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THE TEACHING OF ELEMENTARY CHEMISTRY.

Elementary Chemistry. By M. M. Pattison Muir, M.A., Fellow and Prælector in Chemistry of Gonville and Caius College, and Charles Slater, M.A., M.B., formerly Scholar of St. John's College, Cambridge.

Practical Chemistry: a Course of Laboratory Work. By M. M. Pattison Muir, M.A., and Douglas Carnegie, B.A., Demonstrator of Chemistry, and formerly Scholar of Gonville and Caius College. (Cambridge, at the University Press, 1887.)

DURING the past few years numerous expressions of dissatisfaction have been more or less openly uttered by members of the younger generation of English chemical teachers, and the opinion is gaining ground that instruction in the elements of the science can no longer be imparted entirely on the stereotyped lines of practice devised to suit the requirements of a bygone generation—of a time when a science of chemistry was but beginning to exist, and the conviction had not yet been acquired that the subject *must* ultimately be reckoned as a necessary element of a liberal education. Several of the objectors have advanced their criticisms to the constructive stage, thereby rendering great service to the cause; nevertheless we believe it is the general opinion that, although each contains numerous good points, all the schemes hitherto advanced are in the main failures, and that it is impossible to accept any one as it stands. The senior author of the works now under notice has been one of the most active objectors to the good old-fashioned style of teaching, and has told us in terms somewhat vague and general it is true, but none the less plainly, what we ought to do. Even chemists recognize, however, how comparatively easy it is to preach and yet how difficult to practice, and we have therefore patiently awaited the publication of details to guide us on the tortuous and narrow path to success. These details are now before us in the two books of which the titles are given at the head of this article; "they are intended to be used together," say the authors, and "their object is to teach the elements of chemical science." What will be the verdict of, say, a jury of schoolmasters—by far the most competent judges on such a question—as regards the merits of the scheme put forward by Messrs. Muir, Carnegie and Slater? We venture to predict, and we trust, that it will be, "Impossible." In order to justify this statement we shall proceed to specify our objections to the scheme, trusting that, by so doing, some service may be rendered to a cause in which so many are now deeply interested, and which is undoubtedly of the highest importance to the community on account of the inestimable advantages to be derived from the teaching of the elements of experimental science, and especially of chemistry, in schools in a logical and systematic manner.

The issue of two companion volumes has many advantages: indeed we believe that in the future it will be thought essential to separate the instructions to a student stating what is to be done from any description or discussion of observations or inferences to be deduced from results, in order, as far as possible, to induce the habit of observing and of reasoning from observation; in no other way probably is it possible to force the student to become an independent observer and thinker, and to prevent the teaching of science from degenerating into mere cram, as is too frequently the case in schools. It appears to us, however, that in the earlier part of the "Practical Chemistry" Messrs. Muir and Carnegie do not sufficiently bear in mind their own intention, and that much of the matter would find a more fitting place in the companion volume.

In the "Practical Chemistry," we learn from the preface, "the aim has been to arrange a progressive course in which, as the experiments become more difficult, the reasoning becomes more close and accurate." But surely, in a scientific work, the reasoning should throughout be "close and accurate:" authors who make such a statement almost invite suspicion, and it is to be feared that in this case such suspicion is unfortunately not entirely unwarranted; the reasoning is indeed but rarely close, and not infrequently conspicuously absent. As a typical case, and as an illustration of the manner in which the experiments are usually set forth, Experiment 1, Chapter VI., p. 22, may be quoted:—

"Place a small piece of sodium in a little cage of wire-gauze attached to a glass rod. Fill a large test-tube with water and invert it in a small basin of water; hold the tube with one hand, and with the other bring the wire cage containing the sodium under the water, so that the gas, which at once begins to bubble through the water, passes into the tube and collects there. When the tube is full of gas, cover the mouth with the thumb, invert the tube, and bring a lighted taper to the mouth; the gas takes fire, and burns with a pale, almost non-luminous flame—the gas is hydrogen. Evaporate the water in the basin to dryness; the white solid which remains is a compound of sodium, hydrogen, and oxygen; it is called sodium hydroxide, or caustic soda. (The composition of this compound cannot be proved at present.) By the interaction of sodium and water, hydrogen and a compound of sodium with hydrogen and oxygen have been formed. Sodium is an element: *if this is taken as proved*, it follows that the hydrogen evolved as gas in the foregoing experiment, and also the hydrogen and oxygen which combined with the sodium, must have formed part of the water at the beginning of the experiment. (*Here we assume* that the material of the vessel was not chemically changed during the process.) Water therefore is a compound of hydrogen and oxygen."

What can be the educational value of an experiment thus described and discussed? That water *therefore* is a compound of hydrogen and oxygen only follows when a variety of assumptions are made. The tendency of such teaching is entirely in the wrong direction: the habit of *assuming* that such and such is the case is one which it is all-important to counteract by experimental teaching, and practical chemistry will never be of value as a rigid mental discipline unless the student be led from the beginning to demand and obtain proof of each successive link in a chain of arguments.

Again, the directions for Experiment 3, Chapter II., p. 7, are to heat copper in dried air, and to weigh the tube containing it before and after heating; the weight is found to increase, whence it follows that the metal has combined with some other kind of matter, the most likely source of which is the air. We then read:—

"We must now *make two assumptions* which *can be, and have been, proved* by accurate experiments. We shall *assume* (1) that the air is a mixture of at least two gases called oxygen and nitrogen; (2) that water is a compound of two gases, hydrogen and oxygen. If then hydrogen is brought into contact with a heated solid substance and water is produced, it follows that oxygen must have been taken away from the heated solid by the hydrogen."

The student is therefore directed to heat the copper oxide previously obtained in a current of hydrogen, and finally to weigh the tube. The weight is the same as at the beginning of the series of experiments.

"You have therefore proved, *on the basis of certain assumptions*, that when copper is heated in air it combines with oxygen in the air to produce a new kind of matter called copper oxide; and that the weight of the copper oxide thus produced is greater than that of the copper from which it has been produced. *By experiments too difficult to be performed at present it can be proved* that the difference between these weights is the weight of the oxygen which has combined with the copper."

The effect of such teaching must be that the mind of a student with inborn intelligence, instead of having logic infused into it, will have become filled with profound contempt of chemical experiments; it is impossible that it should lead to the acquisition of precision of thought or judgment. In a properly chosen series of experiments everything should be proved; no assumption should be necessary.

"The arrangement of the course and the selection of the experiments are the outcome of the experience gained in teaching chemistry for many years" (preface). Having in mind the manifestos issued at various times by one of the authors, we naturally are led by this paragraph to expect an entirely original treatment of the subject. But, alas! we fear we may safely say that "what is true is not new, and what is new is not true"! Thus, in Chapter IV., which bears the imposing heading, "Conservation of Mass of Matter," we no longer meet with the classical candle experiment, and we confess that we little regret its banishment; but what have we in its place? An experiment in which zinc is dissolved in diluted sulphuric acid, the hydrogen being retained in a tube; and a second, in which marble is dissolved in acid, the carbon dioxide being prevented from escaping by potash solution. We venture to think that neither experiment is calculated to impress the beginner, and that the only proper demonstration in this case is by some form of combustion experiment in which there is an apparent destruction of matter; but we hold that it is far better simply to lead the student to observe that in every case of apparent disappearance a new form or forms of matter are produced, and to postpone any attempt to teach the law of the "conservation of matter" until a time when the results of the gigantic labours of men like Stas can be appreciated. Again, is a *blue crystalline solid* obtained (Experiment 3, Chapter III.), on dissolving copper in sulphuric acid and evaporating the liquid nearly, but not quite, to dryness—we presume in a water-bath, as directions have previously been given (p. 3) *always* to use a water-bath, unless otherwise directed. In Experiment 8, Chapter V., the student is directed to electrolyze water containing a little sulphuric acid, and the accompanying cut represents a basin in which tubes are inserted over electrodes connected with *two* bunsen cells; in the figure the bunsens are 7/16 of an inch in diameter, the basin is 1 inch across at the base, and the liquid column 3/16 of an inch deep. Assuming the bunsens used to be 4 inches in diameter, the basin would be 7 inches across at the base, and the liquid $1\frac{5}{16}$ inches deep; there would consequently be a fairly respectable quantity of water to electrolyze. Yet, at p. 7 of the "Elementary Chemistry" we read: "If the process is continued, the water will at last entirely disappear, and in place of it we shall have two colourless gases. This result of "experience gained in teaching chemistry for many years" is indeed remarkable; the store of energy in two bunsen cells is truly marvellous, and we had not previously realized how great is the capacity of tubes such as are figured. At p. 3 the direction is given to add sodium to water in a basin, and, when the sodium is all gone, to place the basin on a *water-bath* and evaporate until the water is wholly removed. A white hard lustreless solid called caustic soda is said to be obtained. Here, again, the authors' experience is probably extraordinary. We are also under the impression that the student would be disappointed with the result of the experiment figured on p. 30 of the "Elementary Chemistry."

Next, as to the arrangement of the course. What strikes us most, and what we are least prepared to excuse, in the "Practical Chemistry," is the entire absence of anything approaching to a *systematic* arrangement. Part I. consists of 102 pages, and the chapters bear the following headings: I. Chemical and physical change; II. Elements and not-elements; III. Not-elements divided into mixtures and compounds; IV. Conservation of mass of matter; V. Methods of bringing about chemical changes; VI. Chemical properties of water; VII. Classification of oxides; VIII. Acids and salts; IX. Classification of salts; X. Alkalis, and alkaline hydroxides; XI. Reactions between acids and salts; XII.-XV. Classification of elements; XVI. Conditions which modify chemical change; XVII. Oxidations and reductions; XVIII. Strong and weak acids. In Part II. (78 pages) the chapters are headed: I. Laws of chemical combination; II. Equivalent and combining weights; III. Molecular and atomic weights; IV. Dissociation; V. Reacting weights of compounds determined by chemical methods; VI. Chemical change; VII. Chemical classification. At the outset the authors are strictly conservative, and in the most orthodox manner possible in the first three chapters instruct the student to dabble with a variety of substances never heard of for the most part in ordinary life, and to this we most strenuously object. We are convinced that the only way of beginning to teach chemistry, if the object be to cultivate the faculties of experimenting, observing and reasoning, is to deal with familiar objects and phenomena; and that at the very outset, after as far as possible determining the properties of familiar objects by means of ordinary appliances, we ought to set our students to analyze. We hold that air and the phenomena of combustion should be first studied: the composition of air should be determined, and oxygen should be *discovered* by the student. This we believe to be both historically and scientifically the correct method. The composition of water should next be qualitatively ascertained. It is a *sine quâ non* that the experiments made with the object of solving such problems be throughout logically interrelated; each experiment should be suggested by the experiment or experiments previously made, and should be made with the object either of verifying or extending the information previously gained. When a student is told to perform experiments selected by the teacher for no apparent reason and merely with the object of demonstrating some particular point, their value as a logical exercise is practically *nil*. In solving such problems as the composition of air and water, &c., the student insensibly realizes the distinctions which are to be drawn between mixtures, compounds and elements, and soon learns to appreciate the characteristic difference between chemical and so-called physical change; but we hold it to be a positive advantage not to insist too strongly on the presumed difference now that it is becoming probable that many phenomena hitherto regarded as physical essentially depend on a change in molecular composition.

These remarks apply also to Chapter IV., already referred to, and to Chapter V.; in this latter, the slain of previous chapters are rekilled. Chapter VI. is headed "Chemical Properties of Water." Experiment 1 was quoted above and appears to be intended to serve as proof of the composition of water. Experiments 2–7 have nothing whatever to do with water, but relate to the preparation and properties of hydrogen and oxygen. Experiment 8 involves the examination of the residues from the preparation of hydrogen and oxygen. Then follows the oracular sentence: "Water is a compound of hydrogen and oxygen; let us examine a few of its properties." Experiment 9 therefore directs the student to add powdered copper sulphate crystals, potassium nitrate and tartar emetic to separate portions of water, and to take note that water acts on these as a solvent, inasmuch as their composition is not changed by it. Experiment 10 consists in adding anhydrous copper sulphate, and also solid sulphur trioxide to water; in both cases, it is found that the water not only dissolves but acts upon the substances. Here the chapter ends: we question whether the most conscientious performance of the experiments will lead the student to acquire any clear conception of the "chemical properties of water."

Thus far we have confined our remarks to the opening chapters, it being our opinion that these are all-important in a work which purports to teach the elements of chemistry. But there is much in the arrangement of the remainder of the book to which we venture altogether to take exception. Thus a fatal error of judgment has led the authors to postpone the experimental discussion of the laws of chemical combination and of equivalent and combining weights, as well as of molecular and atomic weights, to Part II., placing in advance of these all-important subjects a variety of matters—among others a discussion of the properties of the various elements classified in groups in accordance with the periodic law—which cannot properly be considered without a fairly complete knowledge of the laws of chemical combination. It is obvious that the authors to some extent recognize their mistake, as the order is different in the *companion* volume, the laws of chemical combination, and symbols and formulæ being discussed in Chapters V. and VI.

The "Elementary Chemistry" contains a third part dealing with subjects which are only touched on in the companion volume; this part is to be used in conjunction with portions of the "Principles of Chemistry," by one of the authors. Chapter I. of this part should have been included in Part I.; the remaining chapters ought never to have been introduced into an "Elementary Chemistry," and are obviously only included because of the senior author's well-known tendency to worship physical constants. Thus Chapter II. is headed Dissociation, and directions are given for the performance of Lemoine's experiments on the dissociation of hydrogen iodide, and of Horstmann's on ammonium carbamate: the authors evidently to some extent foresee the probable result of making such experiments, as, in summing up those on hydrogen iodide, they say: "The results of your experiments *ought* to show" that such and such is the case. How often would they? Chapter III. bears the title, "Relative Affinities of Acids," and in it experiments are described illustrating Thomsen's and Ostwald's methods; the same subject is briefly referred to in Chapter XVIII., Part I. The main objection to this chapter is that students of elementary chemistry are incapable of performing such experiments with sufficient accuracy. Moreover, it cannot yet be admitted that the conception introduced by Thomsen is warranted: until the part which the water plays is determined, neither Thomsen's nor Ostwald's results can be accepted as furnishing estimates of the relative affinities of acids for a given base. A similar remark applies to Menschutkin's etherification experiments, the repetition of which is directed in Chapter IV.: the complete interpretation of these is yet to be given.

Nothing is farther from our intention than the desire to disparage the study of so-called physical properties—on the contrary, we hold it to be of primary importance that a *proportionate* amount of attention should be devoted by students of chemistry to the physical side of their science; but let them learn before all things to regard the phenomena from the true chemist's point of view. Chemistry is to a large extent an art: a large number of relationships and peculiarities which are obvious to the skilled chemist will probably always elude mathematical treatment; it appears, indeed, to be as impossible to give formal expression to them by means of physical constants as it would be to define the work of a great painter after spectroscopic analysis in terms of wave-lengths. Especially have we felt this to be the case on reading through Ostwald's invaluable work: it has frequently struck us that he has perhaps unduly forgotten his art as chemist in the exercise of his great technical skill in determining and setting forth physical constants, the result being a picture which fails to satisfy. But it is not to be denied that chemists as a class have not yet acquired that belief in the power of physicists to help them forward which, with or without reason, is demanded of them; and this is not difficult to understand. The establishment of the doctrine of structure—the great achievement of modern chemistry—is the outcome solely of chemists' labours; in this particular case, the study of physical properties has served to confirm the conclusions of chemists, but there is nothing to show that it could ever have led to them. And all recent attempts to directly apply the results of physical determinations have proved most unfortunately barren of results: a striking example of this is afforded by the complete failure which appears to have attended Thomsen's attempt to deal with the vast mass of thermal data accumulated by his unwearied study of carbon compounds. Chemists have not as yet received much assistance from physicists: the determination of physical constants has served to give precision to chemical statements, but little else; and it is not probable that it will ever be otherwise. In fact, the attitude of the two classes of observers towards natural objects is different, and appears to be somewhat as follows. The physicists are much like a party engaged in the investigation of a strange nation: they walk through the streets of its towns and most carefully observe how the houses are externally constructed and arranged, and study the traffic in the streets, but they do not enter the houses or take note of the mental peculiarities of the people. The chemists, however, enter the houses: they observe their internal structure, they determine the influence of this internal structure on the character and occupations of the inhabitants, of whose mental peculiarities they also endeavour to gain clear conceptions. Those chemists who are satisfied to merely cross the thresholds without continuing their studies and researches, and who therefore have much to learn before they can appreciate the labours of their more active and curious brethren, have no right to take upon themselves the functions of law-givers.

Lastly, a few words regarding the illustrations. It will no doubt be said that these are only diagrammatic; that students are to perform the experiments themselves and therefore will become acquainted with the actual apparatus. But even diagrams should be drawn to scale: Figs. 37, 38, and 43, are illustrations which show how frequently this is not the case: if such very wide-mouthed flasks were always used as are pictured in most of the diagrams a small fortune would be expended in corks. An elementary work should be properly illustrated by drawings which fairly represent the actual apparatus, as such a book will necessarily fall into the hands of those who have no knowledge of apparatus, and therefore need guidance.

From our remarks it will be gathered that we entirely disapprove of the "Practical Chemistry" as a book for beginners: we do not recommend it even to more advanced students. Teachers will no doubt be able to cull a few useful hints from it, although there is a striking absence of originality or novelty in all practical details.

We have little to say of the "Elementary Chemistry." It is an infinitely better book than the companion volume, and a fairly advanced student will find in it much information of interest and value not to be met with in any other current work of the kind. But it is not an elementary chemistry in any proper sense of the term, and, as in the companion volume, the attempt is made to crowd far too much matter into the space at disposal.

In expressing our opinion thus plainly, we have been guided by the desire to do something to stem the ever-flowing tide of so-called elementary text-books of chemistry; these are mainly the outcome of the existence in this country of a vast amount of pseudo-chemistry, and of little true chemistry, and the very existence of such books is doing an infinity of mischief in helping to perpetuate the evil. We believe that it would be of great advantage to chemical science to form an Association to prevent the further publication of elementary works other than such as had been carefully revised and approved of by a Publication Committee of the Association. The harm done by unsystematic and illogical teaching, and by vague experimenting, can never be repaired, and it is incumbent on an author to ponder the meaning and effect of every word, line, and sentence of an elementary text-book.

The authors of the "Elementary Chemistry" say that the book does not profess to be a descriptive catalogue of chemical facts regarding the properties of the individual elements and compounds. But until a satisfactory practical elementary chemistry shall have been written, it is far better that students should gain simply an exact knowledge of chemical facts, and that in their practical work they should be guided by books which we all acknowledge to be sound, though we may think that they are far too restricted in range. Let each school purchase as many copies as possible of a grand old standard work such as Miller's large "Inorganic Chemistry," full of honest common-sense and all but free from fads, and let this serve as the book of reference. A fair understanding of the broad principles which underlie the science may be gained from books such as Cooke's "New Chemistry," and Wurtz's "Atomic Theory," both master-works in their way. H. E. A.

CHINESE CIVILIZATION.

China: its Social, Political, and Religious Life. From the French of G. Eug. Sîmon. (London: Sampson Low and Co., 1887.)

THE reader who takes up this volume, expecting to find it an ordinary popular sketch of Chinese life and manners, similar to dozens of others which have gone by and dozens which are doubtless yet to come, will be totally mistaken. For in place of a colourless account of China—if any account of that wonderful country with its marvellous civilization could be written wholly devoid of colour,—and a jejune outline of the peculiarities of the Chinese, the reader will find here one of the most closely reasoned, original, and powerful defences of the Chinese social and political system that have ever been published in Europe. Writers of eminence, indeed, there have been who have selected some special peculiarity of Chinese religion, society, or politics, and have held it up to the West as worthy of imitation, and as a mark of profound wisdom; but M. Sîmon defends Chinese polity and civilization all along the line. He lived in China as a French official in the critical years succeeding the war of 1861-62; he travelled widely, and he observed keenly. This volume was not written in the first flush of pleasure and surprise at the strange and wonderful things he saw about him; he returned home, and has had ample time to correct first impressions, to review conclusions formed on the spot by the light of subsequent experience and knowledge, and years afterwards he is able to tell to the West that, as of old, the wise men still come from the East, and that the highest product of the human mind is to be found in the civilization of China. The most civilized

State is that "in which on a given area the largest possible number of human beings are able to procure and distribute most equally amongst themselves the most well-being, liberty, justice, and security." Measured by this standard, China is pronounced to be the most highly civilized country in the world, and the Chinese have this peculiarity—that, while modern nations are only the collateral successors of those of antiquity, China is the direct heir of the generations which created it. "Its history shows the phenomena of heredity in regular succession, neither modified nor obstructed by change of medium, with the evolution of events and ideas —an evolution as regular as that of living beings, freely proceeding unshaken and untroubled by any exterior influence, by which its direction might have been altered or its development retarded; and it is here, I repeat, that we find the deep and original interest of China, and perhaps also the secret of her extraordinary longevity." The book is a study of the progress and organization, in short of the civilization, attained by humanity under such conditions of liberty and development. The student in this case is full of love of his subject, and this no doubt is a great advantage, although it has its disadvantages also. M. Sîmon tells us of a land flowing with milk and honey, moral as well as material. Nothing that he has seen is inharmonious or out of place; everything is for the best, and has had the best effects. Chinese civilization is not a dead, rotten branch, as it is usually represented to be, but a living active power for good; in fact, "nowhere in the world is there such proof of force and vitality" as in the Chinese character and in Chinese civilization.

The book is divided into five parts: (1) the family; (2) labour; (3) the State; (4) the Government; (5) the Ouang-ming-tse family, in which he gives the history of the life, labours, and pleasures of a family with which he got acquainted in his travels, besides illustrating by a concrete instance how Chinese polity and administration work out in an individual case. With regard to the family, he says that it is at the hearth that the government of the country is carried on. The family has the power of passing judgment on any of its members for an offence, and can sentence the delinquent to whipping, exile, and excommunication. From the decision of the domestic tribunal an appeal is permitted to the ordinary courts of justice, but it is unusual for such an appeal to be made. Such is the respect paid by the Chinese to their traditions that there are few who do not submit at once to the sentence passed on them by their family. No punishment inflicted on a Chinaman can be more terrible than exclusion from the family. Socially he becomes an outcast, and, driven from the shelter of his ancestral home, and the protection of the spirits of his ancestors, he wanders in search of employment over the world, and it is the thousands of these abandoned ones who flood the American labour-markets. In the family, ancestral worship is cultivated, and is one of the strongest incentives to labour and progress: each member looks on himself as the guardian of posterity, toiling for their benefit, and satisfying the ancestors who watch over the family home. Each family religiously preserves the records of its ancestors, their lives and acts; and to the assembled members these records are read by the head of the house at regular intervals. At each meeting one biography is read, then the next, and so on in order, till the last of the series is finished, when a commencement is again made with the first. With regard to these family records, M. Sîmon sees no more noble sign of the honesty and independence of the Chinese than the fact that, when any question is in dispute, an entry in one of these sacred family books referring to the dispute is looked on by the authorities as decisive. To be able to make the entries in this book, and to read it to his family, should he ever become its head, every Chinaman is taught to read and write; of this, in connection with education, we shall speak later on. Property is collective and individual; and the living holders look on themselves as the trustees of posterity. The fee-simple belongs to the community, except in a few fast-diminishing cases, where small portions of land are owned by each family, and are considered inalienable; and he who dares to introduce a stranger into this patrimonial land commits sacrilege, and becomes an outcast. China has been described as a despotic monarchy, but there is perfect liberty to all. Religions of all kinds are tolerated and are never interfered with except for political purposes. All public meetings and expressions of public opinion are freely permitted. To prove this, M. Sîmon says that in 1863 he made in one province a collection of proclamations of great virulence, denouncing the Emperor for agreeing to the treaty with the Europeans after the sack of the Summer Palace and the burning of the great library, and they are very numerous: none of the mandarins, he adds, dared to prosecute their authors. Taxation is very light—not one-hundredth part of what it is in France. With regard to legislation, the Academy of Sciences at Pekin is the only legislative power. If any official thinks that a custom, generally observed in his province, might with advantage be used over the whole country, he sends an account of it to this body, which examines it, and, if it thinks the custom useful, orders it to be tried in the other provinces; if successful there, it is finally adopted, inscribed in the code, and becomes law. Though M. Sîmon reserves a more extensive account of education in China for another work, it is easy to gather his views from the present book. The Government gives full liberty to all to open schools. The children are well taught, and there is scarcely a Chinaman who is not able to read, write, add up accounts, and draw. The foundation of the education is laid in the family. From their earliest years, children are taught their duties and their rights. They are taught respect for others, and hence respect for themselves. Obedience to usages, humanity, justice, and right feeling —these are the foundations of their education. Besides the family education there are two kinds of public instruction,—primary and superior. Primary education is given in the institutions attached to the family temples, where there are such, or in private schools, which anyone is at liberty to open. The education of every child is provided for, apart from Governmental aid, the rich paying for their poorer brethren. Inasmuch as each Chinese sign conveys an idea, the child that is taught to write the Chinese characters learns not only words, but ideas, and he is forced to explain and comment on these to his teachers. And it is to this fact, in addition to the influences of family councils and family readings, with the profuse inscriptions in every public place, that M.

Sîmon ascribes the amazing intelligence and precocity of Chinese children. With regard to higher education, it is open to all. The Government give barely the necessary expenses; the rest is contributed by private donors and by the students themselves, of whom there is always an abundance. The directing staff is paid by Government, the teaching staff by the students. Those who wish to enter the public service are trained and examined at the Hanlin College or University of Pekin. All appointments are given to the graduates according to their degrees; the higher the degree the more honourable and lucrative the post. The graduate takes precedence of all minor officials, and ranks with a minister or viceroy, whose post he frequently fills when he has had a little experience in public life. He has rooms allotted to him in the palatial universities. For these degrees the competition is very severe. All the professions stand on an equal footing, except those of teaching and letters. In no country is the man of letters of such influence as in China. Old age alone makes others as worthy of respect as he. Whenever M. Sîmon found the Chinese distrustful or indifferent to him, he always humoured this opinion of their value of learned men, by seeking out the most learned man in the place and paying his respects to him. The tutor retains a life-long power over his pupil, and frequently the people, when they have had some cause of complaint against an official, have sent long distances to bring his tutor to expostulate with him. The great goal of the literary man is to obtain a public post, such posts being held in high esteem in China. There are few vacancies, however, and the vast majority of candidates being unsuccessful become tutors, public writers, &c.; others turn their talents to commerce and agriculture, and so elevate the educational standard of the industrial classes. Labour is so honourable that handicraftsmen rank as high in public estimation as lawyers and doctors.

M. Sîmon sums up his views of Chinese civilization, of which a few examples have been given here, by stating that the fact which always seemed to him the most wonderful "was the progressive substitution of individual for collective action in all the works of civilization, from the simplest to the most complex, from mental to material. The individual freed from the slavery of collectivity, independent, and free in unity, thanks to that unity, is the salient fact apparent from the study of the relations between the people and the Government in China, and appears to me to justify the theories prevalent there." Very few readers who possess a personal acquaintance with China and the Chinese will be found to agree with all of M. Sîmon's statements of fact, or with all of his conclusions from them. But he has nevertheless produced a book which deserves to be carefully studied, and which will strike the mind by the originality of its propositions and the skill and ingenuity with which they are defended. In these days, when the Chinese are treated amongst many highly civilized communities in different parts of the globe with loathing and scorn, and when elective Legislatures do not hesitate to speak of members of the Chinese race as *hostes humani generis*, it is perhaps well to be reminded, as M. Sîmon forcibly reminds us, that this race has solved, apparently with success, some of the social and political problems before which Western statesmen and philosophers stand helpless.

THE METHOD OF CREATION.

The Creator, and what we may know of the Method of Creation. The Fernley Lecture of 1887. By W. H. Dallinger, LL.D., F.R.S. (London: T. Woolmer, 1887.)

IT is not the province of this journal to deal with theological questions; at the same time, the one discussed in this volume is in such close relation with science, and of such universal interest, that a brief sketch of Dr. Dallinger's argument may be permitted. He deals with a question which takes precedence of those sundering Churches,—one which may briefly be stated thus: Have the recent advances in physical and biological science placed the Theist in an unreasonable position? Obviously this is a fundamental question. If the answer be in the affirmative, all investigations into the minutiæ of theology are less than the shadows of a shade.

Dr. Dallinger commences by pointing out the necessary limits of scientific inquiry. On this he insists, not in any hostile spirit, but only because it is so often forgotten. "The researches of science are physical. The observable finite contents of space and time are the subjects of its analysis. Existence, not the cause of existence; succession, not the reason of succession; method, not the origin of method, are the subjects of physical research. A primordial cause cannot be the subject of experiment nor the object of demonstration. It must for ever transcend the most delicate physical reaction, the profoundest analysis, and the last link in the keenest logic. Absolute knowledge concerning it can only be the prerogative of itself."

This, of course, is a position which many so-called Agnostics would frankly accept. But in working out the argument the author indicates that a more definite creed is attainable. Commencing with the physical universe, he shows that whatever discoveries have been made, whatever simplifications introduced into the so-called laws of which it is the result, the physicist is at last arrested by two mysteries—matter and force. But what are these, "the alpha and omega of existence" as some would call them? They are two names, and nothing more. We deal with the properties or qualities of matter, with the consequences of force, but we are no nearer to knowing the one or the other. In addition to these, however, many hard-headed thinkers assert "the existence of a third thing in the universe—to wit, consciousness." Now we may juggle as we please with these terms, we may construct on them elaborate systems explanatory of the universe; but beyond laws either mechanical or vital there lies inevitably, however we may try to smother it by words, the idea of causation; and from this idea that of "volition" cannot be separated. We are, as the author shows in an elaborate argument, reduced at last to this alternative: "either chance or mental purpose gave primal origin to all that is." The former he shows is almost inexpressibly improbable: most men will not hesitate to accept the latter.

Considerable space is next devoted to a discussion of Mr. Herbert Spencer's view that "from matter in motion, and nothing else, the whole universe is supposed to arise; life emerges; and mind in its most transcendent forms comes forth." In this discussion we are again confronted with an alternative: either the primordial matter was in a state of homogeneity, and so "infinitely incapable of change," or the homogeneity was disturbed by some external force. But an outside influence is not in the philosophic system. "The admission of inability to evolve the universe without it is an admission that the mechanical philosophy fails at the outset. Nor can it serve the emergency to invoke 'force.' A Divine origin of the universe is usually rejected, because the Divinity eludes the methods of science. But we cannot supplant the Divinity by enthroning force. Science can tell us what force *does*, but it can no more find out what force *is* than what an infinite mind is. Force is an irresistible mental inference from matter in motion, but its ultimate nature is defiantly beyond the reach of science."

The phenomena of life, as exhibited in one of the lower and more minute organisms, are then considered. These are "free and self-originating action"; multiplication; and cyclic change in each new organism. Tiny and humble in organization as these creatures are, they differ vastly from chemical compounds of any kind. The force which animates them differs widely from any mode of force which we call physical. So far as we at present know, the break between "life and not life" is abrupt. Hence, whether or not in the remote past the transition from the one to the other may have been what we should call continuous, our present knowledge offers no explanation of it, and the fact is a stumbling-block in the way of a purely mechanical philosophy.

The remainder of the essay is chiefly devoted to a discussion of the theological aspect of the theory of evolution. This, as designed for the non-scientific part of his audience, need not be further mentioned in these pages. It will be enough to say that, as is now generally admitted by the more intelligent among theologians, he maintains that there is no necessary antagonism between their beliefs and scientific theories.

As might be expected from him, Dr. Dallinger is temperate in expression and eloquent in language. Some readers perhaps would have preferred a little more conciseness in style and statement, but it must be borne in mind that the discourse was delivered as a lecture to a non-scientific audience, who required leading gradually, or even alluring, into unfamiliar paths of thought. Among such persons the book cannot fail to do excellent work in allaying needless fear and silencing ignorant clamour; among opponents it will serve to show that the Theist's position is more defensible than they suppose, and that, in their own, unsuspected difficulties lurk beside the seemingly easy path of a euphonious terminology.

OUR BOOK SHELF.

The Harpur Euclid. Book I. By E. M. Langley and W. S. Phillips. (Rivingtons, 1888.)

THE editors are mathematical masters of two Bedford schools under the Harpur Trust; hence the title. For the work itself the title-page further informs us that it is an edition of Euclid's "Elements" revised in accordance with the Reports of the Cambridge Board of Mathematical Studies, and the Oxford Board of the Faculty of Natural Science. Extracts from these Reports are given in a prefatory note: this is the only part of the work which is not strictly adapted for the use of school-boys.

We began our task with no special liking for it, but had not proceeded far when we found that there were new adornments which rendered our perusal of the familiar lines very agreeable. We read on through 102 out of the 120 pages without break, and then ceased, as we had come to some matters which required more careful examination. The editors have kept to the usual sequence, but in many cases have replaced the Simsonian demonstrations by easier ones, and have discarded much of the superfluous matter which has led anti-Euclidians to inveigh so strongly against the "Elements."

We are glad to see that exercises come in right from the outset; these all seem to have been most carefully selected, and are such as a fairly intelligent boy ought to be able to solve from the previous propositions. We refer here to the examples in the body of the book. Frequent reference is made to that excellent, though perhaps hardly sufficiently appreciated, little book of Prof. Henrici, "Congruent Figures," and to the "Syllabus" of the Association for the Improvement of Geometrical Teaching. At the end, as a kind of appendix, are some judicious sections on properties of triangles, on quadrilaterals, on loci, on solving geometrical problems—(1) method of intersection of loci; (2) method of intersection of sets; (3) method of analysis and synthesis. Considerable pains has been bestowed on the arrangement of the text, the selection of the various types, and the drawing of the figures; in fact, the little book is the beau-ideal of a Euclid for boys. We wish we had had such a book in the "auld lang syne," and then our first perusal would not have been so painful. It is the authors' intention to bring out the successive books in like form. We wish them like success, and trust that their venture will find a welcome in many a school.

A Course of Quantitative Analysis for Students. By W. N. Hartley, F.R.S. (London: Macmillan and Co., 1887.)

AFTER the almost infinite number of books, mostly small, "and mostly to meet certain requirements of our own students" on qualitative analysis, it is a relief to meet with a small book for students—beginners—on quantitative analysis, written evidently for beginners, and in a manner to really lead them up from qualitative notions, not by one great bound, but by good sober practice and order, to the appreciation of the care and exactitude, and most important still, the "criticising" state of mind necessary to make a real analytical chemist.

As the author says in his preface: "To be a good analyst does not necessitate a profound knowledge of chemistry;" but any student who has worked at all well through this little book will have a good platform of knowledge under him, and be in a position to enlarge his knowledge with infinitely greater ease, and that very necessary regard for accuracy which is not possible to a student who has not done any quantitative work.

The author begins in a sensible manner by giving the metric weights and measures, with English equivalents, and then the dimensions of various laboratory apparatus, beakers, &c., and all this is very useful. In the introduction, manipulation and reagents are dealt with. The author might have added the use of folded or plaited filters. It is quite as safe and accurate to use them for quantitative purposes as to employ a pump.

Before proceeding to simple estimations of constituents of salts, &c., we have about twenty pages of introductory examples devised with the intention of enabling students to realize the meaning of the atomic and equivalent weights of elements; which they do not always do when put on to determinations without any introduction. This is the most useful and original part of the book. The following exercises, "simple estimations," are fairly in order of difficulty. The middle portion of the book is on volumetric analysis. It is short but workable, and is followed by a good section on analysis of silicates and some technical products. The book does not attempt to cover all the field of analysis, but what is done will be found really useful by a beginner or a junior student.

W. R. H.

LETTERS TO THE EDITOR.

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

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*

"A Conspiracy of Silence."

THE Duke of Argyll can scarcely be congratulated upon his latest discovery of a new ground of attack upon geologists. In the year 1862 a very eminent physicist, whose loss we all so deeply deplore, made the somewhat rash suggestion that flint implements are found deep down in the drift, owing to their high density as compared with that of the matrix in which they are inclosed. Seeing that the material in which the implements are found is usually a *flint*-gravel, everyone acquainted with the subject saw that the suggestion was, to say the least, a somewhat unfortunate one, and Prof. P. G. Tait, in seeking for an opportunity to sneer at "advanced geologists," was scarcely kind to the memory of a deceased friend in rescuing such a suggestion from oblivion. But to the Duke of Argyll, the finding of a new basis from which to attack geologists seems to have been a chance which he could not afford to let slip.

The Duke of Argyll now asks when we are going to begin to discuss his magazine-article upon coral reefs. I reply that in the article in question there is not a single new fact or fresh argument—nothing which has not been already brought forward by Mr. Murray himself, or by Dr. Archibald Geikie, and met by Prof. Dana in a singularly exhaustive memoir well known to all geologists. The subject has, moreover, been treated at considerable length by Profs. Prestwich, Green, James Geikie, De Lapparent, and others. Surely no exception can be taken either to the eminence of the authorities who have written on the subject, to the length to which their notices have extended, or to the prominence of the journals or treatises in which these discussions have appeared. If it be said that the general scientific public have not had the matter fully laid before them, it is only necessary in reply to call attention to the pages of NATURE, in which a succession of articles dealing with the subject will be found.

The Duke of Argyll says that he has "nothing to retract." Here I regret to have distinctly to join issue with him. He has asserted that scientific men have refrained from discussing a particular theory, and that in taking this course they have been actuated by the worst of motives—a fear of the truth; he has charged the Geological Society with refusing in the spring of 1885, through its then President, to accept a certain paper from the same cause; and now he adopts and gives fresh currency to an equally offensive charge of a similar kind.

These charges have, each and all of them, been shown to be absolutely destitute of foundation. The Duke of Argyll must judge for himself if the principle of *noblesse oblige* should not lead him, not only to *retract* the charges, but also to *apologize* for having made them. But his Grace may rest assured that, until he does so, the grounds for the deep indignation at his conduct, which is so strongly felt both at home and abroad, will still remain.

JOHN W. JUDD.

On the Constant P in Observations of Terrestrial Magnetism.

I REGRET that Prof. Rücker should have largely misunderstood my last letter. I have not raised the question of fallible observations at all. Referring to the correspondence on pages 127–8 of the present volume of NATURE, my principal contention was and is that the ordinarily accepted formula for P differs by terms of the second and higher orders from Gauss's theory, and that that difference necessarily persists in any rigorous expansion of the formula. By the ordinarily accepted formula for P I mean Prof. Rücker's formula (α); and by Gauss's theory I mean my formulæ (1), (2), and (3). From two observations of $f(u)$, made respectively at the distances r and r_1, the L of Gauss's theory might be found by a direct solution of equations (1) and (2); but instead of that, it is customary to find L from equations (7) and (8) by substituting in them the value of P_0 computed through equation (α). To render the latter procedure rigorous, P should be used in (7), and P_1 in (8). Equation (11) shows that P and P_1 differ by quantities of the second and higher orders, and as the ordinarily accepted value of P_0 lies between P and P_1, it necessarily differs from one or both of these quantities, and therefore from Gauss's theory, by terms of the second and higher orders.

While freely admitting the justice of Prof. Rücker's criticism upon my arbitrary assumption that $P_0 = \frac{1}{2}(P + P_1)$, I cannot assent to the process by which he has deduced equation (γ). Equations (7) and (8) show that we may have either one L and two P's, or two L's and one P. In the latter case these equations become—

$$\tfrac{1}{2}L' = A(1 - P_0 r^{-2}) \quad \ldots\ldots (15)$$

$$\tfrac{1}{2}L'' = A_1(1 - P_0 r_1^{-2}) \quad \ldots\ldots (16)$$

and P_0 must be determined so as to make L′ and L″ as nearly as possible identical with L. To that end we must have $2L = L' + L''$; and then, from the difference between (7) + (8) and (15) + (16)

$$P_0 = B(A - A_1)\frac{r_1^2 + r^2}{Ar_1^2 + A_1 r^2} \quad \ldots\ldots (17)$$

Expanding to terms of the second order

$$P_0 = B\frac{(A - A_1)}{A}\left\{1 + \frac{r^2}{r_1^2 + r^2}\left(\frac{A - A_1}{A}\right)\right\} \quad . (18)$$

Whence, by equation (13)

$$P_0 = \frac{r_1^2 r^2}{r_1^2 - r^2}\left(\frac{\log A - \log A_1}{M}\right) - \frac{r_1^2 r^2}{2(r_1^2 - r^2)}\left(\frac{\log A - \log A_1}{M}\right)^2 \quad . . (19)$$

This result agrees better with equation (14) than with equation (γ).

WM. HARKNESS.

Washington, D.C., December 30, 1887.

I AM afraid that the new method of calculating P_0 adopted by Prof. Harkness is not less arbitrary than that which he previously employed. He says that "P_0 must be determined so as to make L′ and L″ as nearly as possible identical with L." If the object is only to deduce a correct value of L by combining equations (15) and (16), this condition is certainly not necessary. For if we substitute from (17) in (15) and (16), and take the mean of the values of L′ and L″, we get by a very roundabout process the same value of L as we should have obtained without using P_0 at all. But we should have reached the same final result if we had started with the assumption that

$$(n + m)L = nL' + mL'',$$

where n and m are any numbers whatever. By properly choosing n and m we could deduce the correct value of L with any assigned value of P_0. It appears to me that the equation $2L = L' + L''$ is based upon the tacit assumption that L′ and L″ are to be combined in accordance with the rules applied to fallible measures, and cannot otherwise be justified if the only object is the correct deduction of L from (15) and (16).

If, however, P_0 is introduced to enable us to calculate another approximate value of L by observing (say) A_2 at some other distance, r_2, the best value to select will depend on circumstances. If r_2 is nearly $= r$ we shall get the best result by writing $P_0 = P$ and so on, so that the equation $2L = L' + L''$ is again arbitrary.

I am quite in agreement with Prof. Harkness as to the fact that if we start from the basis of equations (1) and (2) a small theoretical error is introduced by substituting P_0 for P and P_1. Indeed I think this step can only be justified by our knowledge that the inaccuracy thus caused is less than the error of experiment. It is thus impossible to discuss the proper value of P_0, as Prof. Harkness wishes to do, without raising the question of fallible observations. If it is raised, the method of treatment by least squares follows.

Prof. Harkness tried to show that, although the second term which I introduced brought the approximate value of P_0 nearer to that given by the ordinary formula, it removed it further from another value which he regarded as the standard. I venture to think that I have justified my position by showing that the introduction of P_0 is useless unless the equations are regarded as fallible; that the ordinary value is that given by least squares, and that the standards proposed by Prof. Harkness are founded on assumptions which have no theoretical basis.

In conclusion I may perhaps be allowed to make two remarks, one of which would, I think, from the point of view assumed by Prof. Harkness have strengthened his case. In the first place he is wrong in saying that the ordinary value of P_0 lies between P and P_1. It is smaller than both of them if A is $> A_1$.

In the next place I may point out that by treating a number of fallible expressions of the type of equations (1) and (2) by the method of least squares, a general value of L could be found without the introduction of the small theoretical errors which have caused this correspondence. There is however little doubt that by the introduction of P_0 we obtain a more convenient and practically no less accurate method of dealing with the observations.

ARTHUR W. RÜCKER.

Science Schools, South Kensington, January 10.

The Mist-Bow.

IN a letter to the *Times* of January 12, Prof. Tyndall calls attention to a white mist-bow, which he has seen on one or two occasions, and mentions its rarity of occurrence. It may therefore be of interest to record that I witnessed a similar phenomenon on January 9 last. My point of view was an elevated band-stand at the head of Weymouth Pier; the time 11 a.m. The air, as on the occasions mentioned by Prof. Tyndall, "swarmed with minute aqueous particles," *i.e.* was foggy, and on looking away from the sun, which was shining weakly, I saw a well-defined white bow cast upon the mist. The bow appeared to be about 60 feet distant. My point of view being high, a full semicircle was visible. It was, as may be imagined, a beautiful and graceful object.

ALBERT BONUS.

St. Leonards, Exeter, January 13.

IN reference to Dr. Tyndall's letter in the *Times* of Thursday last upon the ullao as observed by him, I beg to call your attention to my paper read before the Stockport Society of Naturalists upon the same subject (see pp. 11 and 35). Not having seen the phenomenon described before, I ventured to call it the dew-bow.

THOMAS KAY.

Moorfield, Stockport, January 14.

THE character and persistence of the recent fog have been so exceptional that perhaps you may deem the following observations on it worthy a record in NATURE.

I was staying in Mid-Devon at a place in the valley of the River Taw, some 10 miles north of Dartmoor. On Monday, the 9th instant, we were enveloped in a dense, damp, white fog, a rare occurrence in that part of the country. Surmising that the fog had no great vertical thickness, I sallied forth in the afternoon to mount a hill immediately to the eastward. At a slight elevation the sun was already making his appearance, and as I continued my ascent, and the fog became more and more thin, I saw before me on the then pale blue sky a beautiful white bow, similar to the rainbow, only broader and without colour. When the top of the hill was reached, the fog and bow had disappeared, the sky was deep blue, and the sun shining with quite spring-like warmth.

The scene I now had around me was most enchanting. The fog could be traced lying in the river valleys like arms of the sea, with the bordering hills simulating cliffs, and here and there an island appearing in the midst, whilst the distant Dartmoor hills stood out calm in unbroken sunshine. No movement of the air could be detected, but, below, the surface of the fog seemed as if being rolled along by a wind from the east towards the river valley. The white fog-bow is seldom seen, and I imagine owes its absence of colour to the minuteness and close proximity of the water globules, allowing the divided rays to coalesce and so again form white light.

C. O. BUDD.

Atmospheric Effects at Sunset.

ON Sunday, January 8, upon leaving the house at half-past four in the afternoon, I observed that the clouds were suffused with a kind of pink or lurid coppery tinge, a sort of angry sunset tint spread over the whole sky. The clouds were of the stratus type which is common in a winter anticyclone, but were moving or rather driving with a swiftness quite unusual under such conditions. The barometer was very high and rising rapidly; but during the afternoon there were several violent and noisy gusts of wind almost amounting to squalls, though during the greater part of the day the atmosphere was still almost to stagnation. The air was mild and intensely humid, and everything was dripping with moisture. In fact the weather was in many particulars the opposite of what we expect during the prevalence of an anticyclone. The diffused sunset effects were quite unlike anything I ever remember to have witnessed before. The gas-lamps had just been lit, and the flames not only appeared of a greenish tint, but seemed to be inclosed in green glass. Several persons stopped me in the street and inquired what it all meant, and one acquaintance said, "What is going to happen?" In the green tint of the gas there is, of course, some suggestion of a colour complementary to the strange red glow which seemed to pervade the atmosphere. But in the absence of all, even the most rudimentary, knowledge of the subject, I should be glad if you or some of your readers can explain the cause to me and to others who witnessed the unaccustomed phenomenon.

CHARLES CROFT.

Prestwich, near Manchester, January 9.

Newton's "Principia."

IT may perhaps interest your readers to know that the 200th anniversary of the publication of Newton's "Principia" was solemnly celebrated on December 20 (old style) by a united meeting of two learned Societies of Moscow—the Imperial Society of Friends of Natural Knowledge, and the Mathematical Society. Prof. Mendeléeff, of St. Petersburg, was Honorary President. Prof. Stoletow (President of the Physical Section in the first-named Society) presented a sketch of Newton's life, and spoke on his optical discoveries; Prof. Zinger (President of the Mathematical Society) treated Newton's mathematical work; Prof. Joukowski pointed out his merits as founder of rational dynamics; and Prof. Ceraski exhibited the creation of celestial mechanics by Newton. The large hall of the Polytechnic Museum, where the meeting took place, was attended by the *élite* of the city. The lectures were illustrated by some optical experiments with electric light and some lantern-slides relative to Newton's biography.

A. STOLETOW.

University of Moscow, December 21, 1887
(January 2, 1888).

Meteors.

IN the moonlight on the evening of January 2, at 10h. 58m., a fine meteor, equal in brightness to Jupiter, was observed by Mr. D. Booth at Leeds, and by myself at Bristol. As seen from Leeds, the meteor passed from Musca to the head of Cetus, and terminated its course about 3° east of α Ceti. It moved rather quickly, leaving a long thin train. The fore-part of the nucleus was tinted with red, but the train was yellow. At the finish the motion became slower. At Bristol the meteor was first seen when about 6° S.E. of ζ Draconis, and it travelled some 8° in the direction of β Cephei. Colour yellow, motion very slow. The course was evidently much foreshortened close to its radiant.

Comparing the two paths, it will be found that they intersect each other at 250° + 57°, so that the meteor was not a member of the January Quadrantids, which attain a maximum on January 2, but belonged to a neighbouring shower of Draconids, which, between January 14 and 19, I have previously observed at 253° + 56°. The meteor appears to have been observed earlier in its flight at Bristol than at Leeds, for at the latter place the observer was watching the southern sky, and only caught the later part of the course. From a mean of the two observations the height at commencement was 98 miles above a point west of Appleby, Westmoreland, and the end occurred at 60 miles above Chester. The earth-point was near Tiverton, in Devonshire. The real length of path was 109 miles, and it was inclined at an angle of 20½° to the horizon. The meteor was travelling in a direction from north to south, the bearing of the radiant being N. 8½° E.

It would be interesting to hear of further observations of this bright meteor. It must have been seen by many persons, as the night was very clear.

The fireball of February 21, 1865, had a radiant at 255° + 55°, and close to that of the meteor of January 2 last, but the difference of date is too considerable to permit an inference that the wo bodies diverged from the same stream.

January 8. W. F. DENNING.

IN NATURE, November 10, p. 36, it is stated in reference to a meteor that "a Norwegian astronomer" is of the opinion that the track of the meteor must have lain too high to be heard. "He calculates from the reports to hand that the bursting of the meteor occurred at an altitude of about 6000 feet (*sic*), and he thinks that even this figure may be safely doubled."

It may interest some of your readers to know that on the night of July 3, 1884, at 8.27 p.m. standard time of the 75th meridian, a meteor was seen by me, as well as by others, here, and about 5m. 17s. afterwards a sound was heard something like distant thunder, except that it seemed to swell rapidly and steadily to a maximum intensity, and then diminish again in much the same way, but more slowly. I immediately connected the sound with the appearance of the meteor, and stated that it must have been a little over sixty miles distant, and from the estimated angle of elevation about *thirty miles* above the surface of the earth. This estimate was borne out by the accounts from other places of the course of the meteor. The sound I should be inclined to attribute to the rushing together of the air in the wake of the meteor, or perhaps more probably to the sudden compression of the air in front of it, and not to its bursting.

The following account of the meteor was given in the *Canadian Weather Review* of July 1884:—"A magnificent meteor was seen on the night of the 3rd at 8.27 p.m. standard time, passing from south-east to north-west, colours brilliant red and green. Two distinct explosions are reported to have been heard. After the first explosion a sinuous streak remained visible until covered by clouds; the time of flight was from seven to eight seconds, and the apparent size about one-fourth that of the moon. Reports have been received from Listowel, Hastings, Beatrice, Belleville, Lakefield, Pembroke, Peterborough, Kingston, Deseronto, Lindsay, and Huntingdon, all substantially agreeing as to course, size, &c.; it passed two or three miles south of Belleville, and about the same distance north of Lindsay." CHARLES CARPMAEL.

Toronto, December 16, 1887.

The Electrification of the Air.

IN writing upon the electrical condition of the Peak of Teneriffe, the Hon. Ralph Abercrombie (NATURE, vol. xxxvii. p. 31), begins by stating that "the limited number of observations on atmospheric electricity which have been already made all point, with one exception, to a normal positive difference of potential between a point some few feet above the earth and the ground itself;" and farther on he writes: "the electrical conditions of the Peak of Teneriffe [the one exception] were the same as in every other part of the world." As similar statements still find their way into text-books and treatises on electricity and meteorology, I trust you will permit me to point out that, unless a very special meaning be attached to the word "normal," this generalization is decidedly too wide.

In a paper read at the Aberdeen meeting of the British Association in 1885 (printed *Phil. Mag.*, November 1885), I pointed out that, in Madras at least, a negative electrification of the air was a normal, and not an abnormal, condition for many hours of the day at certain seasons of the year. Observations since taken have entirely confirmed the opinion that with a hot, dry, west wind the air at Madras is usually negatively electrified, and often to a very high potential.

With regard to observations made on mountains in the tropics, though perhaps hardly within what Mr. Abercromby terms "the zone of constant electrical discharge," I would venture to call his attention to a short paper on observations made on the top of Dodabetta (8642 feet) in the Transactions of the Royal Society of Edinburgh, vol. xxxii. p. 583.

I may add that during the periods of incessant discharges of sheet lightning which we often experience here the electrification of the air is sometimes positive and at other times negative, but generally positive. C. MICHIE SMITH.

Madras Christian College, Madras, December 14, 1887.

Wind Force at Sea.

PROF. WALDO, in the *American Meteorological Journal* for October, recommends the use of instruments for determining the velocity of the wind at sea. In a paper read before the Meteorological Society, I discussed the comparative results, obtained from a great number of observations under all conditions at sea, between two very simple and small anemometers, showing that, although the two instruments were on entirely different principles, the results obtained differed only by about 10 per cent. In a paper read in March last before the Meteorological Society, "Notes on taking Observations at Sea, &c.," I again urged the desirability of observers using some form of anemometer, so that more uniform results could be obtained, and I gave a table for correcting the apparent velocity of the wind as registered by the instrument for the speed of the ship and for aberration.

For instance, at the present time you may have two sailing-ships close together, one carrying top-gallant-sails, the other only reefed top-sails, and the wind will be logged accordingly. Again, two steamers going in opposite directions are very likely to experience apparently different wind velocities, and the senses of officers in steamers are not so acute for detecting differences in wind velocities as are those of officers in sailing-ships. The use of instruments would eliminate these errors.

With instruments similar to those I use—the coefficient of friction of which is slight—the relative velocity of the wind may be obtained fairly accurately; and I contend that this is of more importance than the chance there is of obtaining the estimated true velocity; and, I may add, the trouble attending the use of these instruments is small.

There are two other subjects which, up to the present, have received little attention at sea, viz. the registration of rainfall and the electrical condition of the atmosphere. Observations on both could easily be carried out on board some ships, and the observations would be both valuable and interesting.

DAVID WILSON-BARKER.

A Troublesome Parasite of a Brittle-Starfish.

IN a valuable work on certain parasitic Crustacea ("Contributions à l'Etude des Bopyriens," p. 181), Prof. A. Giard and J. Bonnier have done me the honour of calling attention to my discovery of a Copepod (?) which lives in the body of an Ophiuran, *Amphiura squamata*. They regard the mutual relationship of the Copepod and the Ophiuran as an instance of the castration of the host by the parasite. Although all my observations indicate the correctness of some such an interpretation, I failed to recognize it as a fact until after they had pointed it out. The explanation seems a possible one, and is provisionally accepted, with a few modifications, as the best as far as research has gone. The modifications are important.

The state of knowledge of the subject is as follows. Ova and young of a Crustacean are found in the body of an American brittle-star, identified as *Amphiura squamata*. In some instances an adult Crustacean was also found in the same place. When these ova, young, or adults are found parasitic in the Amphiura, the remains of the ovary of the host appear as an amorphous mass, and there is no possibility of future young of the Amphiura in the brood sac, since the ova have been destroyed.

The conclusion seems inevitable, for observations indicate that the mother Crustacean makes her way somehow into the body of the host (Amphiura), then affects the brittle-star so that the young of the host will not develop, after which she leaves packets of ova to mature in the sacs where normally young Amphiuræ would develop. It thus happens that the products of the ovary of the host are destroyed before the Crustacean ova are developed, or while they are in an early stage of cleavage. Consequently it is legitimate to conclude that if the ova of the host is destroyed it may be done by the adult Crustacean.

If Prof. Giard and Bonnier are right in their interpretation that this is an instance of parasitic castration, as I think they are, we possibly have an interesting case of a parasite destroying the reproductive powers of the host *for the future good of her own offspring*. Such a condition of things is unique, and among Ophiurans the writer recalls but the single instance of the present case of Amphiura. The case of the Crustacean and its brittle star host seems to differ from that of Entoniscus in that in the one instance the destruction of the ovary may be of advantage to the parasite, while in the other the destruction or modification of the spermary of the host is simply a concomitant circumstance of the parasitism. It seems hard to believe that the simple presence of the packets of Crustacean ova in the brood sac of an Amphiura would lead to a destruction of the ova of the brittle-star, but it does not seem impossible that the adult Crustacean could have spayed the Amphiura.

The character of this phenomenon is so unusual that one hesitates to accept it on insufficient data. There are gaps in my observations which may be serious to the theory. In the first place, it has not been observed that the Crustacean spayed the Amphiura. The ovarian gland of the brittle-star is destroyed, and indications point to the Crustacean as the culprit. Secondly, it is not known that the parasite enters the *brood sac* through the genital slits to deposit the ova. Thirdly, the difficulties of determination whether the ova are in the body cavity, stomach walls, or brood sac, are very great. I believe it is probable that they are in the brood sac. Lastly, the family name of the strange parasite who repays hospitality so ungraciously is unknown. There is no doubt that it is a Crustacean, as I have traced the egg through a nauplius into an adult.

As this condition of life is believed to be a novel one, and needs verification, the writer takes this opportunity to call the attention of marine zoologists to it, and to request correspondence from anyone who may have made similar observations. Before we can definitely accept the conclusions towards which my observations lead, there is a call for re-examination and verification of the observations. The most important question is to determine whether or not the ova of the Crustacean live in the brood sac.

Cambridge, Mass., U.S.A. J. WALTER FEWKES.

Raised Beaches *versus* High-Level Beaches.

IF you can find space for the subjoined list of shells from the ancient beach on the Thatcher rock in Torbay, it may prove acceptable to such geologists as interest themselves in the question recently resuscitated by Prof. McKenny Hughes, as to whether the ancient Devonshire beaches are "raised," as commonly supposed, or merely high-level, as some hold them to be.

Added to the late Mr. Godwin Austen's "Hope's Nose" list, my list runs up the total number of species from the two beaches to forty-six, and this without reckoning Mr. Godwin Austen's *Cardium tuberculatum*, which I think must have been an oversight for *C. echinatum*. This number has not, I believe, been beaten by any British raised beach hitherto.

When the Thatcher beach was accumulated, the northern shell *Trophon truncatus* was abundant in the neighbourhood; so was *Tellina balthica*, a shell which only occurs, I believe, in this vicinity, in or near the tidal harbours of Torbay.

The Thatcher collection evidences the great antiquity of the beach, a considerable change of temperature, differences in the rock-components of the coast-line, and variation in its contour. Of these subjects I hope some day to treat, but in the meantime the facts so far as they have been ascertained are presented to geologists in the following list of shells for them to deal with as they please:—

Ostræa edulis	*Litorina obtusata*
Pinna rudis	*L. rudis*
Mytilus edulis	*L. litorea*
M. modiolus	*Turritella terebra*
Nucula nucleus	*Scalaria turtonæ*
Cardium echinatum	*Natica alderi*
C. edule	*Adeorbis subcarinatus*
C. norvegicum	*Cerithium reticulata*
Cyprina islandica	*Purpura lapillus*
Astarte sulcata	*Buccinum undatum*
Venus exoleta	*Murex erinaceus*
V. fasciata	*Trophon truncatus*
V. gallina	*Fusus gracilis*
Tellina balthica	*F. jeffreysianus*
Lutraria elliptica	*Nassa reticulata*
Mactra subtruncata	*N. incrassata*
Solen vagina	*Pleurotoma striolata*
Mya arenaria	*P. brachystoma*
Saxicava rugosa	*P. turricula*
	Cylichna cylindracea
Patella vulgata	
Trochus zizyphinus	42 species.
Lacuna puteolus	

The shells have been identified in odd lots and at different times by the late Mr. Gwyn Jeffreys, Mr. J. T. Marshall, and Mr. D. Pidgeon, to whom my warmest thanks have been due. The bulk of the work has, however, been done by the last-named gentleman, without whose hearty co-operation, both in searching the beach material and naming the shells and fragments found therein, the list would have been shorn of much of its goodly proportions. A. R. HUNT.

Torquay, December 28, 1887.

Vegetation and Moonlight.

THE letter of your Trinidad correspondent, given in NATURE, vol. xxxvi. p. 586, referring to a Committee appointed to determine moon influence, has a practical interest for me. Among the wood-cutters in Cape Colony, both east and west, there is a fixed belief, which no arguments can turn, that to cut timber at, or shortly after, full moon, is to cut it when the sap is up; and when, consequently, it is out of season. The same belief prevails in various parts of Southern India, notably in Travancore. I have always combated the belief, pending time and opportunity to test it, indulging in the provisional hypothesis that the bush-workers' belief may be due to the fact that they can only work by night at or near full moon; and that at night trees should contain more sap than by day, when watery exhalation is active.

It seems possible that in the habitually cloudless nights of certain countries the moon may exert influences not noticeable elsewhere. It is well known in Cape Colony that fish, pork, and other provisions go bad if left exposed to moonlight; though possibly this may be due to the light acting as a guide to insects. D. E. HUTCHINS,

Cape Colony, December 8, 1887. Conservator of Forests.

Centre of Water Pressure.

DR. ROUTH has done me the favour of pointing out that in the first volume of his "Rigid Dynamics" he has given the following very simple result with regard to the centre of pressure of a triangle occupying any position in a liquid:—"This point is the centre of gravity of three particles at the middle points of the sides, with masses proportional to their depths."

This result of Dr. Routh's is one of many very remarkable theorems of integration published by him in the *Quarterly Journal*, No. 83, 1886. GEORGE M. MINCHIN.

A New Magnetic Survey of France.

IT should not be difficult to do foreigners justice without belittling our own countrymen, and *a fortiori* without robbing any of the latter of their birthright.

In Prof. Thorpe's paper in last week's NATURE there occurs the sentence, "Even the surveys of their own country (France) have been made for them by Germans and Englishmen." This sentence taken in connection with the opening paragraph of the paper conveys the unfortunate impression that Von Lamont, the author of the "Untersuchungen über die Richtung und Stärke des Erdmagnetismus . . ." and of numerous other similar works, was a German, the truth being that he was merely a "Scot abroad" (see NATURE, vol. xx. p. 425). T. M.

Bothwell, Glasgow, January 14.

TIMBER, AND SOME OF ITS DISEASES.[1]

V.

IT has long been known that timber which has been felled, sawn up, and stored in wood-yards, is by no means necessarily beyond danger, but that either in the stacks, or even after it has been employed in building construction, it may suffer degeneration of a rapid character from the disease known generally as "dry-rot." The object of the present paper is to throw some light on the question of dry-rot, by summarizing the chief results of recent botanical inquiries into the nature and causes of the disease—or, rather, diseases, for it will be shown that there are several kinds of "dry-rot."

[1] Continued from p. 254.

The usual signs of the ordinary dry-rot of timber in buildings, especially deal-timber or fir-wood, are as follows. The wood becomes darker in colour, dull yellowish-brown instead of the paler tint of sound deal; its specific weight diminishes greatly, and that this is due to a loss of substance can be easily proved directly. These changes are accompanied with a cracking and warping of the wood, due to the shortening of the elements as water evaporates and they part from one another: if the disease affects one side of a beam or plank, these changes cause a pronounced warping or bending of the timber, and in bad cases it looks as if it had been burnt or scorched on the injured side. If the beam or plank is wet, the diseased parts are found to be so soft that they can easily be cut with a knife, almost like cheese; when dry, however, the touch of a hard instrument breaks it into brittle fibrous bits, easily crushed between the fingers to a yellow-brown, snuff-like powder. The timber has by this time lost its coherence, which, as we have seen, depends on the firm interlocking and holding together of the uninjured fibrous elements, and may give way under even light loads—a fact only too well known to builders and tenants. The walls of the wood-elements (tracheides, vessels, fibres,

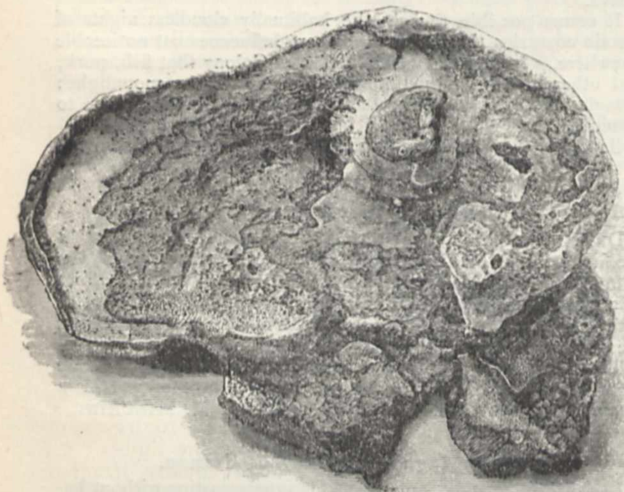

FIG. 17.—Portion of the mycelium of *Merulius lacrymans* removed from the surface of a beam of wood. This cake-like mass spreads over the surface of the timber, to which it is intimately attached by hyphæ running in the wood-substance. Subsequently it develops the spore-bearing areolæ near its edges. The shading indicates differences in colour, as well as irregularities of surface.

or cells, according to the kind of timber, and the part affected) are now, in fact, reduced more or less to powder, and if such badly diseased timber is placed in water it rapidly absorbs it and sinks: the wood in this condition also readily condenses and absorbs moisture from damp air, a fact which we shall see has an important bearing on the progress of the disease itself.

If such a piece of badly diseased deal as I have shortly described is carefully examined, the observer is easily convinced that fungus filaments (mycelium) are present in the timber, and the microscope shows that the finer filaments of the mycelium (hyphæ) are permeating the rotting timber in all directions—running between and in the wood elements, and also on the surface, much as in the case shown in Fig. 17. In a vast number of cases, longer or shorter, broader or narrower, cords of grayish-white mycelium may be seen coursing on the surface and in the cracks: in course of time there will be observed flat cake-like masses of this mycelium, the hyphæ being woven into felt-like sheets, and these may be extending themselves on to neighbouring pieces of timber, or even on the brick-work or ground on which the timber is resting. These cord-like strands and cake-like masses of felt, with their innumerable fine filamentous continuations in the wood, constitute the vegetative body or mycelium of a fungus known as *Merulius lacrymans*. Under certain circumstances, often realized in cellars and houses, the cakes of mycelium are observed to develop the fructification of the fungus, illustrated in Fig. 18.

To understand the structure of this fructification we may contrast it with that of the *Polyporus* or *Trametes* referred to in the last article; where in the latter we find a number of pores leading each into a tubular cavity lined with the cells which produce the spores, the *Merulius* shows a number of shallow depressions lined by the sporogenous cells. The ridges which separate these depressed areolæ have a more or less zigzag course, running together, and sometimes the whole presents a likeness to

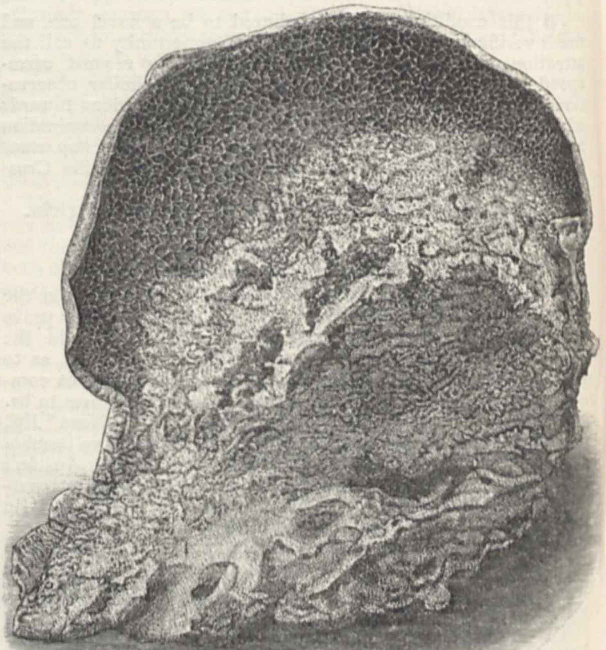

FIG. 18.—Mature fructification of *Merulius lacrymans*. The cake-like mass of felted mycelium has developed a series of areolæ (in the upper part of the figure), on the walls of which the spores are produced. In the natural position this spore-bearing layer is turned downwards, and in a moist environment pellucid drops or "tears" distil from it. The barren part in the foreground was on a wall, and the remainder on the lower side of a beam: the fungus was photographed in this position to show the structure.

honey-comb; if the ridges were higher, and regularly walled in the depressed areas, the structure would correspond to that of a *Polyporus* in essential points. The spores are produced in enormous numbers on this areolated surface, which is directed downwards, and is usually golden-brown, but may be dull in colour, and presents the remarkable phenomenon of exuding drops of clear water, like tears, whence the name *lacrymans*. In well-grown specimens, such as may sometimes be observed on the roof of a cellar, these crystal-like tears hang from the areolated surface like pendants, and give an extraordinarily beautiful appearance to the whole; the substance of the glistening *Merulius* may then be like shot-velvet gleaming with bright tints of yellow, orange, and even purple.

It has now been demonstrated by actual experiment that the spores of the fungus, *Merulius lacrymans*, will germinate on the surface of damp timber, and send their germinal filaments into the tracheids, boring through the cell-walls, and extending rapidly in all directions. The fungus mycelium, as it gains in strength by feeding upon the substance of these cell-walls, destroys the wood by a process very similar to that already described (compare Fig. 14, Article III.).

It appears, however, from the investigations of Poleck and Hartig, that certain conditions are absolutely necessary for the development of the mycelium and its spread in the timber, and there can be no question that the intelligent application of the knowledge furnished by the scientific elucidation of the biology of the fungus is the key to successful treatment of the disease. This is, of course, true of all the diseases of timber, so far as they can be dealt with at all, but it comes out so distinctly in the present case that it will be well to examine a little at length some of the chief conclusions.

Merulius, like all fungi, consists of relatively large quantities of water—50 to 60 per cent. of its weight at least—together with much smaller quantities of nitrogenous and fatty substances and cellulose, and minute but absolutely essential traces of mineral matters, the chief of which are potassium and phosphorus. It is not necessary to dwell at length on the exact quantities of these matters found by analysis, nor to mention a few other bodies of which traces exist in such fungi. The point just now is that all these materials are formed by the fungus at the expense of the substance of the wood, and for a long time there was considerable difficulty in understanding how this could come about.

The first difficulty was that although the "dry-rot fungus" could always be found, and the mycelium was easily transferred from a piece of diseased wood to a piece of healthy wood provided they were in a suitable warm, damp, still atmosphere, no one had as yet succeeded in causing the spores of the *Merulius* to germinate, or in following the earliest stages of the disease. Up to about the end of the year 1884 it was known that the spores refused to germinate either in water or in decoctions of fruit; and repeated trials were made, but in vain, to see them actually germinate on damp wood, until two observers, Poleck and Hartig, discovered about the same time the necessary conditions for germination. It should be noted here that this difficulty in persuading spores to germinate is by no means an isolated instance: we are still ignorant of the conditions necessary for the germination of the spores of many fungi—*e.g.* the spores of the mushroom, according to De Bary; and it is known that in numerous cases spores need very peculiar treatment before they will germinate. The peculiarity in the case of the spores of *Merulius lacrymans* was found by Hartig to be the necessity of the presence of an alkali, such as ammonia; and it is found that in cellars, stables, and other outhouses where ammoniacal or alkaline emanations from the soil or elsewhere can reach the timber, there is a particularly favourable circumstance afforded for the germination of the spores. The other conditions are provided by a warm, still, damp atmosphere, such as exists in badly ventilated cellars, and corners, and beneath the flooring of many buildings.

Careful experiments have shown beyond all question that the "dry-rot fungus" is no exception to other fungi with respect to moisture: thoroughly dry timber, so long as it is kept thoroughly dry, is proof against the disease we are considering. Nay, more, the fungus is peculiarly susceptible to drought, and the mycelial threads and even the young fructifications growing on the surface of a beam of timber in a damp close situation may be readily killed in a day or two by letting in thoroughly dry air: of course, the mycelium deeper down in the wood is not so easily and quickly destroyed, since not only is it more protected, but the mycelial strands are able to transport moisture from a distance. Much misunderstanding prevails as to the meaning of "dry air" and "dry wood": as a matter of fact, the air usually contains much moisture, especially in cellars and quiet corners devoid of draughts, such as *Merulius* delights in, and we have already seen how dry timber rapidly absorbs moisture from such air. Moreover, the strands of mycelium may extend into damp soil, foundations, brick-work, &c.; in such cases they convey moisture to parts growing in apparently dry situations.

A large series of comparative experiments, made especially by Hartig, have fully established the correctness of the conclusion that damp foundations, walls, &c., encourage the spread of dry-rot, quite independently of the quality of the timber. This is important, because it has long been supposed that timber felled in summer was more prone to dry-rot than timber felled in winter: such, however, is not shown to be the case, for under the same conditions both summer- and winter-wood suffer alike, and decrease in weight to the same extent during the progress of the disease. There is an excellent opportunity for further research here however, since one observer maintains that in one case at any rate (*Pinus sylvestris*) the timber felled at the end of April suffered from the disease, whereas that felled in winter resisted the attacks of the fungus: internal evidence in the published account supports the suspicion that some error occurred here. The wood which succumbed was found to contain much larger quantities of potassium and phosphorus (two important ingredients for the fungus), and Poleck suggests that this difference in chemical constitution explains the ease with which his April specimens were infected.

It appears probable from later researches and criticism that Poleck did not choose the same parts of the two stems selected for his experiments, for (in the case of *Pinus sylvestris*) the heart-wood is attacked much less energetically than the sap-wood—a circumstance which certainly may explain the questionable results if the chemist paid no attention to it, but analyzed the sap-wood of one and the heart-wood of the other piece of timber, as he seems to have done.

The best knowledge to hand seems to be that no difference is observable in the susceptibility to dry-rot of winter-wood and summer-wood of the same timber; *i.e. Merulius lacrymans* will attack both equally, if other conditions are the same.

But air-dry and thoroughly seasoned timber is much less easily attacked than damp fresh-cut wood of the same kind, both being exposed to the same conditions.

Moreover, different timbers are attacked and destroyed in different degrees. The heart-wood of the pine is more resistant than any spruce timber. Experimental observations are wanted on the comparative resistance of oak, beech, and other timbers, and indeed the whole question is well worth further investigation.

When the spore has germinated, and the fungus hyphæ have begun to grow and branch in the moist timber, they proceed at once to destroy and feed upon the contents of the medullary rays; the cells composing these contain starch and saccharine matters, nitrogenous substances, and inorganic elements, such as potassium, phosphorus, calcium, &c. Unless there is any very new and young wood present, this is the only considerable source of proteid substances that the fungus has: no doubt a little may be obtained from the resin-passages, but only the younger ones. In accordance with this a curious fact was discovered by Hartig: the older parts of the hyphæ pass their protoplasmic contents on to the younger growing portions, and so economize the nitrogenous substances. Other food-substances are not so sparse; the lignified walls inclose water and air, and contain mineral salts, and such organic substances as coniferin, tannin, &c., and some of these are absorbed and employed by the fungus. Coniferin especially appears to be destroyed by the hyphæ.

The structure of the walls of the tracheides and cells of the wood is completely destroyed as the fungus hyphæ extract the minerals, cellulose, and other substances from them. The minerals are absorbed at points of contact between the hyphæ and the walls, reminding us of the action of roots on a marble plate: the coniferin and other organic substances are no doubt first rendered soluble by a ferment, and then absorbed by the hyphæ. This excretion of ferment has nothing to do with the excretion of water in the liquid state, which gives the fungus its specific name: the "tears" themselves have no solvent action on wood.

It will be evident from what has been stated that the practical application of botanical knowledge is here not only possible, but much easier than is the case in dealing with many other diseases.

It must first be borne in mind that this fungus spreads, like so many others, by means of both spores and mycelium: it is easy to see strands of mycelium passing from badly-diseased planks or beams, &c., across intervening brick-work or soil, and on to sound timber, which it then infects. The spores are developed in countless myriads from the fructifications described, and they are extremely minute and light: it has been proved that they can be carried from house to house on the clothes and tools, &c., of workmen, who in their ignorance of the facts are perfectly careless about laying their coats, implements, &c., on piles of the diseased timber intended for removal. Again, in replacing beams, &c., attacked with dry-rot, with sound timber, the utmost ignorance and carelessness are shown: broken pieces of the diseased timber are left about, whether with spores on or not; and I have myself seen quite lately sound planks laid close upon and nailed to planks attacked with the "rot." Hartig proved that the spores can be carried from the wood of one building to that of another by means of the saws of workmen.

But perhaps the most reckless of all practices is the usage of partially diseased timber for other constructive purposes, and stacking it meanwhile in a yard or outbuilding in the neighbourhood of fresh-cut, unseasoned timber. It is obvious that the diseased timber should be removed as quickly as possible, and burnt at once: if used as firewood in the ordinary way, it is at the risk of those concerned. Of course the great danger consists in the presence of many ripe spores, and their being scattered on timber which is under proper conditions for their germination and the spread of the mycelium.

It is clearly an act approaching those of a madman to use fresh "green" timber for building purposes; but it seems certain that much improperly dried and by no means "seasoned" timber is employed in some modern houses. Such wood is peculiarly exposed to the attacks of any spores or mycelium that may be near.

But even when the beams, door-posts, window-sashes, &c., in a house are made of properly dried and seasoned deal, the danger is not averted if they are supported on damp walls or floors. For the sake of illustration I will take an extreme case, though I have no doubt it has been realized at various times. Beams of thoroughly seasoned deal are cut with a saw which has previously been used for cutting up diseased timber, and a few spores of *Merulius* are rubbed off from the saw, and left sticking to one end of the cut beam: this end is then laid on or in a brick wall, or foundation, which has only stood long enough to partially dry. If there is no current of dry air established through this part, nothing is more probable than that the spores will germinate, and the mycelium spread, and in the course of time—it may be months afterwards—a mysterious outbreak of dry-rot ensues. There can be no question that the ends of beams in new houses are peculiarly exposed to the attacks of dry-rot in this way.

The great safeguard—beyond taking care that no spores or mycelium are present from the first—is to arrange that all the brick-work, floors, &c., be thoroughly dry before the timber is put in contact with them; or to interpose some impervious substance—a less trustworthy method. Then it is necessary to aërate and ventilate the timber; for *dry* timber *kept dry* is proof against "dry-rot."

The ventilation must be real and thorough however, for it has been by no means an uncommon experience to find window-sashes, door-posts, &c., in damp buildings, with the insides scooped out by dry-rot, and the aërated outer shells of the timber quite sound: this is undoubtedly often due to the paint on the outer surfaces preventing a thorough drying of the deeper parts of the wood.

Of course the question arises, and is loudly urged, Is there no medium which will act as an antiseptic, and kill the mycelium in the timber in the earlier stages of the disease? The answer is, that mineral poisons will at once kill the mycelium on contact, and that creosote, &c., will do the same; but who will take the trouble to thoroughly impregnate timber in buildings such as harbour dry-rot? And it is simply useless to merely paint these specifics on the surface of the timber: they soak in a little way, and kill the mycelium on the outside, but that is all, and the deadly rot goes on destroying the inner parts of the timber just as surely.

There is one practical suggestion in this connection, however; in cases where properly seasoned timber is used, the beams laid in the brick walls might have their ends creosoted, and if thoroughly done this would probably be efficacious during the dangerous period while the walls finished drying. I believe this idea has been carried out lately by Prof. Hartig, who told me of it. The same observer was also kind enough to show me some of his experiments with dry-rot and antiseptics: he dug up and examined in my presence glass jars containing each two pieces of deal—one piece sound, and the other diseased. The sound pieces had been treated with various antiseptics, and then tied face to face with the diseased pieces, and buried in the jar for many months or even two years.

However, I must now leave this part of the subject, referring the reader to Hartig's classical publications for further information, and pass on to a sketch of what is known of other kinds of "dry-rot." It is a remarkable fact, and well known, that *Merulius lacrymans* is a domestic fungus, peculiar to dwelling-houses and other buildings, and not found in the forest. We may avoid the discussion as to whether or no it has ever been found wild: one case, it is true, is on record on good authority, but the striking peculiarity about it is that, like some other organisms, this fungus has become intimately associated with mankind and human dwellings, &c.

The case is very different with the next disease-producing fungus I propose to consider. It frequently happens that timber which has been stacked for some time in the wood-yards shows red or brown streaks, where the substance of the timber is softer, and in fact may be "rotten": after passing through the saw-mill these streaks of bad wood seriously impair the value of the planks, beams, &c., cut from the logs

Prof. Hartig, who has devoted much time to the investigation of the various forms of "dry-rot," informs me that this particular kind of red or brown streaking is due to the ravages of *Polyporus vaporarius*. The mycelium of this fungus destroys the structure of the wood in a manner so similar to that of the *Merulius* that the sawyers and others do not readily distinguish between the two. The mycelium of *Polyporus vaporarius* forms thick ribbons and strands, but they are snowy white, and not gray like those of *Merulius lacrymans*: the structure, &c., of the fructification are also different. I have shown in Fig. 19 a piece of wood undergoing destruction from the action of the mycelium of this *Polyporus*, and it will be seen how the diseased timber cracks just as under the influence of *Merulius*.

Now *Polyporus vaporarius* is common in the forests, and Hartig has found that its spores may lodge in cracks in the barked logs of timber lying on the ground—cracks such as those in Fig. 1 (see p. 182). In the particular forests of which the following story is told, the felling is accomplished in May (because the trunks can then be readily barked, and also because such work cannot be carried on there in the winter), and the logs remain exposed to the sun and rain, and vicissitudes of weather generally, for some time. Now it is easy to see that rain may easily wash spores into such cracks as those referred to, and the fungus obtains its hold of the timber in this way.

The next stage is sending the timber down to the timber-yards, and this is accomplished, in the districts referred to, by floating the logs down the river. Once in the river, the wood swells, and the cracks close up; but the fungus spores are already deeply imprisoned in the cracks, and have no doubt by this time emitted their germinal hyphæ, and commenced to form the mycelium. This may or may not be the case: the important point is simply hat the fungus is already there. Having arrived at the

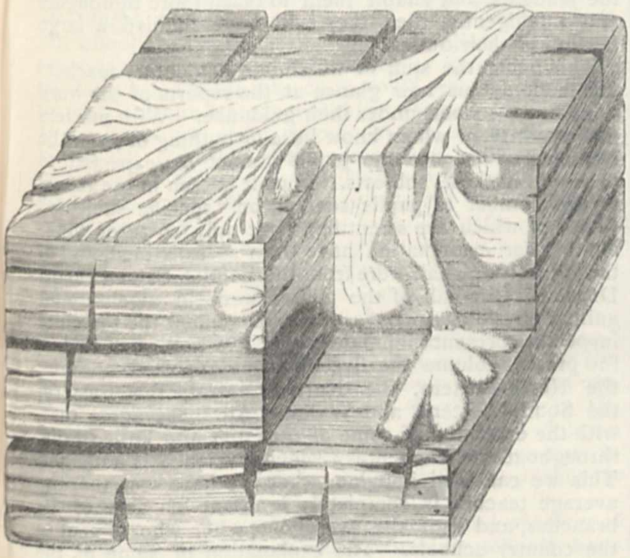

FIG. 19.—A piece of pine-wood attacked by the mycelium of *Polyporus vaporarius*. The timber has warped and cracked under the action of the fungus, becoming of a warm brown colour at the same time; in the crevices the white strands of felt-like mycelium have then increased, and on splitting the diseased timber they are found creeping and applying themselves to all the surfaces. Except that the colour is snowy white, instead of gray, this mycelium may easily be mistaken for that of *Merulius*. The fructification which it develops is, however, very different. (After R. Hartig.)

timber-wharves, the logs are stacked for sawing in heaps as big as houses: after a time the sawing up begins. It usually happens that the uppermost logs when cut up show little or no signs of rot; lower down, however, red and brown streaks appear in the planks, and when the lowermost logs are reached, perhaps after some weeks or months, deep channels of powdery, rotten wood are found, running up inside the logs in such a way that their transverse sections often form triangles or V-shaped figures, with the apex of the triangle or V turned towards the periphery of the log.

The explanation is simple. The uppermost logs on the stack have dried sufficiently to arrest the progress of the mycelium, and therefore of the disease: the lower logs, however, kept damp and warm by those above, have offered every chance to the formation and spread of the mycelium deep down in the cracks of the timber. I was much impressed with this ingenious explanation, given to me personally by Prof. Hartig, and illustrated by actual specimens. It will be noticed how fully it explains the curious shape of the rotten courses, because the depths of the cracks are first diseased, and the mycelium spreads thence.

Obviously some protection would be afforded if the bark could be retained on the felled logs, or if they could be at once covered and kept covered after barking; and, again, something towards protection might be done by carting instead of floating the timber, when possible. At the same time, this is not a reliable mode of avoiding the disease by itself; and even the dry top logs in the saw-yard are not safe. Suppose the following case. The top logs of the stack are quite dry, and are cut into beams and used in building; but they have spores or young mycelium trapped in the cracks at various places. If, from contact with damp brick-work or other sources of moisture, these spores or mycelia are enabled to spread subsequently, we may have "dry-rot" in the building; but this "dry-rot" is due to *Polyporus vaporarius*, and not to the well-known *Merulius lacrymans*.

There can probably be no question of the advantage of creosoting the ends of such rafters, beams, &c.; since the creosote will act long enough to enable the timber to dry, if it is ever to dry at all. But the mycelium of *Polyporus vaporarius* makes its way into the still standing timber of pines and firs; for it is a wound-parasite, and its mycelium can obtain a hold at places which have been injured by the bites of animals, &c.: it thus happens that this form of "dry-rot" is an extremely dangerous and insidious one, and I have little doubt that it costs our English timber-merchants something, as well as Continental ones. Nor are the above the only kinds of "dry-rot" we know. Hartig has described a disease of pine-wood caused by *Polyporus mollis*, which is very similar to the last in many respects, and the suspicion may well gain ground that this important subject has by no means been exhausted yet.

H. MARSHALL WARD.

SCIENCE IN ELEMENTARY SCHOOLS.[1]

NOTHING could be more unsatisfactory than the present position of the knowledge and teaching of science in our elementary schools. Notwithstanding all the advantages that have been offered to pupil-teachers for the study of science, as a body they appear to be in a most deplorable state in this respect. Though success in the examinations of the Science and Art Department are now taken into account in placing the students of the training colleges for their teaching certificates, and average school-boys when they have been fairly taught are quite competent for these examinations, yet very few of the teachers have availed themselves of this privilege, and it does not appear that the training colleges have helped them in this respect. Very little, indeed, can be expected while the ordinary pupil-teacher is described, as he is in Mr. Oakeley's report on the working of the Training Colleges, as deficient in many elementary branches, notably mathematics. It is satisfactory, however, to notice that the quality of the candidates for admission to the Training Colleges is improving, and that these institutions are growing in teaching capacity and in popularity. The reports of the examiners for admission are not, with regard to the subject in hand, pleasant reading. One cannot expect good answering in science from candidates who are quite unable to paraphrase an ordinary piece of poetry, or to explain a common English expression. Accordingly we find that in Euclid, algebra, and mensuration, though a few papers were especially meritorious, the vast majority of the answers were very inferior. Few, if any, attempted the easy riders in Euclid, and the examiner remarks that he fears that the pupil-teachers receive but little assistance

[1] "Report of Committee of Council on Education (England and Wales), 1886-87."

from those who superintend their work. It is not easy to say whether this poor teaching or defective early training is at the root of the evil. It is worthy of remark that the metropolitan candidates, in their answers to the questions on Euclid, far surpass their provincial competitors. Many amazing blunders are quite common in the algebra papers, such as subtracting the terms of the numerator from those of the denominator, and completely ignoring the signs, and it is stated that the pupil-teachers at Chester at the end of their apprenticeship were unable to work a simple sum in algebra or to write out an easy proposition Mr. Fitch has a very able report on the Training Colleges for schoolmistresses, and from him it is plain that the same defects exist among the female as among the male pupil-teachers. At the admission examination the work in the arithmetic is satisfactory in point of accuracy, but it displays want of method, failure to appreciate the meaning of the question asked, and ignorance of principles. Thus very few of the candidates were able to give an intelligent explanation of simple arithmetical processes, such as subtraction or division. With them, as with the male pupil-teachers, book-work and memory are wholly relied on, and little attention is paid to the intelligent application of principles. "Scarcely three per cent. are able to do much more in the teaching of arithmetic than work sums more or less correctly on the black-board."

With such material to work on, it is not surprising that the results of the work at the colleges are not what they otherwise might be. Those who are below the average at admission rarely succeed very well in the array of subjects to be learnt in two years' training. With regard to the male students the reports at the close of the first year's training record that the answering of the questions set on the first book of Euclid was disappointing. The students appear to have learnt their propositions by rote, and to have displayed great want of neatness and accuracy. Though the riders were joined to the propositions on which their solution depended, and though all these riders were easy, very few of the papers were satisfactory. This inability to solve the easiest geometrical deductions is commented on again and again, and proves beyond doubt that either the students are negligently taught, or that they commit the book-work to memory without understanding it, and consequently are quite incapable of applying their knowledge to solve the simplest riders. The report for the second year is rather better; few candidates answered very well, and few answered badly, and the majority made a fair percentage of marks; but the same inability to apply their knowledge to the solution of easy deductions in Euclid is recorded. With regard to the answering in algebra and mensuration, there is nothing noticeable except that some students show a discreditable ignorance of the most fundamental questions, while the papers were generally satisfactory.

Summing up the results of the working of our male Training Colleges, Mr. Oakeley gives it as his opinion that the students are over-lectured at some of the colleges, and that the lectures are mechanically reproduced, and transferred as closely as possible to the examination papers. This, of course, is due to the defective early training of the students, and to lectures injudiciously delivered on subjects about which students know absolutely nothing. For instance, one lecturer delivered a very excellent discourse on the corrupt form of Latin used by the Roman soldiers in Britain, its causes and its effects, to a class of which few, if any, of the members knew anything whatever of Latin. Mr. Oakeley also points out one of the greatest defects in the present system of training pupil-teachers when he says that as a rule pupil-teachers see but one school at work; they have no opportunity of comparing the mode of teaching in other schools. This is, however, obviated at Homerton, and partly at Durham, by visiting neighbouring schools during school-hours.

The reports of the examiners on the progress made by the students of the female Training Colleges tell us that in arithmetic, questions on theory and principles are not well done; long problems are inaccurately done, and, as a whole, it is seen that there is yet much remains before it can be said that our present system is satisfactory as regards the knowledge given and the methods adopted. There appears to be among the students a very narrow view of their future work, a desire to regard the obtaining of their certificates as the goal and aim of their existence. The views on science of one of these maidens is worth recording:—"If I am successful in obtaining my certificate, I intend (D.V.) going in for two sciences. At the same time I propose attending a tonic sol-fá class to get my advanced certificate. Should the two sciences 'sound, light, and heat,' and 'electricity and magnetism' prove a success, I shall probably take up the science of hygiene." If the Training Colleges tend to remove the impression that the technical qualification is the end of the pupil-teacher's work, if they awaken a spirit of emulation among the students, aud enable them to teach more thoroughly and intelligently, then they will have fulfilled a large portion of their duties.

This being the stuff of which our elementary teachers are made, let us now glance at the reports of the work done in the schools under their guidance. With masters the majority of whom know little or nothing of even the elements of science the pupils cannot be expected to pass well in these subjects. Thus it is seen in the return of the number of pupils sent up on "specific subjects" (most of which are scientific), that only 16·51 of those eligible for examination have been so examined, and of these nearly one-half were from the London School Board District. One-half of the passes were in algebra and animal physiology. By a new arrangement the ten chief inspectors present biennial reports, five each year, and in the present volume the five divisions reported on are: the North-Eastern, the North Central, the Eastern, the South-Western, and Wales. All these agree that, with the exception of some of the cities and large towns, throughout the elementary schools science is untaught. This we can well imagine, when we have seen that the average teacher is completely ignorant of any of its branches, and it is the average teacher who is sent to the country schools. The explanation of some of the inspectors, that in the country for a great portion of the year the attendance of the children who are fit to be taught these subjects is very irregular, does not meet the question; for, even were the children most regular in their attendance, the subjects could not at present be taught, and until our average elementary teacher is altered they will not be taught. Following the individual reports on the subject, we find in the North-Eastern Division that arithmetic is accurately but unintelligently studied. So utterly mechanical is the teaching that in many schools mental arithmetic is regarded as a separate subject, and not as the adjunct and preliminary of all arithmetic. Having seen the complaints made by the examiners of tho quality of the study of the pupil-teachers, it could only be expected that the same defects would show themselves in the scholars under their charge. Elementary science is unknown in the North-Eastern schools, except in Leeds, Sheffield, Bradford, Newcastle, and Sunderland, where algebra and animal physiology are taken up with fair results. But the inspector remarks that physiology is seldom so taught as to be of any practical benefit, and in the teaching of algebra there is a great want of thoroughness. In the North-Central Division, specific subjects are seldom taken; and about one-half the pupils sent up for examination on them passed. These subjects, taking them in the order of the number of pupils sent up on each, are algebra, magnetism and electricity, physiology, agriculture, and mechanics. In this division "arithmetic is always the most unsatisfactory subject we have to deal with." The teaching of it is dull and mechanical, and the rules are rarely intelligently applied. In this large district there is one bright spot, which shows what can be done by ordinary industry and skill. It is the town of Nottingham, in which 2526 children were examined in specific subjects, of whom four-fifths passed. "Mechanics for boys and domestic economy for girls, are the subjects principally taken by the Nottingham Board Schools, and are taught by a specially qualified science demonstrator and assistant, who visit the various schools in turns, bringing the apparatus with them in a specially constructed hand-cart. The lectures given on these occasions are afterwards gone through again by the teachers of the schools, from notes taken at the time. These lectures are simple and interesting, and are given with great care and skill; the results are remarkably good, both as regards the actual knowledge acquired by the scholars and the stimulus given to the general intelligence. Besides the above-named subjects, physiology and algebra are often taken with very good results, and in one school the principles of agriculture are taught with marked success." This extract from Mr. Blandford's report shows that the neglect of elementary science is due, not to the dullness or irregularity of the pupils, as some of the inspectors would seem to imply, but frequently to the ignorance and incapacity of the teachers. In the Eastern Division specific subjects are rarely taken, but in the Norwich district mechanics, chemistry, and botany have been taught satisfactorily in one or more schools, and "are distinctly a gain to the boys." On the whole, however, this division is rather at a standstill. The quality of the education given has not risen as one would expect, and with regard to scientific and technical education, in the words of Mr. Synge, "there is plenty of room and need for progress in the immediate future, but at the present moment too little sign of its beginning." In the South-Western Division "elementary science has hardly any existence." In fact, except in some of the large towns, it is practically non-existent, and in the whole division, there were only about 600 children presented on specific subjects. In Wales, except in a few higher-grade schools, the teaching of science is unknown.

Some of the causes of this almost total absence of any scientific teaching in our elementary schools have been pointed out. Where science has been well taught it has borne good fruit, and where teachers and managers have set themselves steadfastly to overcome the difficulties in their way a high and encouraging measure of success has been obtained. Thus we have the remarkable testimony of the success of the experiment in Nottingham, and surely there are many other districts in England quite as competent to carry on this work as Nottingham. Why it could not be done in any town in England, it is difficult to see. In many cases where these subjects have been taught, the inspectors have wisely set their faces against them, finding but a wretched smattering amongst the pupils. Nothing else can be expected in remote rural districts, where the teacher, whose whole time is scarcely sufficient for the few rudimentary subjects, is so ambitious as to attempt to cram some of his pupils with the elementary knowledge of a science of which he is himself confessedly ignorant. But in our towns and cities competent teachers are always to be had. If the Board masters do not find themselves fit for the extra labour and extra knowledge required, there should be no difficulty in obtaining a specialist, as has been done at Nottingham. And in no place could the foundations of technical education be more surely laid than amongst the elder children of our elementary schools. In the Minutes and Instructions issued to Her Majesty's Inspectors, managers are requested to aid in every way they can the teaching of one or more specific subjects appropriate to the industrial or other needs of the locality, and the rudiments of two higher subjects to supply a foundation for future work. With this object it is suggested that where the teacher is not competent to do so—and this, according to the reports, is the rule, and not the exception—a specialist might be employed by a number of schools in a district, whose instruction would be supplemented by that of the ordinary teachers. There is only one instance, that of Nottingham, given in the reports of such suggestions having been followed.

Geography.—Where there is "a great absence of culture and general intelligence upon the part of a considerable number of the candidates," it is not surprising to find that, though the answers to the geography papers for admission to the male training colleges were fairly accurate, they were not intelligent. Here, again, the metropolitan candidates are superior to the provincial candidates, particularly in the map-drawing, though, in this particular, there has been a falling away of late. Amongst the female candidates, the geography was not very satisfactory, exhibiting inaccuracies in map-drawing, indefiniteness in the answers, and, generally, marks of defective early training. In the examinations for the first year's certificates the male candidates answered fully and accurately; but usually there was a slavish following of the words of the text-books and the lecturers' notes. At the end of the second year, there is the same report, book-knowledge without intelligence, and abundance of information imperfectly digested. With the females, the result is the same: verbatim reproduction of the books or notes they had read; fairly creditable answering; but "the style of the papers reveals the painful poverty of the general reading of the students, and the utter absence of any individuality, or attempt at description in their own words." In many papers there was a constant iteration of the same words and phrases, suggesting that the candidates had learned off by rote the answers to probable questions. With regard to the elementary schools, all the reports agree in saying that there has been a marked improvement in the teaching of geography. Where it is intelligently taught it is the favourite subject; but too frequently the children are not well grounded. While all divisions report progress in this subject, it is worthy of remark that all the maritime districts, and particularly those of the South-Western Division, including the counties of Hampshire, Dorset, Devon, Cornwall, and Somerset, surpass the inland schools in the knowledge of our country, its colonies, and its trade. And this is only natural. The teacher who would not, in Devonshire, interest a class of boys in the voyages of Drake, or who, in Somerset, would not rivet the attention of his pupils on the victories of Blake, would not be worthy of his post. Though the teachers may be congratulated, speaking generally, on the progress made in geography, there are many faults to be found. In portions of Wales and of the centre of England, geography is only fairly satisfactory. The pupils are weak in questions of latitude and longitude; they do not learn intelligently; because, most probably, they are taught mechanically and unintelligently. It should be within the power of every teacher by the use of an ordinary globe to make this portion of the subject intelligible to any ordinary boy; but few lads could understand a lesson on meridians and parallels, given by a teacher who does not use a globe at all. And yet this is quite common! Hence it is that the map-drawing is very poor, even where there is a good knowledge of geographical facts. Many of the inspectors complain of lack of globes, maps, &c.; and even where there is abundance of general maps, there are no local maps, a want which is very widely felt. In this respect our Board of Education might take a lesson from the Commissioners of National Education in Ireland, who have published local maps, and require each pupil in the higher grades to know, in addition to general geography, the map of his neighbourhood.

NOTES.

LAST week we printed an article advocating the claims of M. Giard to the new Chair of Darwinism in Paris. We are now informed that the appointment will certainly be offered to M. Giard, and that, if he declines it, it will be offered to Prof. Perrier, of the Paris Museum of Natural History. It is generally desired that the Chair should be connected with the Faculty of Sciences in the Sorbonne. M. Liard, the Director of Superior Instruction, in the Department of Public Instruction, is favourable to the whole scheme, and hopes are expressed that the lectures may be begun in the course of two or three months.

MR. G. J. ROMANES has been elected Fullerian Professor of Physiology at the Royal Institution. He intends to devote all the three years of his professorship to one continuous course of lectures on "Before and after Darwin." This year's course—"Before Darwin"—will be an historical survey of the progress of scientific thought and discovery in biology from the earliest times till the publication of "The Origin of Species." Next year's course will be "On the Evidence of Organic Evolution," and the third year's "On the Factors of Organic Evolution."

ON Saturday, the 21st inst., at three o'clock, Lord Rayleigh will deliver, at the Royal Institution, the first of a course of seven lectures on Experimental Optics. The remaining lectures of the course will be given at the same hour on the following Saturdays.

THE annual general meeting of the Anthropological Institute of Great Britain and Ireland will take place on Tuesday, the 24th inst., at 8 o'clock p.m. precisely, Mr. Francis Galton, F.R.S., President, in the chair. The following will be the order of business:—Confirmation of the minutes; appointment of scrutineers of the ballot; Treasurer's financial statement; report of Council for 1887; the Presidential Address; report of scrutineers; and election of Council for 1888.

DR. H. LLOYD SNAPE has been elected to fill the Chair of Chemistry at University College, Aberystwith, rendered vacant by the death of Prof. Humpidge. The new Professor acted for three sessions as Demonstrator of Chemistry at University College, Liverpool. Afterwards he studied at the Universities of Berlin and Göttingen under the direction of Profs. Hofmann and V. Meyer respectively. On his return to England he was appointed Director of the Department of Pure and Applied Chemistry in the Manchester Technical School.

WE regret to announce the death of Mr. Hayden, the well-known American geologist. He died on December 22 last.

MR. ANDREW GARRETT, an eminent American conchologist, died at his residence on the island of Huahine, Society Group, South Seas, on November 1 last, in his sixty-fifth year.

THE Meteorological Council has recently published Part III. of the Daily Synchronous Weather Charts of the North Atlantic and the adjacent continents. Parts I. and II. were respectively noticed in NATURE, vol. xxxv. p. 469, and vol. xxxvi. p. 178. The part just issued, dealing with the period from February 15 to May 24, 1883, comprises the weather for the end of the winter and the early spring. The charts show clearly how very different are the conditions which exist over the Atlantic in the winter from those which exist in the spring. The early charts contain numerous instances of storms, and the barometrical disturbances which accompany them embrace a large part of the North Atlantic Ocean. An interesting case of storm development is shown over the American Lakes on February 19. The disturbance subsequently traversed the Atlantic, and passed about 800 miles to the north of Scotland on the 24th, causing a moderate gale in the north of our islands, and gales generally over the north-west of Europe. There is another instance of rapid storm development off Florida on April 2, the disturbance growing into a severe hurricane when south of Newfoundland on the 4th. A storm-area was formed off the north-west coast of Africa on February 20. This seems to have originated in an intensifying of the northerly wind on the eastern side of the Atlantic anticyclone. On the 22nd the storm was fully developed, and the cyclonic circulation was complete, the barometer registering as low as 29·6 inches. This disturbance travelled to the westward as far as the middle of the Atlantic. On the 25th it was clearly dying out, but on the 26th it apparently gained fresh life, and on February 28 and March 1 it was causing a gale close to the American coast, and to the south of Newfoundland and Nova Scotia. It afterwards travelled eastwards, skirting to the north-west of Iceland on March 3, and finally struck the north-west coast of Norway on the 4th. There is also a case of a double-headed depression travelling to the eastward across the Atlantic between March 25 and 31. These charts show very clearly the explanation of the cold northerly and north-easterly winds experienced over England during the spring, the isobaric lines indicating a general extension of the Atlantic high pressure over our islands at this season.

AT the meeting of the French Meteorological Society on the 6th ult. a paper by M. André, Director of the Lyons Observatory, on the influence of altitude on temperature, was read. The observations were made in the environs of Lyons in the years 1881–84. The mean diurnal range was 18°·5 F. at the lowest station (574 feet), and 12°·3 at the highest station (2050 feet). M. Poincaré submitted a table showing the relation between the barometric movements at lat. 40° and 10° N., and the phases of the moon. M. Renon made a communication on the observation of fog. He considered the present method of observation to be defective, as the observer could only note what exists around him; a knowledge of the conditions at a considerable height above him was necessary, to arrive at satisfactory conclusions. This desideratum was also urged by M. Janssen.

ON January 3, snow fell in Christiania from a perfectly clear sky. After a strong southerly wind with cloudy weather in the morning the weather cleared, but at about noon it again thickened, and snow and sleet fell. In the afternoon the sky again became clear and continued thus, with a storm blowing from the west. Just before 8 p.m., however, thick clouds again gathered, the full moon became obscured, and snow began to fall heavily. A quarter of an hour later the wind swept the clouds away, and the sky became completely clear, with the exception of a few clouds in the east. The stars shone brightly, and the full moon illuminated the landscape; still snow continued to fall thickly for some ten minutes. That the snow could not have originated with the clouds in the east is proved by the circumstance that the wind was westerly. A well-known meteorologist ascribes the phenomenon to the presence at a certain elevation in the atmosphere of a very cold layer of air in which the ascending, comparatively warmer, air became condensed, the moisture being thrown out in the form of snow, but not in sufficient quantities to obscure the blue sky, the stars, and the moon. The great chilling of the layer of air referred to may have been caused by the coldness of the heavy snow clouds which a few minutes previously filled the atmosphere.

ON December 24, at 9.45 p.m., a brilliant meteor was observed in the north-western sky at Örebro, in Central Sweden. The light, variegated in colour, was very intense. The meteor seemed to fall perpendicularly to the earth with a slow motion, and dissolved itself without any report. On December 25, at about 5 p.m., another meteor, shining with an intense bluishwhite light, was seen going in a north-westerly direction at Karlskogo, also in Central Sweden.

ANOTHER important paper upon the synthesis of glucose is communicated by Drs. Emil Fischer and Tafel to the current number of the *Berichte*. They have succeeded in artificially preparing glucose directly from glycerine. It will be remembered that this synthesis was first effected by decomposition of acroleïn dibromide, CH_2Br . CHBr . CHO, with baryta water; glycerine aldehyde, CH_2OH . CHOH . CHO, being probably first formed, and afterwards polymerizing into glucose. Hence it might be expected that the same result could be achieved by direct oxidation of glycerine to aldehyde and subsequent condensation by means of alkalies. This supposition has been completely confirmed by experiment, and the new method is at once an easier and a cheaper one. A large quantity of glycerine was first oxidized by means of soda and bromine, the temperature being kept down to 10°. The bromine readily dissolved on shaking, and the evolution of carbonic acid gas soon rendered evident the progress of the change. After half an hour the reaction was found to be complete; the liquid was then acidified with hydrochloric acid and a current of sulphur dioxide passed through it until all the bromine was reduced. The liquid, after neutralization with soda, was found to contain a large quantity of glycerine aldehyde. About 1 per cent. more soda was then added, and the solution allowed to stand at a temperature of about 0° for four or five days. As the polymerization proceeded, the liquid gradually lost the power of reducing alkaline copper solutions in the cold, but, like sugar, rapidly reduced them on warming. In order to isolate the sugar thus formed, the phenylhydrazine compound was prepared, as in the former experiments, by neutralizing with acetic acid and adding phenylhydrazine and sodium acetate, heating six hours upon a water-bath. After some time crystals of the phenylhydrazine compound, $C_{18}H_{22}N_4O_4$, were deposited, and after purification were found to possess all the properties of the compound obtained from acroleïn dibromide; in fact, they were identical with it. This compound crystallizes in beautiful yellow needles, melting at 217°; on heating it with zinc dust and acetic acid, a base is obtained which, by the action of nitrous acid and subsequent neutralization with soda, yields, on evaporation, syrupy glucose itself. Not only does this later work of Drs. Fischer and Tafel confirm their former striking results, but it leaves the subject in a much more complete state, and furnishes chemists with a far readier method of preparing artificial glucose in the laboratory.

THE habits of a running spider of Southern Europe, *Tarantula narbonensis*, Latr., studied by Herr Beck, are curious. It makes a vertical round hole in the ground about 10 inches deep, and this, with a small earth-wall sometimes made round the mouth, is lined with web. A little way down is a small lateral hole, into which the spider shrinks when an animal falls into the tube; when the animal has reached the bottom the spider pounces on it. One can readily tell that a tube is tenanted, by the bright phosphorescent eyes of the spider turned upwards. In fight the spider erects itself on its last pair of legs, striking with the others. The bite is not fatal to man, but it causes large swellings. The children in Bucharest angle for these spiders by means of an egg-like ball of kneaded yellow wax tied to a thread. This is lowered with jerks into the hole, and the spider fastens on it and can be pulled out; whereupon another thread is passed round one of the legs, and the animal is played with.

LEMMINGS are very numerous in several valleys in Southern Norway this winter. In many places the snow is furrowed for miles by the march of these little animals on their migration southwards.

IN November last a Runic stone was found at Häggerstalund, in Sweden. A lady happened to notice a long stone in the proximity of a well-known Runic boulder, and having had it turned found that there was an inscription on the other side, which has been interpreted thus:—"Gårdar and Jorund raised these stones after (in memory of) their sister's sons, Ernmund and Ingemund." The newly-discovered stone is of importance, as it supplements the Runic inscription of the other stone, viz.:—"These memorial stones are made after (in memory of) the sons of Inga. She took heirloom after them, but these brothers (referred to on the other stone) will take heirloom after her. Gjad's (?) brothers; they died in Greece." The latter stone is made particularly interesting by the reference to the death of the two men in Greece.

WHILST digging for potatoes late last autumn on the Island of Fredöen, on the west coast of Norway, a man unearthed a flat gold armlet with Runic inscriptions, and bearing on the inside the year 875. On the outside is a large bright stone, but of what kind has not yet been ascertained. This island is rich in historical traditions from the Viking era.

IN a late issue of the *Izvestia* of the Russian Geographical Society M. Krasnoff makes some interesting remarks on the antiquities of Turkistan. He points out that in the stone inscriptions he has seen in the Tian-Shan the men are always represented on horseback, armed with bows, arrows, long pikes with flags, and curved swords. Their dress is like the present *khalat* of the Mongolians and the Turks. The scenes represented mostly relate to hunting, and the men are surrounded by stags, *arkhars* (wild sheep), foxes, tigers, wild boars, and some very big animal with a thick hairy tail, and with tusks like those of the mammoth. In the gorge of the Uzun-su, M. Krasnoff saw the drawing of a camel. There are no inscriptions proper by the side of these drawings; but plenty of wild sheep, like the *tau-tek* of our days, are represented in files along mountain-paths. These drawings are very rapidly obliterated, and will soon disappear. They ought to be reproduced by archæologists.

THE second number of the "Bibliographies of Indian Languages," by James C. Pilling, has just been issued by the U.S. Bureau of Ethnology. It treats of the Siouan stock.

A USEFUL Catalogue of British Mollusca, published by Mr. H. W. Marsden, of Gloucester, has been sent to us. The Catalogue has been compiled by Mr. Charles Jeffreys, from Jeffreys' "British Conchology," with alterations and additions to date.

THE Royal Botanic Garden of Calcutta has just completed the first hundred years of its existence, having been established in the year 1787. The *Times of India*, in reviewing the history of the Garden, points out the many advantages which it has conferred on India. It has practically established and has done wonders to promote the now flourishing tea industry of India. The directors were the first to introduce potato-growing in that country, and they imported the quinine-yielding cinchonas from South America, and thus took the first step towards the establishment of what is now one of the most successful Indian industries. Besides these great successes, India owes to that establishment, the *Times of India* thinks, almost all the efforts that have been made to improve the quality of Indian cotton, and to push its sale in the European markets. The best sugar-cane has been brought from the West Indian Islands, and has been planted in all parts of the country; and flax, hemp, tobacco, henbane, vanilla, coffee, cocoa, ipecacuanha, india-rubber, tapioca, and many other products have been systematically experimented on in the Garden. Nor has horticulture been neglected by the superintendents, for the presence in India of a large portion of its exotic plants is due to them; and the improved systems of cultivation are in a great measure attributable to their efforts.

THE French Government has commissioned Count Horace de Choiseul, a member of the Chamber of Deputies, to proceed on a voyage of botanical research to Asia and the United States. He will visit the Botanical Gardens at Ceylon, Calcutta, Shanghai, Japan, San Francisco, &c., to collect botanical specimens not indigenous to France.

THE Royal Physical Society, of Edinburgh, seems to be doing much good work. At the second meeting for the present session, Sir William Turner in the chair, Mr. Hoyle read a note discussing the function of the Laurer-Stieda canal in the Trematoda; Mr. J. Arthur Thomson submitted an elaborate paper entitled "A Synthetic Survey of the Influence of the Environment upon the Organism"; the Secretary, Dr. Traquair, communicated a paper on an ornithological visit to the Ascrib Islands, by Mr. John Swinburne; and Mr. Brook gave some valuable notes on the marine Crustacea of the Clyde Estuary.

CAPT. WIGGINS, who successfully performed the sea voyage from Europe to Siberia last autumn in the steamer *Phœnix*, is shortly expected back in this country. He states that at the time of his leaving Yeniseisk, in Siberia, in October, the cold varied from 70° to 80° below zero, and that the mercury was frozen in the bulb.

AT the annual meeting and distribution of prizes at the School of Science and Art at Bromley, Kent, on Tuesday, Sir John Lubbock delivered an interesting address on technical education. He referred to a recent statement of Mr. S. Smith, one of the Commissioners on Technical Education, to the effect that it was not so much the longer hours and lower wages of Continental workmen, nor the tariffs, which were having such objectionable influence on our industries, but rather, in nearly all instances, the great attractiveness of the goods themselves, which had been made by workmen who had received special training in schools. Sir John Lubbock went on to say that if we had spent one tithe of the treasure which we sent abroad every year to buy the produce of the skill of other countries on the training of our own people, we should have been making these goods ourselves and shipping them to the East and West and to every country under the sun. We were constantly crying out for new markets, while there was a new market in every house in the country. We were apt, indeed, to forget how much we owed to science, because many things which were in reality scientific discoveries had become so familiar to us that we looked upon them almost as a matter of course. The electric light was still felt to be a triumph of science, but we forgot sometimes that the common candle was the result of a whole series of chemical discoveries. The Chinese were said to have examined candidates for the army until lately in the use of bows and arrows. We saw the absurdity of this; but we were not free from the same error ourselves.

IN a recent Consular Report there is a complete description of the Technical University of Belgium, which was founded in 1852, as well as a general sketch of the system of commercial and technical training prevailing in that country. Formerly the education in Belgian public schools (*Athénées*) was in the main classical, but in recent years a *section professionelle* (commercial and scientific) has been added, and now takes its place as an integral portion of the public-school system. Here youths intended for commercial pursuits, from the fourth class upwards, receive special instruction, and then pass on to the *Institut*, or University, where the course lasts two years. The number of pupils is 150, a number which would be largely increased, but for the difficult entrance examination, the inability of many parents to keep their children so long at school, and the prevailing idea that a youth intended for commerce cannot enter a counting-house too soon. The course at the *Institut* includes, besides languages, book-keeping, and the ordinary practical work of a merchant's office, a technical description of the ordinary articles of commerce, political economy and statistics, commercial and industrial geography, maritime and Customs' legislation, and the building and fitting out of ships. The fees range from £11 for the second year at the *Institut*, to £3 5*s.* per annum at the public schools. An extensive commercial museum, a chemical laboratory, and a commercial library are attached to the *Institut*. At the end of the course diplomas are given to the successful candidates, entitling them to the degree of *Licencié en Sciences Commerciales*. The rules, and a programme and syllabus of the lectures, are appended to the Report. The new language, *Volapük*, has been added as an experiment, mainly, it would appear, because of its possible utility for telegraphic communication.

THE additions to the Zoological Society's Gardens during the past week include a Mexican Deer (*Cariacus mexicanus* ♀) from the Island of Dominica, presented by Mr. George Anderson; a Water Rail (*Rallus aquaticus*), British, presented by Mr. G. J. Payne; two Black-headed Gulls (*Larus ridibundus*), British, presented by Mr. Thomas A. Cotton; two Common Peafowls (*Pavo cristatus* ♀ ♀) from India, presented by Mr. Richard Hunter; sixty-six Skylarks (*Alauda arvensis*), British, purchased; an Egyptian Vulture (*Neophron percnopterus*) from North Africa, received in exchange.

OUR ASTRONOMICAL COLUMN.

THE MAURITIUS OBSERVATORY.—The report of the Director of the Royal Alfred Observatory, Mauritius, for 1886, shows that the activity of the institution continues to be exhibited in two directions, viz. meteorological and magnetic observations, and the photographic record of the state of the solar surface. The meteorological observations have been extended during the year by the addition to the daily routine, of observations of the duration of bright sunshine, commenced October 1, of maximum and minimum dry and wet bulb thermometers in screens, begun November 1, and of an earth thermometer at 10 feet below the surface of the ground, begun the same day, the necessary instruments having been received from England. The year 1886 was a particularly dry one, the rainfall being below the average in every month, and the annual fall the smallest on record. No hurricane visited the colony; indeed, the last took place so long ago as March 21, 1879; but several cyclones occurred in the Indian Ocean, some of which passed near the island, and storm warnings were issued. Dr. Meldrum gives considerable importance in his report to the connection between the meteorology of the island and its health. It appears that wet years give specially high fever and death rates, the greatest mortality usually following the maximum rainfall by about two months. At the same time there has been a persistent increase in the death rate of late years, which appears to be independent of meteorlogical causes.

The photoheliograph was in constant operation, 533 photographs having been obtained on 353 days, but the sunspots were much fewer and smaller than in 1884 and 1885. Two photographs were also obtained of the solar eclipse of August 29, which commenced at Mauritius a little before sunset.

OCCULTATIONS OF STARS BY PLANETS.—The following list of possible occultations of stars by planets is in continuation of that given in NATURE, vol. xxxvii. p. 234:—

Planet.	G.M.T. of Conjunction in R.A.	Star.	Mag.	Pl. – ✱.	Max. Duration.
	h. m.			′	m.
♀	Jan. 25...18 30·0	...AOe$_2$ No. 17179	...8·5	–0·39...	5·0
♀	31...17 30·5	...S.D. – 21° No. 4933	...9·3	+0·58...	4·7
♄	Feb. 5...11 18	...D.M. + 20° No. 2073	...9·5	–0·88...	108
♄	16... 7 27	...D.M. + 20° No. 2062	...9·5	+0·38 ..	121

OLBERS' COMET.—The following ephemeris for Berlin midnight is in continuation of that given in NATURE, vol. xxxvii. p. 234:—

1888.	R.A. h. m. s.	Decl. ° ′	Log *r*.	Log Δ.	Brightness.
Jan. 22	17 18 29	3 49·6 S.	0·2866	0·3932	0·36
24	17 21 39	4 5·3			
26	17 24 44	4 20·4	0·2958	0·3948	0·34
28	17 27 44	4 35·0			
30	17 30 40	4 49·2	0·3048	0·3961	0·33
Feb. 1	17 33 31	5 3·0			
3	17 36 17	5 16·3	0·3137	0·3969	0·31
5	17 38 59	5 29·2			
7	17 41 36	5 41·7 S.	0·3224	0·3974	0·30

The brightness on 1887 August 27 is taken as unity.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1888 JANUARY 22–28.

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on January 22

Sun rises, 7h. 55m.; souths, 12h. 11m. 46·3s.; sets, 16h. 28m.: right asc. on meridian, 20h. 16·9m.; decl. 19° 44′ S. Sidereal Time at Sunset, 0h. 34m.

Moon (Full on January 28, 23h.) rises, 11h. 58m.; souths, 19h. 8m.; sets, 2h. 29m.*: right asc. on meridian, 3h. 14·6m.; decl. 12° 39′ N.

Planet.	Rises. h. m.	Souths. h. m.	Sets. h. m.	Right asc. on meridian. h. m.	Declination on meridian. ° ′
Mercury..	8 16	12 24	16 32	20 29·3	21 11 S.
Venus.....	5 7	9 15	13 23	17 19·6	21 7 S.
Mars......	23 47*	5 19	10 51	13 22·8	6 13 S.
Jupiter....	3 35	7 53	12 11	15 57·2	19 33 S.
Saturn....	16 26*	0 19	8 12	8 22·5	19 56 N.
Uranus...	23 29*	5 1	10 33	13 4·6	6 9 S.
Neptune..	11 56	19 35	3 14*	3 41·8	17 54 N.

* Indicates that the rising is that of the preceding evening and the setting that of the following morning.

Occultations of Stars by the Moon (visible at Greenwich).

Jan.	Star.	Mag.	Disap. h. m.	Reap. h. m.	Corresponding angles from vertex to right for inverted image. ° °
23	*f* Tauri	4	1 19	near approach	51 —
26	χ^3 Orionis	6	0 36	1 20	178 258
26	68 Orionis	6	4 57	near approach	215 —
28	B.A.C. 2683	6	5 10	near approach	209 —

Jan.	h.	
22	1	Uranus stationary.
23	14	Saturn in opposition to the Sun.
24	23	Jupiter in conjunction with and 0° 8′ south of β^1 Scorpii.
28	14	Saturn in conjunction with and 1° 10′ north of the Moon.

Variable Stars.

Star.	R.A. h. m.	Decl. ° ′		h. m.	
U Cephei	0 52·4	81 16 N.	Jan. 25,	21 20	*m*
Algol	3 0·9	40 31 N.	,, 23,	20 37	*m*
S Aurigæ	5 19·7	34 3 N.	,, 28,		*M*
R Canis Majoris	7 14·5	16 12 S.	,, 27,	20 36	*m*
			,, 28,	23 52	*m*
S Cancri	8 37·6	19 26 N.	,, 28,	22 28	*m*
W Virginis	13 20·3	2 48 S.	,, 26,	5 0	*m*
R Camelopardalis	14 26·1	84 20 N.	,, 25,		*M*
δ Libræ	14 55·0	8 4 S.	,, 22,	19 51	*m*
			,, 25,	3 42	*m*
U Ophiuchi	17 10·9	1 20 N.	,, 24,	3 4	*m*
			and at intervals of	20 8	
β Lyræ	18 46·0	33 14 N.	Jan. 25,	23 0	*m*
V Cygni	20 37·7	47 45 N.	,, 22,		*M*
S Delphini	20 37·9	16 41 N.	,, 24,		*M*
Y Cygni	20 47·6	34 14 N.	,, 22,	20 40	*m*
			,, 25,	20 33	*m*
δ Cephei	22 25·0	57 51 N.	,, 28,	0 0	*m*

M signifies maximum; *m* minimum.

Meteor-Showers.

	R.A.	Decl.	
Near ι Ursæ Majoris	133	48 N.	
,, σ Leonis	167	5 N.	Very swift.
,, α Coronæ Borealis	236	25 N.	January 28. Very swift.

GEOGRAPHICAL NOTES.

DR. MEYER has been giving an account of his ascent of Kilimanjaro to the Berlin Geographical Society, and from the brief abstract which has appeared his statements are not quite consistent with those made in his letter already referred to. For one thing, Alpinists are doubtful if Dr. Meyer got so close to the summit by a thousand feet as he himself thinks he did; and moreover, from his own statements, his aneroid was quite untrustworthy.

A SPECIAL meeting of the Paris Geographical Society was held on Saturday, to welcome MM. Bonvalot, Capus, and Pepin, who have been journeying in Central Asia. We have already on several occasions referred to this journey, during which the travellers crossed the Pamir, but not for the first time, as they themselves seem to believe. So far it would appear as if the original results of this expedition were of no great value.

THE paper at Monday's meeting of the Royal Geographical Society was by a young engineer, Mr. W. J. Steains, on an exploration of the Rio Dôce and its northern tributaries (Brazil). The Rio Dôce has been in past years a classical region for research in natural history, but for many years it has been neglected. It flows through a region that has scarcely been touched by the influences of civilization, a region which is the home of the Botocudos, one of the most primitive people on the face of the earth. The Rio Dôce lies between parallels 19°–21° S. latitude, and is formed by several small streams springing from the eastern slope of an important range of mountains known by the name of the Serra da Mantiqueira. This range, running in a north-easterly direction, forms a portion of the irregular "coast-range" of Brazil, and forms, so to speak, the "retaining wall" of the series of elevated, undulating tablelands composing the greater portion of Central and Southern Brazil. The total length of the Rio Dôce is a little over 450 miles. That portion of the Rio Dôce basin lying east of the Serra dos Aymôres is a densely wooded lowland, sloping gradually towards the coast from an elevation of about 900 feet. Near the coast this plain resolves itself into a long stretch of low alluvial ground, studded for the most part with small shallow lakes that communicate with each other by means of long, narrow, winding streams, called "vallões." The largest of these lakes is the Lagôa Juparaná, which communicates with the Dôce some 30 miles above its mouth by means of a narrow, tortuous, deep channel 7 miles long. The lake is 18 miles long, and about 2½ miles broad at its southern extremity. It is very deep, and with the exception of some low alluvial ground at its northern and southern ends, is surrounded by high wooded bluffs, composed for the most part of reddish clay overlying a stratum of coarse red sandstone. At the head of the lake is a river—the S. José, which rises in the Serra dos Aymôres, and flows through an unexplored district, inhabited by wandering hordes of wild Botocudo Indians. Throughout the whole of its course, the S. José flows through dense forest abounding in the much sought-after "Jacarandá," or rosewood tree (*Bignonia cærulea*, Will.) The Botocudos number about 7000 people, and among some of the more savage tribes cannibalism still prevails. Mr. Steains stayed several weeks among these people, and is therefore able to add something to our knowledge of them. In appearance Mr. Steains states, the Botocudos can scarcely be called prepossessing. The average height is 5 feet 4 inches. Their chests are very broad, and this accounts for the facility with which they can bend their bows, which are exceedingly strong, being made out of the tough springy wood of the Ayri or Brijaubá palm (*Astrocaryum Ayri*, Mart.). The feet and hands of the Botocudos are small rather than delicate, and these are in fair proportion to their legs and arms, which are lean but muscular. Concerning the colour of their skin, these Indians are of all shades, some being of a dark reddish-brown, whilst others, and especially the women, are quite light. With regard to features, the Botocudos struck Mr. Steains, as they have done others, as bearing a wonderful resemblance to the Chinese, and if, instead of wearing their hair cut round their heads so as to form a kind of mop, they wore pigtails, the casual observer would scarcely be able to tell where the difference lay. The hideous custom for which the Botocudos have always been so famous, viz. that of wearing huge lip- and ear-ornaments of wood, is fast dying out, and at the present time is only to be met with among some of the older members of the tribes, who retain all the habits and manners of their primitive forefathers intact.

THE January number of *Petermann's Mitteilungen* contains a paper by Count Pfeil, describing his journey last summer in East Africa, from Pangani along the Pangani River, south through Useguha to the Kingani River, and north to Bagamoyo. Dr. Henry Lange briefly describes the region watered by the Rio Tubarao and Rio Ararangua in Brazil. Dr. H. Fritsche contributes a series of astronomico-geographical and magnetic observations at thirty-one places in North-West Russia and North Germany in 1885-6-7, and Mr. S. Brooke gives a short acount of an excursion he made into the West Australian desert, starting from Israelite Bay on the south coast.

IN the January number of the *Scottish Geographical Magazine*, Mr. John Murray publishes the final results of his long research on the height of the land and the depth of the ocean. The paper consists mainly of a series of elaborate measurements giving the detailed data on which he founds his general conclusions. The conclusions to which Mr. Murray comes are of great interest, but they are too important to be stated in a note. The mean height of the land of the globe he estimates at 2252 feet. He finds that 84 per cent. of the land of the globe lies between the sea-level and a height of 6000 feet. The mean depth of the ocean again is 14,640 feet. In contrast with the land, only 42 per cent. of the waters of the ocean lie between the surface and a depth of 6000 feet; while 56 per cent. of the ocean waters are situated between depths of 6000 and 18,000 feet. The total area of the dry land Mr. Murray makes to be 55,000,000 square miles, while that of the ocean is 137,200,000 square miles. The bulk of the dry land above the sea is 23,450,000 cubic miles, and the volume of the waters of the ocean 323,800,000 cubic miles. The amount of matter carried from the land each year in suspension and solution, he estimates at 3·7 cubic miles; it would thus take 6,340,000 years to transport the whole of the solid land down to the sea. Should the whole of the solid land be reduced to one level under the ocean, then the surface of the earth would be covered by an ocean with a uniform depth of about two miles. The volume of the whole sphere, Mr. Murray estimates at 259,850,117,778 cubic miles. With the data now published should be compared Mr. Murray's Aberdeen lecture (NATURE, vol. xxxii. p. 581).

IN the last number of the *Comptes rendus* of the Paris Geographical Society, M. Chaffaujon gives a detailed narrative of his recent journey up the Orinoco. The section of greatest interest is that which relates to the upper course of the river, which M. Chaffaujon found to be all wrong on existing maps. This he has traced with much care. He examined also with care the outlet of the Casiquiare, by which the river is connected with the Rio Negro and the Amazons. He finds the bank of the river here to be mostly gravel, and in the rainy season the river coming down from the mountains with considerable force impinges against the bank, and forces a passage out. He states that the place of outlet seems to be shifting downwards every year.

THE TOTAL ECLIPSE OF THE MOON, JANUARY 28.

A TOTAL eclipse of the Moon offers some special advantages for the exact determination of the diameter and distance of our satellite. Observations of the bright limbs are exposed to considerable errors from the effect of irradiation, and liable to be affected by personal habit in the observer. The method of occultations has, under ordinary circumstances, proved scarcely more successful, owing chiefly to the fact that immersion and emersion so seldom take place under similar conditions. But in a total eclipse of the Moon, the disappearances and reappearances occur at limbs under similar illumination, and since the diminution of the Moon's light allows much fainter stars to be seen close to the Moon than can usually be observed, a much greater number of observations can be made than under ordinary conditions, and the effects of local irregularities of the Moon's circumference can be eliminated by observations made at a great number of points. If, then, as many Observatories as possible would combine to observe the occultations of the small stars passed over by the Moon during its eclipse, the labours of a few hours would give materials for a better determination of its diameter and parallax than could otherwise be obtained from the observations of many years. In view of these advantages, and noting too how hitherto they had been neglected by astronomers, Dr. Döllen, of Pulkowa, published a paper in the *Astronomische Nachrichten*, No. 2615, previous to the eclipse of October 4, 1884, in which he gave a catalogue of 116 stars which would be occulted during that eclipse, and begged for the co-operation of as many observers as possible. Unfortunately, the weather in many places was very unfavourable, and even where the sky was clear an unforeseen hindrance to observation was experienced in the unusual faintness of the eclipsed Moon. The part of the sky, too, through which it was passing was bare of stars above the 9th and 10th magnitudes. Still the results were sufficiently successful to encourage Prof. Struve and Dr. Döllen to repeat the attempt, especially as under several aspects the approaching eclipse of January 28 presents more favourable conditions than that of October 4, 1884: the magnitude of the eclipse will be somewhat larger, and the duration of the total phase a few minutes longer. Accordingly, Dr. Döllen has drawn up a catalogue of 300 stars which will be occulted, whilst Prof. Struve has computed by a graphical method the times of disappearance and reappearance, and the position-angles of the occulted stars, for 120 Observatories, which he has invited to cooperate with him in the work of observation. The experience gained during the 1884 eclipse has led Dr. Döllen to include only those stars occulted during the total phase or immediately before and after, but he has thought it well to give stars down to the 11th magnitude.

Of the 300 stars given in Dr. Döllen's catalogue, the majority of course will not be seen to be occulted from any part of this country. The following, however, may be observed here:—

No.	R.A.	Decl.	No.	R.A.	Decl.
87	130° 25'·18	17° 26'·95 N.	164	131° 3'·87	17° 26'·81 N.
91	27·98	35·12	165	3·96	25·64
93	28·70	35·57	166	4·48	32·90
97	29·14	45·66	172	6·26	17·96
98	29·53	37·64	180	10·35	32·80
100	30·08	38·14	181	12·61	38·34
102	30·18	23·95	190	16·58	12·54
108	34·21	44·27	192	18·52	44·17
110	35·90	30·12	194	19·26	38·34
112	36·51	47·21	197	21·11	19·06
114	130 37·43	17 19·16 N.	198	131 21·33	17 26·69 N.
115	37·44	47·07	201	23·15	37·63
116	37·89	48·54	207	24·96	26·65
124	40·69	49·34	209	25·71	22·85
125	40·76	18·56	210	26·11	30·07
126	41·76	30·46	212	28·48	17·66
128	43·50	34·10	216	30·76	17·96
130	45·17	45·27	219	31·77	8·64
134	48·24	42·16	221	32·45	35·77
136	49·50	45·96	223	32·58	26·14
138	130 50·10	17 26·35 N.	224	131 33·05	17 32·50 N.
142	54·18	18·36	225	33·65	22·31
144	54·71	35·17	226	33·71	13·84
148	56·91	38·34	233	37·74	9·24
150	57·53	22·75	236	39·74	21·26
152	57·97	28·93	237	40·51	30·82
153	59·04	22·95	242	43·43	17·36
155	59·88	15·96	247	48·32	24·55
156	131 0·48	36·32	248	48·44	11·24
157	0·75	39·91	251	49·29	9·44

The positions given are the apparent positions for January 28, 1888, and are expressed for R.A., as well as declination, in degrees, minutes of a degree, and hundredths of a minute.

The following are the times of disappearance and reappearance as furnished by Prof. Struve for the stars which will be occulted by the Moon at Greenwich. The angles are counted from the true North through the true East as in observations of double stars, &c.:—

Disappearances.

Star's No.	Angle. °	G.M.T. h. m.
148	74	10 23·1
152	107	25·8
156	80	30·5
Beginning of total phase		
150	131	10 32·3
157	65	33·8
153	128	34·8
142	154	37·1
166	89	38·7
164	111	39·7
165	116	41·1
180	86	52·0
155	163	55·3
172	145	58·8
181	63	11 1·3
198	100	17·6
194	57	18·6
197	127	24·4
207	97	25·5
201	56	27·8
210	84	28·1
209	110	29·4
190	164	34·2
212	127	41·2
223	94	42·9
216	124	45·3
224	70	46·4
225	107	46·9
221	56	49·4
226	138	58·2
236	105	12 0·8
237	70	3·5
End of total phase		
242	116	12 11·9
219	168	12·1
233	155	17·4
247	87	19·1

Reappearances.

Star's No.	Angle. °	G.M.T. h. m.
87	243	10 22·3
97	316	23·6
124	351	29·3
116	339	30·2
102	234	30·2
Beginning of total phase		
91	277	10 32·3
112	330	32·7
93	278	33·7
115	331	34·6
98	286	34·6
114	211	35·1
100	288	35·4
108	314	35·7
125	211	42·5
110	264	50·1
130	328	53·1
136	337	57·9
126	269	11 3·7
134	317	6·4
128	283	6·6
138	260	22·1
142	228	22·3
144	294	29·8
148	308	30·2
155	221	31·5
157	318	34·5
150	252	38·1
156	303	40·3
152	275	40·6
153	254	41·8
166	294	52·6
164	273	54·4
172	240	54·5
165	268	54·7
181	322	59·7
180	298	12 4·8
End of total phase		
190	222	12 10·9
194	328	11·2
201	330	19·4

The following table gives the magnitude of the occulted stars:—

Star's No.	Mag.	Star's No.	Mag.	Star's No.	Mag.	Star's No.	Mag.
100	9·5	150	10	181	10	219	10
108	9·3	153	10	197	10	221	10
126	9·5	157	9·4	198	9·5	225	10
128	9·5	164	8·0	201	8·7	226	10
136	9·5	165	9·4	209	10	236	9·5
142	10	166	9·5	210	9·5	247	9·2
148	10	180	9·5	216	10		

The remaining stars are all of the eleventh magnitude.

It would be advisable for intending observers to make a rough map of the stars they are to observe, and to acquaint themselves as completely as they are able with their configuration. The observations should be rehearsed as far as possible on previous evenings, that the necessary quickness in changing from one point of the Moon's limb to another may be acquired, and a fair acquaintance made with the sequence of the settings. It will be well probably, to somewhat reduce the list of stars for observation; since some of the phenomena follow each other so closely that some must be lost, and if the work of selection is left for the actual time of observation probably more stars will be lost than necessity demands, and a risk of confusion and mistake will be incurred. The suggestion has also been made that the eye-piece to be employed should not be placed as usual in the centre of the field, but be made to revolve round it at the distance of the Moon's radius. The Moon would then be brought to the centre of the field, and kept there throughout the entire series of observations, and only the eye-piece would be moved. A fairly high power will probably be found the best for the work.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Among the lectures for the present term we note the following:—

Chemistry: Prof. Dewar, on Organic Chemistry; Mr. Pattison Muir (Caius), on Chemical Affinity; Mr. Heycock (King's), on Chemical Philosophy for Natural Sciences Tripos, Part I.; Mr. Robinson, on Agricultural Chemistry.

Physics: Prof. Stokes, Physical Optics; Prof. J. J. Thomson, Properties of Matter; Mr. Shaw (Emmanuel), Thermodynamics and Radiation.

Geology: Prof. Hughes, Geology of a District to be visited at Easter; Mr. Marr, Principles of Geology.

Botany: Mr. Gardiner, Advanced Anatomy of Plants; Mr. Potter, Advanced Systematic Botany.

Zoology: Prof. Newton, Geographical Distribution of Vertebrates; Mr. Sedgwick, Morphology of Mollucsa and Echinodermata; Mr. Gordon, Morphology of Amniota, recent and extinct.

Physiology: Dr. Lea, Chemical Physiology; Mr. Langley, Advanced Histology and Physiology; Dr. Gaskell, Advanced Physiology of Vascular System.

Prof. Ray lectures on Pathology, and has practical classes; Prof. Latham on the Physiological Actions and Therapeutical Uses of Remedies; Dr. Anningson gives demonstrations in Practical Hygiene.

In Mathematics the following are among the lectures:—Prof. Cayley, Analytical Geometry; Mr. Forsyth, Modern Algebra, symbolical methods and ternary forms; Dr. Ferrers, Elliptic Functions; Dr. Besant, Integral Calculus, Definite Integrals, Mean Value and Probability, Calculus of Variations, and Differential Equations; Mr. Ball, History of Mathematics up to 1637; Mr. Mollison, Discontinuous Functions and Conduction of Heat; Mr. Whitehead, Grassmann's Ausdehnungslehre, with special reference to its applications.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 22, 1887.—"The Early Stages in the Development of *Antedon rosacea*." By H. Bury, B.A., F.L.S., Scholar of Trinity College, Cambridge. Communicated by P. Herbert Carpenter, D.Sc., F.R.S., F.L.S.

In the orientation of the larva, J. Barrois' suggestion (*Comptes rendus*, November 9, 1886) has been adopted, viz. that the stalk of the Pentacrinoid represents the præoral lobe of other Echinoderms. Besides the right and left body-cavities, an anterior unpaired body-cavity is developed (distinct from the hydrocele), and opens to the exterior by the water-pore in the free-swimming larva.

A larval nervous system is developed, but is lost after fixation.

The vestibule of the fixed larva (Cystid) is formed by invagination, as described by Barrois (*Comptes rendus*, May 24, 1886).

The water-tube (stone canal), by opening into the anterior body-cavity (now very small), places the water-vascular ring in indirect communication with the exterior.

The anus opens in the same interradius as the water-pore.

In the skeleton, besides the parts already known, three underbasals are present, which are of great phylogenetic interest.

Geological Society, December 21, 1887.—Prof. J. W. Judd, F.R.S., President, in the chair.—The following communications were read:—On the correlation of some of the Eocene strata in the Tertiary basins of England, Belgium, and the north of France, by Prof. Joseph Prestwich, F.R.S. Although the relations of the several series have been for the most part established, there are still differences of opinion as to the exact relation of the Sable de Bracheux and of the Soissonnais to the English series; of the Oldhaven Beds to the Woolwich series; and of the London Clay and Lower and Upper Bagshots to equivalent strata in the Paris basin. The author referred to the usual classification of the Eocene series, and proceeded to deal with each group in ascending order. The Calcaire de Mons is not represented in England, but may be in France by the Strontianiferous marls of Meudon. It contains a rich molluscan fauna, including 300 species of Gasteropods, many of which are peculiar, but all the genera are Tertiary forms. The Heersian are beds of local occurrence, and the author sees no good reason for separating them from the Lower Landenian or Thanet Sands. He gave reasons for excluding the Sands of Bracheux from this group. Out twenty-eight Pegwell Bay species, ten are common to the Lower Landenian, and five to the Bracheux Sands, which present a marked analogy with the Woolwich series. These Sands of Bracheux are replaced in the neighbourhood of Paris by red and mottled clays. Out of forty-five species at Beauvais, only six are common to the Thanet Sands, and ten to the Woolwich series. Out of seventy-five species in the Woolwich and Reading Beds, nineteen occur in the Bracheux Beds, if we add to these latter the sands of Chalon-sur-Vesles. Respecting the Basement Bed of the London Clay (Oldhaven Beds in part), the author would exclude the Sundridge and Charlton fossils, which should be placed on a level with the Upper Marine Beds of Woolwich. He allowed that the former were deposited on an eroded surface, but this involves no real unconformity, whilst the palæontological evidence is in favour of this view, since, out of fifty-seven species in the Sundridge and associated beds, only sixteen are common to the London Clay. He therefore objected to the quadruple division. Either the Oldhaven should go with the Woolwich or with the Basement Bed. He admitted that the term "Basement Bed" is objectionable, and preferred Mr. Whitaker's term for the series, as he would limit it. The Lower Bagshot Sands the author would call "London Sands," whose Belgian equivalent is the Upper Ypresian, and the French the Sands of Cuise-de la-Motte, forming the uppermost series of the Lower Eocene. A group of fossils has been discovered in the Upper Ypresian sands of Belgium, which leaves no doubt of their being of Lower Eocene age, and consequently the Lower Bagshots must be placed upon the same horizon. There is no separating line of erosion between the London Clay and the Lower Bagshots, the upper part of the former is sandy, and the lower part of the latter frequently argillaceous. Similarly no definite line can be drawn between the Upper and Lower Ypresian; but in both countries this series is separated from overlying beds by a well-marked line of erosion. So also in France the base of the Calcaire Grossier (Bracklesham Beds) is a pebbly greensand resting on an eroded surface of the Sands of the Cuise-de-la-Motte. In Belgium, in Whitecliff Bay, and in the Bagshot district the Upper Eocene rests upon an eroded surface of the Lower Eocene. The reading of this paper was followed by a discussion in which the President, Mr. Whitaker, Dr. Evans, Dr. Geikie, and others took part.—On the Cambrian and associated rocks in North-West Caernarvonshire, by Prof. J. F. Blake.

PARIS.

Academy of Sciences, January 9.—M. Janssen, President, in the chair.—Remarks on M. Cornu's last note regarding the synchronizing of time-pieces, by M. C. Wolf. The author points out that M. Cornu has misunderstood the language of the English physicist, Mr. Everett, whose theory is shown to be perfectly applicable to the Vérité method of synchronization. The efficiency of this system has received a remarkable confirmation from the circumstances attending an accident by which the synchronizing apparatus was recently put out of order in the city of Paris.—Researches on ruthenium, by MM. H. Debray and A. Joly. In continuation of previous studies of this rare metal, the authors here deal with its oxidation and the dissociation of its bioxide. From these researches it appears that hyperruthenic acid must now be added to the list of compounds which are easily destroyed by heat, although obtained at such high temperatures that their existence was long considered problematical. Their formation at these temperatures is analogous to the dissociation of bodies that were supposed to be incapable of decomposition before H. Sainte-Claire's discovery.—Researches on the breath of man and other mammals, by MM. Brown-Séquard and d'Arsonval. These researches make it evident that the air exhaled by mammals, even in a healthy state, contains a very powerful toxic element, to which should probably if not certainly be attributed the bad effects caused by breathing a close atmosphere.—Variation of temperature of a condensed or expanded vapour while preserving the same quantity of heat, by M. Ch. Antoine. An easy method is given for calculating the final tension that results from the variation of a given temperature, and the final temperature that results from a given degree of condensation or expansion.—On the influence of temperature on the magnetic state of iron, by M. P. Ledeboer. Although it has long been known that a magnet raised to a red heat loses its magnetic properties, no successful attempt had hitherto been made to determine by direct measurement the actual degree of temperature at which iron ceases to be a magnetic body. The experiments here described now show that iron remains magnetic up to 650° C., after which a rapid variation is observed in its magnetic condition. At 750° the magnetic properties are scarcely perceptible, and at 770° they disappear altogether, returning in the same way as the metal cools down. This presents a remarkable analogy to the conclusions of M. Pionchon, who, in his recent paper on the specific heat of iron at high temperatures, has shown that this metal undergoes a sudden change of state between 660° and 720°.—On the present value of the magnetic elements at the Observatory of the Parc Saint-Maur, by M. Th. Moureaux. The absolute values, as deduced from the mean of horary observations recorded by the magnetograph are as follow: declination, 15° 52'·1; inclination, 65° 14'·7; horizontal component, 0·19480; vertical, 0·42245; total force, 0·46520; longitude of the Observatory, 0° 9' 23" E. of Paris; N. lat., 48° 48' 34".—On the employment of sulphureted hydrogen for purifying the salts of cobalt and nickel, by M. H. Baubigny. The experiments here described clearly show that from a mixture of the salts of these two metals it is impossible to obtain a pure sulphuret either of nickel or of cobalt by the action of sulphureted hydrogen. Dellfs' statements regarding the action of hydrogen on the salts of the heavy metals are thus shown to be groundless.—On a new method of quantitative analysis for the nitrites, by M. A. Vivier. This method consists in using the reaction discovered by Millon for the analysis of urea, but with absorption of carbonic acid and measurement of the nitrogen liberated in the process.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

A Treatise on Algebra: Charles Smith (Macmillan).—The Nervous System and the Mind: C. Mercier (Macmillan).—Reports on the Mining Industries of New Zealand, 1887 (Wellington).—The Ethic of Freethought: K. Pearson (Unwin).—Year-book of Pharmacy, 1887 (Churchill).—An Elementary Text-book of Physiology: J. M'Gregor Robertson (Blackie).—Bergens Museums Aarsberetning for 1886 (Griegs, Bergen).—Zoological Record, vol. 23, 1886 (Gurney and Jackson).—A Course of Lectures on Electricity: G. Forbes (Longmans).—Report on Indian Fibres and Fibrous Substances (Spon).

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