the origin of the change—was founded on recommendations of the board of visitors at that date, and those recommendations did not propose that seven gentlemen should be dismissed. It was clear that the general public looked upon the board of visitors as the governing body, and in so doing were resting on a broken reed. The board appeared to have had little to do with the matter. The object of the memorial was threefold—(1) To protest earnestly in the public interest against the proposal for the sudden and arbitrary dismissal of seven out of fourteen of the staff of the college; (2) to call attention to the continued prosperity of the college and the need for reform in the curriculum; (3) to express a hope that the Secretary of State would countermand these changes, until adequate inquiry was made and they were shown to be necessary for the good of the college. Sir Horace Walpole rested the case on economy. Now the cost of the whole scientific staff was 7970*l*., and the fees were 22,143*l*., or about 36 per cent. of the receipts for tuition. When the number of students did not fall below 121 there was a surplus; and thus retrenchment could hardly be the real reason. The proposed change would effect a saving of 2750*l*.; and certainly economy at the expense of efficiency was a great mistake. The dismissal was sprung upon the threatened persons, and was certainly not creditable. One of them—an old pupil of his own—described it as a blow in the dark, and said he could not understand it. It might, his correspondent said, have been desirable to reduce the number, but it was inconceivable that the abolition of the professorships of chemistry and of physics and of the posts of demonstrator of physics and of instructor of physics should have been recommended by the board of visitors. The chemistry for the future, it appeared, was only to be such as should enable engineers to understand the statements of results of professed chemists. There was to be no electricity or magnetism. Did the authors of this scheme know anything of the requirements of engineering? Electrical engineering was still on the list. That was an applied science; and thus we had a British Government college, teaching the application but not the fundamental principles of a science. Was that worthy of this country? The public might fairly expect that the present staff would, at all events, continue to the end of the present year, as entering students could hardly be deprived of adequate teaching of the full curriculum of subjects. The Secretary of State himself had borne testimony to the excellence of the college—even so recently as last year. There might have been some falling off, but a high standard was kept up. There had, no doubt, been some complaints, and from India the telegraphy course was found fault with. But that course was not intended to be exhaustive, but was to be supplemented by other members of the staff. But there was no complaint about any candidate who entered the Public Works Department of India. In the telegraph department two gentlemen were admitted into the public service whom Coopers Hill refused to certify. He earnestly hoped the noble lord would let the existing prospectus be that of 1900, and that Colonel Ottley and his staff would contrive to work together and remove causes of mutual friction. Discipline, law and order were doubtless necessary, but they might be harshly enforced; and of these gentlemen there was no recorded complaint.

Lord Lister said there were two questions; one the manner of the dismissal, and the other the expediency of the changes in the curriculum. On the first he needed to add nothing to what Lord Kelvin had said. Such a step was a great discouragement to those who wished to follow a scientific career; such appointments were rare, and a man's lifework might be abruptly stopped by such treatment as was being accorded. In his own profession he had to lament the tendency of examining bodies to abolish or minimise scientific training.

Lord Rayleigh said that unless such educational posts under the Crown were reasonably secured, there would be great difficulty in getting good men. Of the men to be dismissed he had personal knowledge of some, and Prof. McLeod was a man of world-wide repute among chemists.

Sir Henry Roscoe was sure that Lord George Hamilton had acted for the best: but they were convinced that he was mistaken. The dismissal of these men without notice was subversive of the interests of science and prejudicial to the college itself.

Prof. H. E. Armstrong said that these gentlemen's colleagues felt the action of the Government to be a positive affront. None of the signatories to the memorial, he thought, objected to a careful revision of the subjects and methods of the college; but that was another matter. If the new teaching of chemistry was to be such as had been described, it would be better to drop the subject altogether. If our engineers of India had been competent chemists they would have been able to advise the indigo planters and prevent the transfer of a trade of three millions to German planters.

Dr. G. J. Stoney said the letter of appointment to Coopers Hill was that it was tenable so long as the work was satisfactory; but with the proviso of three months' notice, without cause assigned on either side. The substantive clause and the proviso ought to have been read together, and the proviso ought not to render the words of the clause nugatory. The proviso was only to prescribe the method of dismissal if the work was not efficiently done. The interpretation of the proviso acted upon by the authorities virtually overrode the words of the substantive clause.

Lord George Hamilton, in replying to the deputation, is reported by the *Standard* to have said that as soon as he received a memorial to which were attached such distinguished signatures he felt it his duty to take the first opportunity of meeting the gentlemen who had expressed such interest in the future well-being of Coopers Hill College. He was under the impression when he read the memorial that it was based entirely on certain suppositions, and the more he listened to the speeches the clearer was it to him that the great mass of the signatories had, under some misapprehension, attached their names to the memorial. He had the honour of seeing a number of gentlemen whose names were household words all over the world as investigators in original science, and who had made discoveries of the utmost benefit to mankind. He ventured to point out that the memorial as drawn up would reverse the process by which they had achieved fame. That fame had been attained by an investigation into the phenomena of facts, and this memorial asked for an inquiry, but every speaker had with the utmost confidence pronounced an opinion upon the subjects on which he asked for investigation. He did not in the least find fault with the signatories, who had been misled, nor could he attach any blame to himself. The Coopers Hill Staff had adopted a very unusual and inconvenient course. They had a perfect right to protest against any action which they thought prejudicial to their personal interest, and to press the India Office to reconsider the question, but they sent a memorial to himself, and before it was possible to consider it they at once embarked in a newspaper agitation, with letters written by the gentlemen themselves or by their friends. He wished to explain very fully the reasons for the action the India Office had taken, and then he would ask the deputation whether, when the facts had been brought before them, the India Office could have acted otherwise than they had done. He then gave a short history of the foundation of Coopers Hill. From the outset the College had been a financial failure, and it had placed a considerable burden upon the revenues of India, and until quite recently there was a considerable deficit in the revenues of the College. In 1895, Mr. Fowler, his predecessor, appointed a Committee to inquire into the financial position of Coopers Hill, which unanimously reported that the teaching staff of Cooper's Hill was out of all proportion to the number of students they had to teach, but there was then no inquiry made into the efficiency of the education given. Shortly after he became Secretary of State for India he came in contact with various members of the board of visitors, and he was warned that the College was very far from being in a satisfactory state, either as regards teaching or discipline, and that the best thing would be to abolish the College altogether. He declined to do that, and thought they ought to try to improve the College before attempting to abolish it. Nine months after Colonel Ottley became president of the College he presented a report in accordance with the instructions of the India Office. The memorial asked for an inquiry by competent persons. The inference rather was that whatever inquiry had been made was inadequate and had not been made by competent persons. His lordship quoted the names of the gentlemen forming the board of visitors, and mentioned their various qualifications, adding that there had not been a change made in the College that had not had the unanimous approval of the gentlemen to whom he had referred. Those gentlemen had gone through every proposition made to them, and it seemed to him a little unreasonable on the part of Sir Douglas Fox to try to convey to the public what passed at a meeting at which he was not present. The report which Colonel Ottley made showed a very unsatisfactory state of affairs at the College, and he (Lord George) was sorry to have to publish it. It was self-evident that the state of things was such that they could not tolerate. The deputation had come to him because they believed that one-half of the teaching staff had been summarily dismissed. He was afraid, therefore, he must detain them by going through each particular case. The reasons were so self-evident in each particular instance that he thought they would all agree that the Council had no option but to do what they had done. His lordship then gave details of the proposed scheme of retrenchment, mentioning the names of Mr. Reilly, Mr. Hurst and Prof. McLeod, and the gratuities and pension granted them. He now came to the four displacements, which were the result of changes that were to take place in the teaching at Coopers Hill. He had no doubt it would surprise gentlemen to learn that though electrical engineering had made enormous progress in recent years, it was not an obligatory subject at the College, and was hardly taught at all. They proposed to make it a compulsory subject, and to bring in a gentleman of high attainments from outside, who would be assisted by the very best lecturers that could be obtained. These changes necessitated the retirement of Mr. Stocker and Mr. Shields, who would be compensated. The two cases which were left were probably the most important of any of the changes they proposed. Everybody who had looked into the teaching at the College was of opinion that the right course was to place the whole course of engineering in the hands of one professor, with a competent assistant, and that being so, they were bound to appoint to the post the most competent professor for the position. That gentleman was Dr. A. W. Brightmore, and his appointment necessitated the retirement of Mr. Hearson and Mr. Heath, to whom pensions have been granted. The upshot of the whole matter would be this—there would be an increase in the hours of work in class and lecture from twenty-six to thirty-two, that the standard of the entrance examination would be raised, electricity as a subject would be thoroughly taught, outside examiners would be appointed, and the whole course at Coopers Hill would be brought, as far as practicable, into accord with modern engineering requirements. He had stated exactly the reasons and courses which had induced them to take the action they had done, and he thought they would see it was an impossibility for them to reopen the subject, or have a fresh inquiry. The noble lord went on to say: I often wonder how it comes to pass that when we spend so much money on our educational system, which in every branch is the most expensive in Europe, that we attain such unsatisfactory results. In every newspaper devoted to education in recent years there have been complaints by parents and others, pointing out the necessity of improvements if we are to hold our own. What is the main obstacle? What is the great impediment to all educational reform? I pass to a subject on which we shall all be in harmony—the system of education prevalent in our public schools. I read the other day an instructing report drawn up by a gentleman who had thoroughly investigated the system of teaching in force at the preparatory schools for the great public schools, and this was his comment:—"That in these preparatory schools the curriculum in force for boys of from twelve to thirteen is as follows: Hours per week: Eleven for Latin, five for Greek, three-quarters of an hour for English, two for history and geography, three for French, and six for mathematics," and he goes on to say that "this course of study is obviously faulty, though the fault is not with the preparatory schoolmasters, who are quite alive to the need of reform, and prepared to admit it when the public schools, which in this country depend upon the Universities, will allow them to do it." Why will not the Universities and public schools allow this ancient and antiquated system to be changed? Because the personal interests of those who teach classics stand in the way, and if you come to me, then, in the interests of scientific teaching for the future, are you not rather emphasising and accentuating the difficulty that must always face educational reform if the personal interests of those who teach are to be predominant over every other consideration? And there is another consideration which I think will come home to you—that no college is worth maintaining unless discipline and subordination can be infused into the students. I think it is very unfortunate that these gentlemen began to agitate in the way they did. The result has been that the students of the Coopers Hill College have begun to write to the newspapers, and I know of one very improper letter that was repudiated by the older students. I am most anxious to treat all the gentlemen at Coopers Hill College with the utmost consideration, but I am quite determined—and in that I express the unanimous opinion of the Council—that, so long as we are responsible for Coopers Hill College, we are determined to maintain discipline and subordination there. I should be exceedingly sorry if you went away with the impression that we had been harsh or discourteous or arbitrary towards the gentlemen who are to be dismissed; but we entered into a contract which necessitated our giving them notice if we wanted to dispense with their services. We are compelled to give them notice, and I do not see how we could have acted otherwise. I hope always to treat all gentlemen of scientific attainments with the utmost consideration, and to pay all attention to their wants; but it must be self-evident to everybody who dissociates himself from the subject under discussion, that the Government cannot for a moment admit that any gentleman who happens to be engaged in scientific teaching is to have such vested interest in the permanence of the post he holds that he is to hold it regardless of the terms or conditions of the engagement into which he has entered. Such a position is an impossible one, and, therefore, I cannot hold out to you any hope of going back on the decision which has been conveyed to these gentlemen. What we did we did deliberately, and after the fullest examination, and after we had availed ourselves of the advice of the best authorities at our disposal. Any suggestions that may be made by the gentlemen before me with regard to improving the curriculum and time-table at Coopers Hill or enabling the president of the College and the board of visitors to establish harmonious relations with the teaching staff will receive our most careful consideration. But we cannot undo what we have done, and, therefore, though the statements I have made will not be satisfactory to you all, I cannot help thanking you for the interest you have taken in Coopers Hill College, and I hope that if ever it becomes again the subject of discussion between us, I shall be able to show that the changes which we have made will result in improving the utility of the College and bringing it fully up to modern requirements.

Lord Kelvin thanked the noble lord for his courtesy in receiving the deputation, but expressed disappointment at the nature of his reply.

The deputation then withdrew.

NOTES.

PROF. J. A. EWING, F.R.S., has been elected a member of the Athenæum Club under the provisions of the rule which permits of the election of persons "of distinguished eminence in science, literature, the arts or for public services."

THE French Association for the Advancement of Science will hold its annual meeting this year at Ajaccio in Corsica, probably about the middle of September, under the presidency of Dr. Hamy.

WE deeply regret to see the announcement that Prof. Max von Pettenkofer, of Munich, distinguished for his work in hygiene and metabolism, shot himself on Sunday in a fit of depression. He was eighty-three years of age.

THE Institution of Naval Architects has awarded a gold medal to Prof. G. H. Bryan, F.R.S., for his paper on "Bilge Keels," read last year, and printed in abstract in NATURE of June 11, 1900 (vol. lxii. p. 186).

WE learn through the *Lancet* that a disastrous fire has occurred at the Pathological Institute in Berlin, and that the most valuable portion of Prof. Virchow's private museum has been destroyed. The loss of the anthropological collection made in the Philippine Islands by Prof. Jagor is especially regretted.

AT the annual general meeting of the Royal Astronomical Society on Friday last, it was decided by a large majority to hold future meetings at five o'clock instead of eight o'clock as hitherto. Dr. J. W. L. Glaisher, F.R.S., was elected president of the Society. Mr. Choate, the American Ambassador, was present at the meeting, and received the gold medal awarded to Prof. E. C. Pickering.

THE Brussels Academy of Sciences has awarded a gold medal, of the value of six hundred francs, to M. F. Swarts, for a memoir on the subject of carbonates of an element the compounds of which are little known. A similar award has been made to Prof. J. Massart, for a memoir on the nucleus of Schizophytes, and the Edouard Mailey prize of one thousand francs, for assistance in the extension of the knowledge of astronomy in Belgium, has been awarded to M. F. Jacobs, the founder of the Société Belge d'Astronomie.

A COMMUNICATION from Prof. A. Newton, F.R.S., relating to some bones of the crane found in excavating the Lynn Docks in the year 1867 or 1868, and now in the Gunn collection in the Castle Museum, was read at the last meeting of the Norfolk and Norwich Naturalists' Society. Prof. Newton gave some interesting information as to the remains of this bird which have been found in the peat of the Fen district, and mentioned other bones in the collections at Cambridge. Mr. Southwell read a paper on the crane in East Anglia, giving a summary of what is known from old authors with regard to the bird as a resident in the Fens, and tracing, as far as he was able, its extinction as an inhabitant. The crane now only visits Norfolk on very rare occasions, at the time of its periodic migrations, the last occurrence being in 1898, when four of these birds visited the neighbourhood of Cley and Runton.

A DEVELOPMENT of Mr. Marconi's system of wireless telegraphy was announced by Prof. J. A. Fleming, F.R.S., on Tuesday, in the course of an address to the members of the Liverpool Chamber of Commerce. Mr. Marconi's private work is carried on chiefly between stations at St. Catherine's, Isle of Wight, and Poole, in Hampshire. The line joining these stations is crossed by the Admiralty line between Portsmouth and Portland, but Mr. Marconi has been able to send and receive two messages simultaneously between his stations without in the least interfering with the Admiralty tests. He has also established a station at the Lizard, in Cornwall, which is 200 miles over sea in a direct line from St. Catherine's. Prof. Fleming said he had Mr. Marconi's permission to announce in public for the first time the result of the latest experiments. Setting up his improved apparatus and a mast 160 feet high, Mr. Marconi accomplished the astonishing feat of sending wireless messages between those two places on the first day of the reign of King Edward VII. Since then Mr. Marconi has established perfect communication without wires between the Lizard and St. Catharine's in both directions, and he can now receive two or more messages at once at each place.

To give men of science and others the opportunity of visiting lands and places of particular interest, a number of cruises have been made in connection with our contemporary, the *Revue générale des Sciences*. The eleventh excursion will be to Sicily, Naples, Pompeii, Salerno, the ruins of ancient Paestum, and neighbouring places, at Easter, the party leaving Marseilles on March 31 and returning on April 16. The scientific guides of the party will be MM. G. Perrot and E. Bertaux, and at each place other distinguished men specially familiar with the objects, buildings, monuments and natural phenomena of interest will cooperate with them. The object of these excursions is more the study of lands and peoples, ancient and modern civilisation, scientific institutions and objects of archæological importance, than casual sight-seeing, and every effort is made to enable the members of each party to derive the fullest advantage from the visits. A programme of the Easter arrangements can be obtained from M. Louis Olivier, *Revue générale des Sciences*, 22, rue du Général-Foy, Paris.

THE accompanying illustration shows the arms recentl granted to the University of Birmingham. The two-headed lion is taken from the arms borne by Sir Josiah Mason, the founder of Mason College, now absorbed in the University, and the mermaid was his crest. The University, having no helmet, needs no crest. Following the usual university pre-

cedent, the motto is placed on an open book, and not on a ribbon below the shield. The arms are thus described in the grant:—Per Chevron the Chief per pale Gules and Azure in dexter a Lion rampant with two heads in sinister, a Mermaid holding in the dexter hand a Mirror and in the sinister a Comb Or the base Sable charged with an open book proper with two buckles and straps and edges of the third inscribed "PER ARDUA AD ALTA" of the fourth.

A REUTER correspondent at Cairo reports that Sir John Aird and Sir Benjamin Baker have completed their visit of inspection to the great engineering works at Assuan, where the immense dam to hold up the waters of the Nile is being constructed. The total extent of the dam is one mile and a quarter, of which one mile and an eighth of the foundation is finished. Temporary dams enabling the remaining section to be put in are now carried across the channel. The dam is pierced with 180 openings, about 23 feet high and 7 feet wide, which openings are controlled by stee sluices. The work for the latter is now well advanced. The discharge through these sluices at high Nile may reach 15,000 tons of water per second. The navigation channel and chain of locks are equally advanced with the dam itself, and the lock gates will also be in course of construction in about three months. Unless anything unforeseen occurs the reservoirs will be in operation for the Nile flood of 1903. At Assiut the great regulating dam across the Nile approaches completion, the foundations being practically all in position, leaving a portion of the superstructure to be completed. The sluice openings here number 119, all 16 feet wide. This dam is somewhat similar in principle to the well-known barrage near Cairo, but the details of construction are entirely different, as the foundations are guarded against undermining by a complete line of cast iron and steel-piling above and below the work. The barrage itself is constructed of masonry instead of brickwork as at the old barrage. Although the Assiut barrage is overshadowed by the greater magnitude of the Assuan dam, it will, doubtless, rank second as the monumental work of Egypt.

WE have received from the Government Astronomer of Western Australia the meteorological report of the observations made at the Perth Observatory and other places in that Colony during the year 1899. Observations have been made since 1876 in the botanical gardens at Perth, and are still continued; for practical purposes these are very valuable, but since the year 1897 much more complete and trustworthy observations have been made at the new observatory. Most of the outlying stations have been inspected, and the observations now appear to be taken with much more care and regularity than in former years. Owing to the absence of any well-defined natural features, the Colony has been subdivided into one-degree squares, and the rainfall values of each square are shown very clearly in monthly and yearly maps. Other maps show, equally clearly, the mean monthly barometer and temperature, and the mean maximum day and minimum night temperature by the usual method of isobars and isotherms. A set of four platinum resistance thermometers has been sunk in the earth at Perth, and appear to give very satisfactory results. Morning and evening weather forecasts are issued, and have been remarkably correct, the amount of complete success reaching 82 and 89 per cent. respectively.

THE Palæontographical Society announces that monographs on the following groups of fossils are in course of preparation, and will be published by the Society: the Carboniferous Lepidodendra, by Dr. D. H. Scott; the Cycadeæ, by Mr. A. C. Seward; the Graptolites, by Prof. Lapworth, assisted by Miss Elles and Miss Wood; the Fishes of the Chalk, by Dr. A. S. Woodward; the Reptilia of the Oxford Clay, by Dr. C. W. Andrews; and the Cave Hyæna, by Mr. S. H. Reynolds. The volume issued by the Society for 1900 contains the Cretaceous Lamellibranchs, by Mr. H. Woods; the Carboniferous Lamellibranchs, by Dr. W. Hind; and the Carboniferous Cephalopods of Ireland, by Dr. A. H. Foord.

MR. HUGH J. L. BEADNELL, of the Egyptian Geological Survey, has published a brief account of the Eocene and Cretaceous series in the Libyan Desert and Nile Valley (*Geological Magazine*, January 1901). He has also expressed his opinion that the Nile Valley in Egypt, hemmed in as it is by lofty cliffs, was in the main brought about by faulting and disturbance in Lower Pliocene times. After the deposition of the Pliocene strata a gradual elevation led to the final retreat of the sea, and the valley then became the site of a series of freshwater lakes. In later Pleistocene times the then youthful Nile commenced its career by carving out a channel in the valley deposits, before, owing to changed conditions, it began depositing layer upon layer of Nile mud.

THE pre-Cambrian igneous rocks of the Fox River Valley, Wisconsin, are described by Dr. Samuel Weidman (Wisconsin Geol. and Nat. Hist. Soc., *Bulletin* 3 of Scient. Ser. No. 2). Three areas of these rocks are noted, and they represent various phases from old volcanic flows to masses of deep-seated origin. In the area of the Utley meta-rhyolite, metamorphism has taken place under static conditions, no cleavage is developed, and the alteration has been produced through chemical change without the aid of mechanical deformation. On the other hand, the Berlin rhyolite-gneiss has been subjected to extreme deformation, the original rhyolite being mashed into a gneiss; while the metamorphism of the Wanshara granite has been in part static and in part mechanical, cleavage has been developed and granulation of the quartz has taken place to some extent.

A FLORA of Staffordshire, by Mr. J. E. Bagnall, is being issued as a monthly supplement to the *Journal of Botany*.

THE Report on the Botanic Gardens and Domains, New South Wales, for the year 1899, gives an account of the new herbarium and museum buildings which were erected during that year. The director undertook no less than thirteen botanical explorations during the year, including one of Mount Kosciusco. The botanical results of these expeditions have been published in the *Agricultural Gazette of New South Wales* or elsewhere.

THE importance of variations in the osmotic pressure to the phenomena of vegetable life is illustrated in a reprint from the *Botanical Gazette*, by Mr. B. E. Livingston, entitled "On the nature of the stimulus which causes the change in form in polymorphic green Algæ." A series of experiments on a species of Stigeoclonium led him to the conclusion that these changes in form were due to variations in the concentration of the nutritive medium (Knop's solution), and not in any way to changes in its chemical composition.

AN important contribution to our knowledge of the flora of North America is issued by the U.S. Department of Agriculture (division of botany), as vol. vii. No. 1 of *Contributions from the U.S. National Herbarium*. It consists of a monograph of the North American Umbelliferæ by Profs. John M. Coulter and J. N. Rose. It enumerates and describes 62 native genera and 332 native species, besides introduced genera and species, the highest previous publication having been 52 native genera and 217 native species. The monograph is illustrated by a number of excellent wood-cuts representing either the general habit or the characteristics of the fruit of the species.

A BILATERAL division in the parietal bones of monkeys, according to a paper by Dr. Aleš Hrdlička in the *Bulletin* of the American Museum for December 31, seems to be a rare feature.

THE October issue of the *Bulletin* of the New Mexico College of Agriculture and Mechanic Arts is devoted to a series of observations and notes on the injurious insects of the country, by Prof. T. D. A. Cockerell.

DR. W. F. PURCELL contributes an important paper on the anatomy of *Opisthopatus cinctipes* to the *Annals* of the South African Museum (vol. ii. part 4). This arthropod, we may remind our readers, is a near ally of the more familiar Peripatus. The author is of opinion that the members of the group met with in Africa may be classified as follows:—(1) Peripatopsis, South Africa; (2) Opisthopatus, South Africa; (3) Peripatus, America, Africa, and possibly India. The distribution of the last-named, in connection with prevalent ideas as to the relationship of the South American and African faunas, is significant.

MR. J. D. E. HOLMES, superintendent of the Civil Veterinary Department, calls attention, in *Bulletin* No. 42 of the Department of Agriculture, Madras, to native beliefs connected with "hair-marks" on horses and cattle. These hair-marks, it appears, are formed by the changes in the direction of the hair on certain parts of the body, and, according to their shape, are denominated a crown, ridge, or feather-mark. Throughout India, but more especially in Madras, the value of a horse or an ox in native estimation depends almost entirely on the presence and situation of certain of these hair-marks. According to native ideas, the old maxim that "a good horse cannot be a bad colour" does not hold good, white, dun, grey, piebald and skewbald animals being much more highly esteemed than those of other colours. A white bullock, again, is held to be of little value, while a black one is regarded as vicious.

SEVERAL popular scientific articles appear in the February number of *Pearson's Magazine*. Mr. R. S. Baker gives a description of some of Sir John Murray's work in oceanography, this being the first of a series on the science of the sea. Mr. Alder Anderson describes Russian Imperial forestry; Mr. T. E. James writes about the remarkable Crater Lake, Oregon; and Mr. T. Morton corrects some mistakes about rainbows in pictures, illustrating his contribution with several good photographs of rainbows. In *Good Words*, Miss G. Bacon describes the Yerkes Observatory; and there are also articles on an ascent of Mount Rainier—the highest mountain in the United States outside Alaska—the effect of light of various wave-lengths upon the growth of plants, the Purbeck marbles, and Miss Mary Kingsley.

IN an address recently delivered to the Chemical Society of the Goldsmiths' Institute, Dr. Julius Lewkowitsch dealt with "The Profession of an Industrial Chemist." The views of Dr. Lewkowitsch, who has had a long experience of manufacturing chemistry both in Germany and in this country, are entitled to very careful attention. He is able to recall the days when in Germany the chemical manufacturer was chiefly a merchant who thought he was marching with the times when he took into his works a young man to act as a testing machine and to become, later on, when he had shaken off the last remnants of chemical knowledge, assistant works manager. Dr. Lewkowitsch points out how entirely this condition of things, which is still prevalent in England, has changed in Germany. His main contention is that that the training which is most effective is that which is most liberal and educationally thorough. He has no grudge against the classics; on the contrary he extols their educational value when properly taught, and he is more solicitous that the school teaching of science should develop the logical faculty than that it should impart a fund of specialised knowledge. In the University period he would have a broad, thorough and unbiased study of chemistry and allied sciences ending, where possible, with some training in the special methods of technological laboratories. He concludes with a very graphic and complete account of the circumstances with which the chemist, so far trained, will have to contend in the works and the conditions necessary for his becoming the scientific master of his surroundings. Dr. Lewkowitsch's address combines high educational ideals with keen appreciation of practical requirements, and it deserves a wide circulation among those who are concerned directly or indirectly with chemical industries.

THE additions to the Zoological Society's Gardens during the past week include a Red-faced Ouakari (*Ouacaria rubicunda*) from the Upper Amazons, presented by Mr. Alfred Hutchinson; a Long-eared Bat (*Plecotus auritus*), a Common Bat (*Vesperugo pipistrellus*), British, presented by Mr. Louis Grundel; a Feline Dourocouli (*Nyctipithecus vociferans*) from South Brazil, a Yellowish Capuchin (*Cebus flavescens*) from South America, two Sharp-tailed Conures (*Conurus acuticauda*) from Paraguay, a Common Waxbill (*Estrelda cinerea*) from West Africa, seventeen Blue-tongued Lizards (*Tiliqua scincoides*) from Australia, deposited; a Sœmmerring's Pheasant (*Phasianus soemmerringi*) from Japan, an Elliot's Pheasant (*Phasianus ellioti*), two Amherst Pheasants (*Thaumalea amherstiae*) from China, a Black-backed Kaleege (*Euplocamus melanotus*) from Sikkim, purchased.

OUR ASTRONOMICAL COLUMN.

VARIABILITY OF EROS.—A circular from the Centralstelle at Kiel calls attention to an important notice from Dr. E. von Oppolzer respecting the planet Eros. He says that Eros shows a variation of brightness of about one magnitude, the change taking place in a few fours. It is in the highest degree desirable that, so far as possible, numerous estimations with neighbouring stars should be made in the course of each night.

CATALOGUE OF PRINCIPAL STARS IN COMA BERENICES CLUSTER.—The sixteenth issue of *Contributions from the Observatory of Columbia University*, New York, contains the discussion and reductions by Mr. W. C. Kretz of a series of measures of this cluster, from photographs obtained by Dr. Rutherford with his 13-inch refractor during 1870–76. The eleven standard stars adopted were reduced from the records of thirty five catalogues, extending from that of Bradley in 1755 to the Greenwich results, 1887–94. The method of reduction is given in detail with tables of data for determining final positions, concluding with a list of twenty-four stars showing corrected coordinates and proper motions.

UNITED STATES NAVAL OBSERVATORY.—The report of the superintendent of the Naval Observatory at Washington deals with the progress of work during the fiscal year ending June 30, 1900. All the instruments have been in use on every clear night and day.

The 26-inch equatorial has been devoted to observations of difficult double stars, satellites of planets, and a long series of investigations on the use of ocular colour screens for planetary and double star measurements. The double floor, mentioned in a previous report, has undoubtedly improved the working conditions in partly eliminating the variable air currents in the dome. Certain markings have been observed on the disc of Neptune indicating a similarity to the belts of Jupiter.

Photographs of the sun have been taken with the photoheliograph of 40-feet focal length on every fine day, except in April and May, when it was dismounted for use during the total eclipse of the sun. For this eclipse an extensive programme, including spectroscopic, polariscopic and other items, was successfully carried out, the report of which will be ready shortly.

DOUBLE STAR MEASURES.—In the *Astronomische Nachrichten* (Bd. 154, Nos. 3680–1), Dr. Doberck gives a long series of measures of double stars obtained with the 14-inch refractor of the University Observatory, Copenhagen. Comparisons are discussed between the performance of short and long focus instruments with respect to the measurement of close doubles.

SCIENCE AT SHEFFIELD UNIVERSITY COLLEGE.

TWO addresses delivered at the University College of Sheffield on Thursday last, the occasion being the annual distribution of medals, prizes and certificates to successful students of the Technical Department, should be of service to science and technical education in the city. One was by Dr. H. C. Sorby, F.R.S., who during the greater part of the past fifty years has been occupied with scientific research. His remarks on the practical value of scientific theory admit of wide application, and the following report from the *Sheffield and Rotherham Independent* will be read with interest. A valuable address on technical and scientific education was also given by Alderman W. E. Clegg, who in the course of his remarks indicated three directions in which future efforts should be devoted in order to maintain our position in the industrial world; they are:—

(1) Greater energy and enterprise on the part of our manufacturers in utilising to the utmost existing markets, finding fresh ones, seizing every opportunity which presents itself to develop our increasing output and a greater adaptability and suitability of our goods to the requirements of our customers. (2) A closer union and real sympathy between employers and employed, each realising that the interests of the one are bound up in the interests of the other. (3) Greater interest and appreciation of the advantages of a technical and scientific education, and in connection with this all possible facilities should be given to men and boys to enable them to learn the science—the why and wherefore of the particular work they are engaged in—so that they can take an intelligent interest in what they are doing and what they have to do.

Dr. Sorby spoke as follows :—

What he proposed that evening was to say something with regard to the interdependence of the different branches of knowledge. He would speak only of physical science, and he would confine his remarks to what bore directly on the Technical School. He was very sorry to say that as things were at present many looked upon the University College as quite a distinct thing from the Technical School. Unfortunately there were two buildings, and he thought that had something to do with the idea. But he did hope that before long there would not be two buildings. He hoped they would succeed in erecting a University College that would include all the branches, and he would very much like to see written over the door: "Scientia una et indivisa."

He took it that he might assume that knowledge such as they were trying to teach in the University College might be divided into two divisions—what they might be pleased to call science, theoretical and practical. Now he maintained that the division between theory and practice was perfectly evanescent. It might be convenient to divide them, as it was convenient to divide yesterday and to-morrow; but when to-morrow came, to-morrow would not be to-morrow. It was the same with theory and practice in science. What was looked upon to-day as abstract theory, and of no practical use, would probably be to-morrow the foundation of some most important practical question which would revolutionise the whole world. He could not call it a feud, but the division of these two branches—theory and practice —was now non-existent. He was afraid that a good many people looked upon some branches of the subjects which were studied in the college as of not very much use, simply because they did not enable them to make puddings or construct anything else. He maintained that that was a very false view of the matter. Now, he had often heard in years gone by that theory was no good! What was wanted was good practical knowledge. In illustrating that idea, he would refer to a matter he recollected when we were carrying on the war in the Crimea. It was said that when the Russians built Sebastopol they furnished the labourers with wheelbarrows. The men had never seen a wheelbarrow before, and they filled them with earth and carried them on their backs. They could very well imagine some accomplished Russian officers pointing out the advantage of the wheelbarrow, and telling them how much labour might be saved by pushing the barrows instead of carrying them. Some of those labourers might have replied that they did not care a bit for what the officer said; what they really wanted was a good practical knowledge of how to carry the wheelbarrow on their backs. It was not so many years ago that one heard similar remarks to this in reference to a great many other subjects than wheelbarrows. He thought he might even say that in some cases pure theory was much more practical than practice.

There were cases where they could obtain a result with ease and accuracy by calculation, and if they attempted to do it by practice they would not do it so easily, and they would not do it with anything like accuracy. In such a case he held that theory, after all, was the much more practical of the two. He had been talking to Dr. Hicks about a subject for a lecture which he hoped to give from that desk in time to come, and he suggested as the title of that lecture, "The value of knowledge thought to be useless." There were no end of interesting illustrations to be found, and he was sure it would be a very good subject for a popular lecture. He could not help slightly trenching on that lecture because it had a lot to do with what he was trying to point out that evening. Some 2500 or 3000 years ago it was found that if you rubbed amber on cloth or anything of a similar nature it would attract little bits of paper. The Greek word for amber was "Electron." What would anybody have thought in those days if any one had said that if you only studied that peculiarity a little more you would be able to have tramcars with halfpenny fares? He need not describe what would have been the opinion of people in those days on that subject. Then again, the lodestone was called by a word which ultimately led to the word "magnetism." It was known that lodestone would attract bits of iron, and he believed it was Pliny who said that it had "such a great love for iron that it pulled pieces of iron to it." No doubt that idea and very little more than that notion existed for something like 1500 years. Then somebody found out that you could magnetise a needle, and that it would point to the north, and shipping was entirely revolutionised. Then again, Galvani, fortunately, was taken ill, and it was thought it would be a very good thing for him to have some frogs for dinner. When the cook placed the frogs' legs on the pewter plate on which they were served she noticed that they began to kick. She thought this very curious and drew Galvani's attention to it. The result was the discovery of Galvanism. These things were known for a very long time. He remembered the time before the principle of electro-plating was discovered. He recalled the man who discovered how to electro-plate with silver. They used to entertain themselves with making galvanic batteries and trying experiments. He remembered very well that his friend said, "Well, now, Sorby, I don't see any reason why we should not study these things, although people say that electricity is a thing that can never be of any use to anybody." What would anybody say if that remark were made to-day?

About thirty-six years ago he pointed out how very important was the investigation of the microscopical study of iron and steel. He read a paper at the British Association meeting at Bath, and his specimens were exhibited before the Royal Society. They were very much admired, and thought very pretty, but for twenty-three years nobody did anything; nobody took the slightest interest in the subject. Eventually the Iron and Steel Institute asked him to read a paper on the subject. He did so, and the result was that the study of the microscopic structure of iron and steel was now thought of great importance. One felt very pleased to think that things had moved so, because this microscopic investigation, which was so long dormant, was now employed in almost every civilised country, and he was very proud to think that the Sheffield Technical School was at the front so far as this subject was concerned. Prof. Arnold, whom he very greatly regretted was ill, was selected by the Admiralty to make an investigation into the structure of the steel shaft which failed on one of H.M.'s torpedo boats. Prof. Andrews was also an authority on the structure of steel rails, and he was often consulted in connection with railway accidents. He did not want to occupy too much time, but what he did wish to impress on his audience was this, that judging by the experience of years gone by there was nothing that you could discover that might not turn out to be of the greatest possible value. You could not say that it would, but you could not say that it would not. As an example, some few years ago a friend of his was examining under the microscope with a very high power the blood discs in the blood of frogs, and he discovered in these blood discs certain curious little things which were found to be very minute parasitic animals. If they had mentioned this to the man in the street he would have thought that it was a most absurd idea to pay much attention to a thing like that. But a further study of that subject had led to the knowledge of the real cause of a disease which in India killed annually about as many people as the whole of the population of England, and not only had they learned the cause of the disease, but there was every probability that they would succeed in putting a stop to it. The magnitude of the result was almost incomputable.

He could liken them all to a small colony on a big continent. They made a few roads and settled down. But if they were content with these few roads and never troubled themselves about the backland, how would they progress? Some other country would take the backland. What they wanted was to explore the unknown; to march to the top of some mountain and look down on the country never seen before by civilised eyes. They would then find valuable gold mines, coal, and all manner of things. If they were content with what they knew they would make no progress. They might hold their own, but he did not know whether they would do that. They should try to learn fresh things. His friend, Alderman Clegg, was about to distribute the prizes, which were all very well in their way, but he should like to see them win prizes for original research, to make discoveries and invent new industries, and conquer the trade of the world. They ought to develop the manufactures in this city in such a way that they might beat the Germans and the Americans, so that they might capture the trade of the whole world in their particular department. This electric railway in London—the only thing that was English about it was the tunnel. The only thing about that railway that was made in England was the tunnel. Everything else was American. It has even been said that it was surprising that the tunnel had not been sent to America to be made. But they did not want that sort of thing to go on, and in order to prevent it they must have no rivalry between theory and practice in science. He hoped they would be able on another occasion to meet in a building worthy of the town, and where all these different subjects would be correlated and united in one.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The degree of D.Sc. *honoris causa* has been conferred upon Dr. Oliver Lodge, and the degree of D.Litt. *honoris causa* upon Dr. F. J. Furnivall.

Mr. A. E. Boycott, of Oriel, has been elected to a senior demyship at Magdalen College to enable him to continue research in physiology and pathology.

CAMBRIDGE.—The collection of ethnological specimens formed in the Maldive Islands by Mr. J. Stanley Gardiner has been gratefully accepted by the University for the Museum of Ethnology.

Dr. A. W. Ward has been elected a member of the council of the Senate in the place of Bishop Ryle.

The following have been appointed electors to professorships:—Chemistry, Dr. A. Macalister; Plumian (astronomy), Dr. Ferrers; Anatomy, Prof. Newton; Botany, Prof. Bayley Balfour; Geology, Dr. R. D. Roberts; Jacksonian (natural philosophy), Dr. J. Larmor; Downing (medicine), Prof. Liveing; Mineralogy, Mr. J. E. Marr; Zoology, Mr. F. Darwin; Mechanism, Prof. Forsyth; Physiology, Dr. P. H. Pye-Smith; Surgery, Dr. D. MacAlister; Pathology, Prof. Allbutt; Agriculture, Dr. D. MacAlister.

Mt. Clinton T. Dent has been appointed an examiner in surgery in the place of Prof. Chiene.

The Isaac Newton Studentship in physical astronomy has been awarded to Mr. S. B. McLaren, of Trinity, third wrangler 1900.

The Adams Prize, for a memoir on electric waves, has been awarded to Mr. H. M. Macdonald, Fellow of Clare.

A Shuttleworth Scholarship in botany and comparative anatomy, of the value of 55*l*. a year for three years, will be filled up at Caius College in March. Candidates must be medical students of not less than eight terms' standing. Application is to be made to the senior tutor by March 1.

MR. E. J. GARWOOD has been appointed to the Yates Goldsmid chair of geology and mineralogy at University College, London, in succession to Prof. T. G. Bonney.

PROF. H. LLOYD SNAPE has been appointed Director of Education to the Lancashire County Council. Formerly the directorship was limited to technical instruction, but the duties of the office have now been enlarged by the inclusion of all education other than elementary. For more than twelve years Dr. Snape has held the chair of chemistry at the University College of Aberystwith.

THE Manufacturers' Association of New York recently voted the sum of 2000 dollars for an industrial scholarship, including the cost of tuition for four years and incidental expenses. The purpose of the association in providing means for the industrial education of a young man of Greater New York is to encourage young men to qualify themselves for leadership in industrial pursuits. A committee has been appointed to arrange the details and to conduct the examination of the candidates.

A PAPER on the national organisation of agricultural education, contributed to the January number of the *Record* of Technical and Secondary Education, directs attention to the need for establishing instruction in agriculture upon a foundation of general science instead of regarding it as a special science with its own particular principles. Other articles in the *Record* deal with the organisation of individual secondary schools, local schemes of commercial education, education at the Paris Exhibition, horticultural education in Surrey, and school gardens.

THE following is a single week's statement of gifts to educational and scientific institutions in the United States. The announcements are from *Science*. John D. Archbold, of New York City, a vice-president of the Standard Oil Company, has given 400,000 dollars to the endowment fund of Syracuse University, on the condition that a like amount be raised among other friends of the institution; Mr. Andrew Carnegie has given 225,000 dollars to the Upper Iowa University, at Fayette, Ia., to be used preferably for a library, and 50,000 dollars to Aurora College, an Illinois institution; Augustana College at Rock Island, Ill., has received about 30,000 dollars from Messrs. E. C. and J. A. Ericsson, of Boone, Ia.; Mr. John D. Rockefeller has offered to give 15,000 dollars to Carson and Newman College, a Baptist institution in Tennessee, provided 50,000 dollars in addition be raised; Carleton College, at Northfield, Minn., has added 150,000 dollars to its permanent endowment fund, 50,000 dollars being the gift of Dr. D. K. Pearsons, and the remaining 100,000 dollars being raised from various sources.

A RETURN just issued by the Board of Education brings together a large amount of information as to the award of scholarships by County Councils in England. The scholarships are divided into three classes, viz. (1) junior scholarships intended to enable pupils in elementary schools to proceed to secondary schools; (2) intermediate scholarships, usually in continuation of junior scholarships, and tenable at secondary schools or technical colleges; (3) major or senior scholarships, comprising also those awarded in various special subjects. It appears from the Return that of the 4678 winners of junior scholarships specified, 4231 were in attendance at an elementary school, and 447 at a secondary or other school. Of the 519 winners of intermediate scholarships, 307 had previously held junior scholarships. The number of major scholarships awarded by the County Councils for general proficiency is 360, in addition to which 188 are awarded for agricultural subjects, 43 for horticultural subjects, and 150 for mining. These scholarships vary considerably in value, but generally they are of larger amount than those of the other classes, and some of them enable students to proceed to institutions of University rank. Particulars are given in the Return of all the County Council scholarships awarded in England in the three financial years ending on March 31, 1899, and also of the occupations of the parents of the winners of the scholarships. We see from this that the children of "professional and general" parents head the list of scholarship winners, and are followed by those of "clerks, agents and warehousemen," and then by children whose parents follow "building trades." It is evident, however, that the relative abilities of the children of parents of the different classes cannot be estimated from the positions of the children in the list without knowing the proportional numbers of each class in the population.

THOUGH there are few signs that the scheme for the establishment of a West of England University is making much headway, the speech by Sir Michael Foster at a meeting held at University College, Bristol, last week, and attended by many men of influence and means, should do something to bring about a *modus operandi* between the authorities of the educational institutions which would form part of the University. Sir Michael Foster remarked in the course of his speech:—"One idea in the establishment of Universities in the renaissance was that each University was a guild for the advancement of learning, and that had, with various changes, remained their object ever since. They were institutions for the advancement of learning; not only for the spreading of knowledge, but for the pushing forward of the known into the unknown. They had been through all time, with little variation, the great instruments of inquiry and research. A teaching body, whether it was called a college or a University, was a University in principle and in reality, and the whole of its actions were governed by the dominant principle of research, of inquiry into the unknown. Universities, to be real and true Universities, ought not to be merely machines for converting knowledge into pap and distributing it into open mouths. They ought to have some living feature and act as ferment upon the young minds, inducing changes, so that knowledge would grow up of itself in the mind when the mind was brought under its influence. It was this vital and living feature which was the dominant feature of a University, or a University College, or of the teaching of any University, by whatever name it was called. He would say to the citizens of Bristol that they had in their midst a body—whether they called it a University or a University College it was practically a University—the teachers of which he knew from personal knowledge to be truly inspired with the feeling of the necessity of inquiry into the unknown. He ventured to suggest that it was desirable such an institution, which must have great influence on all the intellectual progress, and therefore on the material advance of the West of England, ought to be founded, not upon the shifting sands of annual subscription, but upon the solid rock of permanent endowments." The citizens of Bristol should learn from this that they have in University College a nucleus of a modern University like that founded in Birmingham upon Mason College. Nothing should be permitted to delay the formation of an organic plan, to realise which an appeal for endowments can be made. The West of England ought to show that it can nurture education and science as well as the Midlands.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 7.—"On the Proteid Reaction of Adamkiewicz with Contributions to the Chemistry of Glyoxylic Acid." By F. Gowland Hopkins, M.A., M.B., University Lecturer in Chemical Physiology, and Sydney W. Cole, B.A., Trinity College. (From the Physiological Laboratories, Cambridge.) Communicated by Dr. Langley, F.R.S.

The proteid reaction described by Adamkiewicz is not a furfurol reaction, but depends upon the presence of small quantities of an impurity in the acetic acid employed. Some specimens of acetic acid yield no reaction, and all may be deprived of chromogenic power by distillation.

The substance essential to the reaction is glyoxylic acid.

Small quantities of glyoxylic acid are produced during the oxidation of acetic acid by hydrogen peroxide in the presence of ferrous iron. Under the conditions used in this research, part of the glyoxylic acid thus formed is split up, yielding formaldehyde.

Glyoxylic acid is slowly formed when acetic acid stands in the air, and more rapidly in the presence of ferrous iron and under the influence of direct sunlight. Most specimens of acetic acid contain small amounts of glyoxylic acid as an admixture.

A dilute aqueous solution of glyoxylic acid, which may be readily prepared by the reduction of oxalic acid with sodium amalgam, forms an admirable test for proteids when used instead of acetic acid under the ordinary conditions of the Adamkiewicz test.

"Further Investigations on the Abnormal Outgrowths or Intumescences in *Hibiscus vitifolius*, Linn.: a Study in Experimental Plant Pathology." By Elizabeth Dale. Communicated by Prof. H. Marshall Ward, F.R.S.

The conclusions drawn from the experiments are that the outgrowths are formed in a moist atmosphere, provided that there is also adequate light and heat.

The immediate effect of the damp atmosphere is to check transpiration. This, in its turn, by blocking the tissues with water, disturbs the normal course of metabolism, and so leads (when the light and heat are sufficient) to changes in the metabolic activity of the plant, as is shown by the following facts:—

(1) The outgrowths only develop if transpiration is reduced.

(2) The outgrowths are chiefly formed on organs which are actively assimilating, *e.g.* under ordinary red or yellow glass; but only if transpiratory activity is lowered: they are not formed in the open.

(3) They only occur (*ceteris paribus*) in plants in which there is an accumulation of starch.

(4) They are formed under clear glass and under red and yellow glass, but not under blue or green glass, and in no case in darkness.

(5) Their formation is accompanied by the production of oil, which is not found in normal leaves.

(6) The presence of this oil suggests that events similar to those occurring in succulent plants are taking place, viz., reduced respiration and the development of osmotically active substances in excess.

(7) It is therefore probable that the intumescences are due to the local accumulation of osmotically active substances, produced under the abnormal conditions, viz., reduced transpiration and consequent lack of minerals, while carbohydrates are being developed in excess.

Physical Society, February 8.—Annual General Meeting. Mr. G. Griffith, Vice-president, in the chair. The report of the council was read and adopted. Prof. Willard Gibbs and Dr. Rudolph Koenig were elected to the two vacant honorary fellowships of the Society. The following officers and council were elected for the ensuing year:—President: Prof. S. P. Thompson. Vice-presidents (members who have filled the office of president): T. H. Blakesley, C. V. Boys, Prof. J. D. Everett and J. Walker. Secretaries: H. M. Elder and W. Watson. Foreign Secretary: Dr. R. T. Glazebrook. Treasurer: Prof. H. L. Callendar. Librarian: W. Watson. Other members of the Council: Prof. Armstrong, W. R. Cooper, G. Griffith, E. H. Griffiths, Dr. R. A. Lehfeldt. S. Lupton, Prof. Perry, Dr. Porter, W. A. Price and R. Threlfall.—Prof. S. P. Thompson then took the chair and delivered an address. In opening, the President gave in detail the various ways in which the aim of the Physical Society to promote the progress and study of physics has been accomplished during the twenty-six years of the Society's existence. Referring to the election of two honorary fellows, Prof. Thompson said they had added to their roll two men distinguished in very different walks of physics. Prof. Willard Gibbs is a United States mathematical physicist whose work in thermodynamics, elastic solid theory of light and other specialised subjects is of the highest order and is valued for its beauty and profundity. Dr. Rudolph Koenig, of Paris, is known as a maker of acoustical instruments—of perfect standard, tuning-forks in particular. He has, however, found time to extend the borders of acoustics, and to him we owe the manometric flames, the wave syren and other instruments of research. He has also published work on the facts about the combinations of pure tones. The President appealed to all teachers of physics in the country to make use of the Society and give it their active support. It was mainly in the interest of teachers and students that the Society undertook the publication of science abstracts. By means of the abstracts teachers have at hand the latest information on the subject, and can thus continually supplement their text-book knowledge. Every teacher, from time to time, devises new or improved modes of presenting his subject. At the Physical Society the Fellows always welcome contributions of this kind, even though there may be little of actual novelty in the principles so illustrated. The routine work and administrative duties of teachers, although hampering their usefulness to science and diminishing their fruitfulness, prevent their attention, without intermission, to one subject and produce a direction of thought over varions domains of physics which is to be welcomed rather than deplored. It has been the custom for Fellows of the Physical Society to bring models to illustrate physical principles. This practice of using models is regarded by our Continental brethren as a peculiarly English matter and one that shows a sort of mental constitution they do not quite understand. Models have become a part of our mental furniture. It never occurs to us that there is anything unusual in the habit. Faraday has used them in connection with the electrostatic field surrounding charged bodies. Lord Kelvin has made models to convey his ideas of elasticity, of the elastic solid theory of matter and of the constitution of matter itself. Maxwell's models of heterogeneous dielectrics and the mutual induction between two circuits are well known. These models are useful for teaching purposes and for enabling one to grasp that which in its nature is abstract by contemplating the representation of it or its analogue in the concrete. The French physicist cannot understand a complicated phenomenon until he has reduced it to a mathematical equation. The British physicist must construct a model which will produce mechanically the analogous operation. Both methods are right, but judging by their fruitfulness the method of Faraday has advantages over that of Poisson. Referring to the New Teaching University of London, the President said that now was the time for Fellows to offer suggestions for the teaching of physics.—An ordinary meeting of the Society was then held.—A paper on a mica echelon grating, by Prof. R. W. Wood, was read by Mr. Watson. This grating occupies a position midway between an ordinary grating and an echelon with thick plates. A number of sheets of mica were examined with the interferometer and one selected, over a considerable portion of which the fringes were straight and unbroken. This portion was marked off and cut up into rectangles. The mica was about 0·05 mm. thick, and the retardation of one of the rectangles was found to be fifty wave-lengths for sodium light. Nine of these rectangles were used to form the grating, and they were put in position under a microscope and cemented together at the edges with sealing wax. The grating space was 0·5 mm. The battery was mounted on a square of cardboard over a rectangular opening of the same size, a clear space 0·5 mm. wide being left to serve as the first grating line of zero retardation. The number of lines was therefore ten. The resolution of the sodium lines was beyond the power of the instrument, but the yellow mercury lines were easily separated. The distance between the lines was one-third of the distance between the spectra. For the sake of comparison, a grating of the same spacing and number of lines was ruled on a piece of smoked glass, and it was found that in the first order the grating was unable to separate the extreme red and blue ends of the spectrum. The Zeeman effect can be shown with an echelon made of four interferometer plates, the light being the green rays from a mercury tube. The Society then adjourned until February 22.

EDINBURGH.

Royal Society, January 21.—Lord Kelvin, President, in the chair.—The Chairman communicated a paper on one-dimensional illustrations of the kinetic theory of gases, in the course of which he referred to Waterston's doctrine of the partition of energy among molecules of different size, a doctrine which, although supported by Maxwell, Boltzmann and others, he believed to be not only not proved but not true. If the doctrine is found to fail in one particular case, its universality is disproved. By considering the impacts among a row of hard elastic spheres constrained to move to and fro in the same straight line, he had, by direct calculation of the effects of 300 successive collisions, found no tendency towards a state in which the average energy of *all* the masses was the same. When the time of impact was assumed to be infinitely short, so that no more than two spheres could be in contact at the same time, the calculation was simple enough; but the problem quite changed its character when the time of impact was taken as finite, so that three or more particles might be in contact at the same time. It was shown that impenetrability was not a necessary quality of molecules. If we follow Boscovich and regard them as centres of force, then two molecules might, on collision, simply pass through one another.—Dr. Knott read the first part of a paper on solar radiation and earth temperatures, in which a comparison was made between two sets of data, the one derived from Langley's well-known results, the other from a recent discussion by Dr. Buchan of temperature observations made at various depths in the eastern part of the Mediterranean Sea by the Austrian ship *Pola*. These seemed to indicate a daily see-saw of temperature in a stratum of surface water 50 metres thick. It was difficult to credit direct solar radiation with the power to penetrate so deep; but the difficulty was greatly increased when a simple calculation showed that the afternoon excess of temperature which was indicated meant an accumulation of 1460 units of heat under each square centimetre of surface during eight hours of daily sunshine. For, with Langley's value of the solar constant, it could be calculated that the *whole solar energy supplied* to each square centimetre of the earth's surface in the latitude of the Mediterranean during eight hours of the midsummer day did not exceed 750 units. This serious discrepancy seemed impossible of explanation if the general accuracy of both sets of data was assumed.—Dr. Thomas Muir communicated three papers, namely, note on pairs of consecutive integers, the sum of whose squares is an integral square; the differentiation of a continuant; and the Hessian of a general determinant. By direct calculation of the various elements, it was shown that the Hessian of the determinant D of the nth order had the value $\pm(n-1)D^{n(n-2)}$.

PARIS.

Academy of Sciences, February 4.—M. Fouqué in the chair.—Notice on M. Agardh, by M. Bornet.—On the origins of chemical combination. The allotropic states of silver, by M. Berthelot. The method employed is to measure the amount of heat developed by the various allotropic modifications of silver when dissolved in mercury. The five kinds of silver employed gave for 108 grams of the metal amounts of heat varying between 0·08 calorie and 2·03 calories. The values previously obtained for the heats of combination of silver with other elements depend, therefore, upon the state of the metal used, and hence require a correction.—Studies on the combinations of silver with mercury, by M. Berthelot.—On the isentropic stability of a fluid, by M. P. Duhem.—A simple apparatus for the application of the phototherapic method of Finsen, by MM. Lortet and Genoud. The rays from an arc lamp are concentrated by means of a globular flask, through which cold water is kept running. The greater part of the heat is absorbed by the water in the lens, and the apparatus has given good results in actual clinical practice.—Remark on the subject of a note by M. S. Kantor, by M. F. Enriques.—On pencils which are transformed on two sides into orthogonal pencils by the method of Laplace, by M. C. Guichard.—On the density of the zeros and the maximum modulus of a complete function, by M. Pierre Boutroux.—On the relation between the solar activity and the diurnal variation of the magnetic declination, by M. Alfred Angot. This problem has been attacked by applying the method of Fourier to the observations of Paris and Greenwich, the values for the constants obtained in the two cases agreeing very well.—On the borates of magnesium and the metals of the alkaline earths, by M. L. Ouvrard. By heating to a dull red heat a mixture of magnesia, boric anhydride and potassium hydrogen fluoride, the borate $B_2O_3,3MgO$ is obtained in a well crystallised state. The corresponding compounds of barium, strontium and calcium were also isolated.—On the electrolysis of the oxy-acids Preparation of β-amyloxypropionic acid and of the diamyline of butanediol, by M. l'abbe J. Hamonet. To prevent the occurrence of secondary reactions with the hydroxyl group, the hydrogen of this group was replaced by an alkyl group, and the potassium salt of this compound electrolysed. No satisfactory results were obtained with α-oxy-acids, but with β-oxy-acids the synthesis was smoothly effected in the required direction.—On the saccharifying action of wheat germs, and on their use in brewing, by M. Lindet. Owing to the extensive use of roller milling, the germ of the wheat is entirely separated from the farinaceous portion of the grain. A comparative study of the action of wheat germs and malt upon a solution of dextrinised starch showed that practically the same amount of sugar was produced in each case. In the case where the wheat germs are employed, the distillery residues will have a higher feeding value.—The legend of *Lepas anatifera*, and of *Vallisneria spiralis*, by M. Frédéric Houssay.—The *Ramy* of Madagascar, by M. H. Jacob de Cordemoy. The author identifies the *Ramy* of Madagascar with *Canarium multiflorum*. This tree exudes a greenish-yellow resin which is formed in the stem in resinous canals which are specially developed in the liberian tissue.—On a new genus of fossil stem, by M. B. Renault. The fragment of stem described was found in a dolmen of Haute-Alsace. It is named *Adelophyton julieri*.—On the presence of a layer of Devonian anthracite at Koui-tcheou in China, by M. G. H. Monod The fossils found in the coal-measures at Lan-mou-tchang, in Koui-tcheou, and in the neighbouring strata show that these are clearly Devonian. This field shows that the vertical extension of the coal in China is greater than had been supposed, and this extension ought to be still further increased.—The culture and reproduction of the salmon (*Salmo salar*) in fresh water, by M. Jousset de Bellesme. The experiments described prove that the culture and reproduction of the salmon is possible in fresh water exclusively. This gives rise to the belief that although the habit of going to the sea is favourable to its development, it is neither very ancient nor absolutely necessary to its reproduction.—On the constitution of the soil at great oceanic depths, by M. J. Thoulet. As a result of the study of sixty specimens taken at various depths by the Prince of Monaco, the views previously put forward by the author are confirmed.—On a small laboratory furnace, by M. Albery Bruno.

ST. LOUIS.

Academy of Science, December 17, 1900.—Dr. O. Widmann read an account of the great St. Louis crow-roost, in which were embodied many facts concerning the life-history and habits of the common crow.—Prof. F. E. Nipher gave an account of some of his recent results in positive photography. He has now found that hydrochinone baths of normal strength may be used. The formula given in each box of Cramer plates yields good results if the mixed bath is diluted with water to one-third strength. The potassium bromide may be left out, and one drop of concentrated hypo-solution must be added for each ounce of diluted bath. The hypo has a most wonderful effect. With the same bath, plates may be developed as positives in the dark room or in direct sunlight. He had even started the developing of a plate in a dark room, where it progressed very slowly, but very satisfactorily; continued the operation in diffused daylight in an adjoining room, and finished the operation in direct sunlight. The process was accelerated by the light, but did not appear to be otherwise changed by the change in illumination. The resulting picture could not be distinguished from those produced by ordinary methods. This picture was shown by means of the lantern. A box of Cramer's "Crown," "Banner" or "Isochromatic" plates may have the plates individually wrapped in black paper, in the dark room or at night, and all the remaining work may be done in the light. A plate is taken from its wrapping into the lighted room and placed in the slide holder. After exposure, it is taken out into the light and placed in the developing bath, and the picture is then developed in the light, and may be fixed in the light. Of course, during the changes the plate should be shielded from the light as much as possible, and the fixing bath may always be covered. But all of the operations may be carried on without any dark-room conveniences that may not be secured even in the open fields. When weak hydrochinone baths are used, the picture, when developed in strong lamp-light, or in sunlight, has at first a golden yellow colour. When left in the lighted bath for an hour and a half, it slowly darkens to a nearly normal shade, as the details come out more sharply. If the exposure has been correctly made, there will be no trace of fog. With stronger baths the picture comes out in the normal time, and has the normal shade. If the pictures are too dense, the remedy is to reduce the strength of the sodium carbonate solution, or to increase the amount of hypo in the bath. Very fine results are obtained with the sodium carbonate solution at half the strength given in Cramer's formula. When the plate has been sufficiently exposed, a negative of the object can usually be seen upon the plate before development. With long exposure this image is very distinct. It fades out in the bath, and the plate becomes clear. The shadows appear strongly, but indistinctly at first, and of a pink colour, and the high-lights still appear white. The solution remains clear. Too much hypo will cause turbidity and a loss of detail. When the plate is exposed in a printing frame under either a negative or a positive, an exposure of half a minute to diffuse daylight is ample with an ordinary negative. The plate may be over-exposed by placing it for a long time in direct sunlight, and it will then appear on development somewhat like an over-exposed negative. This has not yet been tried with hypo in the bath. Prof. Nipher showed a preliminary diagram, in which exposure and illumination of the developing bath were taken as co-ordinates. The zero condition was represented by a line, and the conditions for producing direct and inverted pictures were represented by areas. He also exposed and developed, in a common bath, in the lighted audience room, negatives printed from negatives, and positives printed from positives. The possible value of radio-active substances acting upon the developing plate in place of, or in addition to, light, was referred to as a most promising field for study.

DIARY OF SOCIETIES.

THURSDAY, February 14.

Royal Society, at 4.30.—Some Additional Notes on the Orientation of Greek Temples, being the Result of a Journey to Greece and Sicily in April and May, 1900: F. C. Penrose, F.R.S.—The Transmission of the *Trypanosoma Evansi* by Horse Flies, and other Experiments pointing to the Probable Identity of Surra of India and Nagana or Tsetse Fly Disease of Africa: Dr. Leonard Rogers.—On the Influence of Ozone on the Vitality of some Pathogenic and other Bacteria: Dr. A. Ransome, F.R.S., and A. G. R. Foulerton.—On the Functions of the Bile as a Solvent: B. Moore and W. H. Parker.——To be read *in title only*: On the Application of the Kinetic Theory of Gases to the Electric, Magnetic and Optical Properties of Diatomic Gases: G. W. Walker.—Heredity, Differentiation, and other Conceptions of Biology: a Consideration of Prof. Karl Pearson's paper "On the Principle of Homotyposis": W. Bateson, F.R.S.

Mathematical Society, at 5.30.—The Distribution of Velocity and the Equations of the Stream Lines, due to the Motion of an Ellipsoid in Fluid Frictionless and Viscous: T. Stuart.—On Factorisable Twin Binomials: Lieut.-Colonel Cunningham, R.E.—Concerning the Abelian and Related Linear Groups: Prof. L. E. Dickson.—A Geometrical Theory of Differential Equations of the First and Second Orders: R. W. Hudson.—Brocardal Properties of some Associated Triangles: R. Tucker.—A Note on Stability, with a Hydrodynamical Application: T. J. I'a. Bromwich.

Society of Arts (Indian Section), at 4.30.—The Greek Retreat from India: Colonel Sir Thomas H. Holdich, K.C.I.E.

Institution of Electrical Engineers, at 8.—Capacity in Alternate Current Working: W. M. Mordey. (Adjourned Discussion.)

FRIDAY, February 15.

Royal Institution, at 9.—Electric Waves: Right Rev. Monsignor Gerald Molloy.

Geological Society, at 3.—Annual General Meeting.

Institution of Mechanical Engineers, at 8.—Light Lathes and Screw Machines: J. Ashford.

Epidemiological Society, at 8.30.—The Epidemiological Aspects of Isolation Hospitals: Dr. Arthur Newsholme.

MONDAY, February 18.

Royal Institution, at 3.—Origin of Vertebrate Animals: Dr. Arthur Willey.

Society of Arts, at 8.—The Bearings of Geometry on the Chemistry of Fermentation: W. J. Pope.

Society of Chemical Industry, at 8.—Discussion on the Occurrence and Detection of Arsenic in Manufactured Products.

Victoria Institute, at 4.30.—The Wahabies: S. M. Zwemer.

TUESDAY, February 19.

Royal Institution, at 3.—Practical Mechanics: Prof. J. A. Ewing, F.R.S.

Zoological Society, at 8.30.

Institution of Civil Engineers, at 8.—The Nilgiri Mountain-Railway: W. J. Weightman.

Royal Statistical Society (St. Martin's Town Hall, W.C.), at 5.30.—The Growth of Municipal and National Expenditure: The Right Hon. Lord Avebury, F.R.S.

Royal Photographic Society, at 8.—Imitative *versus* Creative—a Comparison: W. Edwin Tindall.

WEDNESDAY, February 20.

Society of Arts, at 8.—Some Features of Railway Travelling, Past and Present: Frederick McDermott.

Geological Society, at 8.—Submerged Valleys opposite the Mouth of the River Congo and of Western Europe: Prof. E. Hull, F.R.S.—The Geological Succession of the Beds below the Millstone Grit Series of Pendle Hill and their Equivalents in other Districts in England: Dr. Wheelton Hind and J. Allen Howe.

Royal Meteorological Society, at 7.30.—Report on the Phenological Observations for 1900: E. Mawley.—A Review of Past Severe Winters in England, with Deductions therefrom: Albert E. Watson.

Royal Microscopical Society, at 7.30.—Exhibition of Bacteria and Blood Parasites: C. Beck.

THURSDAY, February 21.

Royal Society, at 4.30.

Linnean Society, at 8.—On the Affinities of *Æluropus melanoleucus*, Alph. Milne-Edw.: Prof. E. Ray Lankester, F.R.S., and R. Lydekker, F.R.S.—Étude d'une espèce nouvelle de Lépapèdes: M. A. Gruvel.

Institution of Electrical Engineers, at 8.—If the discussion on Mr. Mordey's paper is closed, the following paper will be read:—The Electrical Power Bill of 1900: Before and After: W. L. Madgen.

Chemical Society, at 8.—(1) Isomeric Hydrindamine Mandelates and Phenylchloracethydrindamides; (2) Isomeric Benzylhydrindamine bromocamphorsulphonates and some Salts of *d-l*-Hydrindamine: F. Stanley Kipping and H. Hall.—Condensation of Phenols with Esters of the Acetylene Series. IV. Benzo-γ-pyrone and its Homologues: S. Ruhemann and H. W. Bausor.—Constitution of Bromocamphoric Anhydride and Camphanic Acid: A. Lapworth and W. H. Lenton.—The Action of Acetylchlor- and Acetylbrom-aminobenzenes on Amines and Phenyl hydrazine: F. D. Chattaway and K. J. P. Orton.

FRIDAY, February 22.

Royal Institution, at 9.—Metals as Fuel: Sir W. Roberts-Austen, F.R.S.

Physical Society, at 5.—How Air subjected to X-Rays loses its Discharging Property, and how it Discharges Electricity: Prof. Emilio Villari.—(1) On the Propagation of Cusped Waves and their Relation to the Primary and Secondary Focal Lines; (2) On Cyanine Prisms, and a New Method of Exhibiting Anomalous Dispersion: Prof. R. W. Wood.

Institution of Civil Engineers, at 8.—Automatic Coupling: J. L. Cridlan.

SATURDAY, February 23.

Royal Institution, at 3.—Sound and Vibrations: Lord Rayleigh, F.R.S.

Essex Field Club (Essex Museum of Natural History Stratford), at 6.30.—Recent Work in Molluscan Morphology: Prof. G. B. Howes, F.R.S.

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