THURSDAY, NOVEMBER 20, 1890.

KOCH'S CURE FOR CONSUMPTION.

DURING the last week Koch has made a further communication regarding his treatment of tuberculosis, which has been received with intense interest and perhaps with a certain amount of disappointment. For he has described his mode of applying the new remedy with sufficient accuracy to allow medical men to use it in the treatment of their patients, but he has left us still completely in the dark regarding the nature of the remedy itself.

A certain quantity of the remedy can be obtained from Dr. Libbertz, who has undertaken its preparation with the co-operation of Dr. Koch himself and Dr. Pfühl, but their stock is at present small, and larger quantities will not be obtainable for some weeks. In exercising this reserve regarding the nature of the remedy he employs, Dr. Koch has probably done very wisely, for it is evident that the substance he uses is very powerful and any inaccuracy or imperfection in its preparation might prove injurious to patients, and bring discredit upon the mode of treatment.

The remedy is a brownish, transparent fluid which is much too strong for use until it has been largely diluted with water. The diluted solution is applied by subcutaneous injection. There is a remarkable difference between the action of this remedy upon guinea-pigs, healthy men, and phthisical patients. Two cubic centimetres of the undiluted liquid produces no sensible effect when injected under the skin of a guinea-pig; but, calculated by body weight, the fifteen-hundredth part of this quantity produces cough, difficulty of breathing, sickness, vomiting, and fever, lasting for about twelve hours, in a human being. The presence of tubercle in the organism appears to render it extremely susceptible to the action of the remedy, for while the hundredth part of a cubic centimetre, *i.e.* one twenty-fifth part of the dose just mentioned as producing fever in healthy subjects, has no effect upon them, it will cause high fever along with coughing and sickness in tuberculous patients. Nor is this to be wondered at, for the remedy exerts its action upon the tissues which have been infiltrated by the tubercle bacillus and not upon the bacillus itself. It causes these tissues to die and be thrown off along with the bacilli they contain. This process is accompanied by fever, which the dose of the remedy used would not produce in health. In consequence of this the remedy may be used as a means of ascertaining the presence of tuberculosis as well as of curing it. If it causes more fever than it ought to do, in a doubtful case of phthisis, the presence of tubercle may be assumed, and when it ceases to produce fever in a patient under treatment the cure may be regarded as well-nigh complete. The effect of the remedy upon the diseased tissues can be seen in cases of lupus, where the tubercle bacillus infiltrates the skin instead of attacking the lungs as it does in consumption. A few hours after the remedy has been injected into the skin of the back, the spots of lupus on the face, far away from the seat of the injection, begin to swell and redden, and then become brown and dead, while the healthy tissue around becomes red and inflamed. The spots then become converted into dry crusts, which fall off in one or two weeks, leaving a clean red cicatrix behind. This result is very much like that produced by the direct application of a strong arsenical paste to the lupus spots. The tubercle bacilli weaken the vitality of the tissues which they infiltrate. The arsenic finishes the process they have begun, and kills the weakened tissues altogether, while it does not destroy the healthy tissues, and the once diseased but now dead part withers up and falls away from the living and healthy parts around. But arsenic can only do this when applied to the lupus in quantities sufficient to poison the patient many times over if it were absorbed into the blood, and consequently is quite out of the question as a cure for tuberculosis. Koch's remedy, on the other hand, seems to seek out tubercular tissue wherever it may be, and almost certainly produces changes in tubercular lungs and joints similar to those in lupus spots, although its action cannot be seen in the former as it can be in the skin. The fact that the new remedy does not destroy the tubercle bacilli, but only the tissues in which they are embedded, is distinctive of Koch's new method, which promises to effect a radical change in the treatment, not only of tubercle, but of many other diseases.

Since the discovery by Metschnikoff six years ago that the cells of the blood and tissues can eat up and digest the bacilli which constitute the germs of many diseases, the view has been constantly gaining ground that recovery or death in infective diseases is simply a question of the victory of the cells of a living organism or of the bacilli by which they have been attacked. In seeking for methods of cure men have tried either to find a way to weaken and destroy the bacilli, or to strengthen the resisting power of the tissues. When an organism is attacked by a new disease, it succumbs like an untrained army in the presence of an enemy. But the tissues appear to acquire a power of resistance, and if the first attack be recovered from, the organism is in many instances insusceptible to subsequent infection, as is shown in the case of small-pox, whether this has been accidentally acquired or intentionally inoculated. But an army may be trained to military tactics by sham fights instead of actual warfare, and the cells of an organism may become endowed with the power of resisting any infection, however virulent, by successive inoculations of a virus, weak at first but gradually increasing in power. This was the plan followed by Pasteur in his inoculations for anthrax. In these he employed at first anthrax bacilli so weakened by cultivation in an unfavourable medium that they produced nothing more than a slight indisposition, and then a virus less and less weakened until the virus of full strength could be successfully resisted. This process was one of protection rather than cure, but in his researches on rabies Pasteur turned his genius to the discovery of a means of cure. As he informed the Commission which went from this country to report on his method, he was himself not exactly aware how he arrived at his mode of treatment, but the conclusion had formulated itself in his mind that the disease produced a substance which was a protective against its own action. The treatment which he based on this conclusion has been so successful as to lead to many attempts to separate disease-germs and protective. These attempts have hitherto been fruitless in the case of rabies, but have been successful in other diseases. By cultivating disease-germs in a suitable liquid, and afterwards killing the germs themselves by heat, or removing them by filtration through porcelain, solutions have been obtained quite free from germs, and containing only the substances they have formed during their life and growth. Such solutions have been shown by M. Pasteur's pupils and others to have the power of protecting from septicæmia, anthrax, typhoid fever, and diphtheria; and Prof. S. Dixon, of Philadelphia, has succeeded in rendering animals resistant to inoculation with tubercle by previously inoculating them with the products of growth of the tubercle bacillus.

Most interesting experiments on the nature of these protective substances have been made by Wooldridge, Hankin, and Sydney Martin, who have shown that they are probably either globulins or albumoses rather than alkaloids, although Martin has obtained an alkaloid which produces all the symptoms of anthrax, and possibly may protect against it.

Koch's direction that his new remedy is to be prescribed under the name of paratoluid seems to indicate that it belongs to a class of bodies more nearly akin to alkaloids than to albumoses. Para-acet-toluid has been investigated by Jaffe and Hilbert, and found, like Koch's remedy, to be innocuous to the lower animals. It is possible that the new remedy may belong entirely to that class which has furnished us lately with so many valuable antipyretics and analgesics. But it seems more probable that it consists partly at least of a lymph containing the products generated by some microbe. One's first thought would naturally be that the substances formed by the tubercle bacillus itself would be chosen by Koch for curative as they have been by Dixon for protective purposes. But tubercle differs much from many other infective diseases, for anthrax, typhus, scarlet fever, or measles, run a definite course, and if they do not kill the patient at once, they protect him from a subsequent attack. But the attack of hectic fever which daily recurs in a patient suffering from phthisis confers no protection on him at all, but rather hastens the progress of the disease to a fatal termination.

The case is sometimes different when disease due to another microbe attacks a patient suffering from some form of tuberculosis. Thus lupus has been seen to shrivel and die after an attack of erysipelas or measles, and peritonitis, supposed to be tubercular, has disappeared during recovery from diphtheria. Judging from the resemblance between the effects of Koch's remedy and those of erysipelas, measles, or diphtheria, we should be inclined to suppose it to consist of a filtered culture of the germs of one of these or of some such infective disease, probably mixed with some kind of paratoluid.

It may perhaps seem idle to speculate on the composition of a remedy which its discoverer will probably describe fully ere long, but it must be remembered that tuberculosis, though one of the most frightful scourges of mankind, is not the only ill that flesh is heir to. There are others, with a less mortality perhaps, but even more feared by the sufferers themselves, and we may trust that the lines of research just indicated, whether they be exactly those on which Koch has been working or not, may lead to the discovery of certain cures for scarlet fever, diphtheria, gummata, and that most dreaded of all—cancer.

T. L. B.

THE CHEMISTRY OF IRON AND STEEL MAKING.

The Chemistry of Iron and Steel Making. By W. Mattieu Williams, F.C.S., F.R.A.S. (London: Chatto and Windus.)

THIS work differs materially from the ordinary technological text-books with which we are so familiar. Throughout it is evident that the author has thoroughly utilized his varied experience and great ability to their fullest extent, resulting in the production of a mass of suggestive information valuable to the ordinary student, and affording matter for reflection, even to those who have for years made the chemistry of iron and steel a specialty.

The introductory portion of the work is interesting, but chiefly briefly historical; the same may be said as regards chapter ii., on the ores of iron, which includes some speculations on the possible meteoric origin of iron. The wide diffusion of iron in the form of dust is quoted as indicating in part at least the meteoric origin of the metal.

Chapters iii. and iv., on reduction and dissociation, fluxing, roasting, and calcination, are thorough, giving concisely and forcibly the necessary knowledge in a manner well worthy of imitation in more pretentious works. The author's study on the analogy of dissociation to evaporation, commencing with water, followed by illustrations of the dissociation of the metals from their oxides, &c., shows that he not only clearly understands his subject, but also has the faculty of communicating his ideas clearly to others.

It is difficult to do justice to chapters v. and vi., on the blast-furnace, without entering into details which would here be out of place. The descent of the charge in the blast-furnace is first discussed, and the importance of clear ideas as regards the *rationale* of blast-furnace charging is insisted upon. It is not a simple process: (1) the heterogeneous impurities of the ore have to be removed; (2) the iron must be reduced to the metallic state; (3 and 4) the reduced metallic iron must be fused, as also the earthy impurities. All must proceed in due sequence. A definite statement of the problem of modern iron smelting must be before us ere we can follow rationally the reactions which occur. The evolutionary process from the old bloomeries or Catalan forge, next the small blast-furnace up to the huge structures of to-day is clearly set forth. Credit is also given to the practical worker, who, the author acutely remarks, must have possessed more practical scientific knowledge than we have been inclined or able to perceive.

The apparent irrationality of the modern system of smelting, by which iron ore is not only reduced to the metallic state, but the resultant metal becomes loaded with silicon and carbon, &c., is fairly discussed. It is shown that although what is termed the direct process, *i.e.* the simple reduction of the metal from its oxide, may be so conducted as to produce a nearly pure wrought iron, yet such methods are not economical, and are of limited application.

The direct process (p. 85) demands rich ores ; a great expenditure of fuel is incurred ; simple and direct as it appears, a greater cost is involved ; on the whole, it is better to resort to the ordinary purification of crude cast-iron by the puddling process. The relative merits of the direct process *versus* the ordinary practice of smelting and puddling, are, however, still under consideration. Recent investigations, combined with improved methods, indicate that at any rate in some localities the direct process may be advantageously applied. The modern blast-furnace is clearly described ; the form, viz. a circular column swelling in diameter at both extremities, is commented upon, and sound reasons are adduced why this approximate form must be adhered to. Next (pp. 88–93) follows a brief but graphic picture of the behaviour of the mixed charge of ore, coke, &c., during its descent, from the charging to the final fusion of the iron in the crucible or hearth, which deserves careful reading.

The preliminary preparation of ores, *e.g.* drying, roasting, &c., previous to charging into the furnace, is strongly and rightly advocated. Iron manufacturers, however, are averse to anything entailing extra trouble and labour. It is the general opinion that, on the whole, little is gained practically, although theoretically the ordinary practice of charging raw material must, as the author says, entail considerable uncertainty during the subsequent smelting. We agree with Mr. Williams that the reactions of carbonic oxide and carbonic acid gases in the blast-furnace are even now not thoroughly understood ; further, the part which solid carbon plays in the direct reduction of ores seems to us still somewhat mysterious. It is admitted that, when using soft coke, carbonic acid may be deoxidized, forming carbonic oxide. This occurs in the upper region of the furnace, and it is quite as probable that ore in contact with carbon may be also directly reduced in this part of the furnace. We have ourselves ascertained that, when intimately mixed oxide of iron and carbon are heated together, the reduction commences at a lower temperature than is usually supposed.

The theory of puddling is well discussed, and the working processes are lucidly explained. In addition the chemical reactions whereby purification is effected are given ; also, as regards the elimination of sulphur and phosphorus, the work of Percy, Bell, and many others is ably summarized. The author also quotes his own results, derived from his experience and study, which, however, are not always quite in accordance with accepted ideas, but which nevertheless should be carefully considered.

Many pages are devoted to the question of what is steel ; also fallacies concerning steel. Previous to the introduction of the Bessemer process, steel might be defined as a compound of carbon and iron, capable of being hardened, tempered, and welded. Steel containing $\frac{3}{4}$ per cent. of carbon was termed mild steel. The author states that by the Bessemer process steel is made as low as $\frac{2}{10}$ per cent. of carbon ; really, however, large quantities of Bessemer steel, or rather metal are now cast with only $\frac{1}{10}$ per cent. carbon. The author does not mention this. One gathers that there is only one true steel, *i.e.* a compound of iron and carbon free from other constituents.

The old definition of steel, *i.e.* a compound of iron and carbon, is as true as ever, when applied as in the past to a material used for special purposes, viz. tools with cutting edges, &c. ; but it would be perhaps more rational to say that the Bessemer product cannot in this sense be termed steel at all. It may be granted that a true steel is simply composed of iron and carbon, but such a material has its own particular uses ; and should not be compared or confounded with the Bessemer product, where the very properties of being tempered, hardened, &c., with facility must be avoided. In proof of this it has recently been shown that Bessemer metal may be improved by the addition of small quantities of silicon, nickel, or even copper ; also that for certain purposes a large quantity of manganese may be added to iron with advantage. Indeed, a well-known writer has gone so far as to hint that carbon may be eliminated altogether, and some other element advantageously substituted. It appears, therefore, that the author's definition of what is steel may in one sense be strictly true, yet may be inapplicable to the Bessemer product for the above reasons.

In chapter x., on fallacies concerning steel, the author reiterates that steel can only be manufactured from pure iron, showing clearly enough that many novel, promising processes have failed solely from the non-recognition of the necessity of freeing crude iron from certain objectionable elements.

The hardening, tempering, and testing of steel under varying conditions, also the cementation process, are discussed ; as briefly put, they may be considered complete. The author's own investigations should be carefully studied. It is suggested that during the cementation process carbon itself is not transmitted, but that a soaking in of iron carbide occurs. A film of carbide is first formed on the surface of the metal ; this unites or alloys with the layer of iron below ; a lower carbide is formed which reacts in like manner, and so on to the interior ; and borings taken from next to the surface, also at different depths below, indicate, as might be expected, varying properties of carbon. The gases occluded in the charcoal used for cementation appear to assist the reaction of carbon on iron. The writer has been informed that charcoal thus used becomes in time inert, having apparently lost occluded gas. Some metallurgists assert that carbon does not combine directly with iron, but recently this has been questioned, and it has been experimentally demonstrated that iron may combine with pure carbon. Discussing the *rationale* of cementation, it is suggested that possibly iron at a welding heat is really not a solid, but rather in a viscous, semi-fluid condition like sealing-wax or melted glass. Iron is thus rendered more porous to gases, and probably solids are thus absorbed. The experiments of Graham and others on the absorption of gases by iron seem in conformity ; in fact, this absorption may be termed a species of cementation.

The Bessemer process is well described and its early history given ; a clear explanation is afforded showing how the inventor's early anticipation that wrought or malleable iron could be manufactured direct was not realized, although the chemical reactions, viz. oxidation, &c., were similar in degree to those in the puddling furnace and refinery. Credit is given to Mr. R. Mushet, who first suggested the addition of spiegeleisen to the blown metal, thus converting a worthless material into the valuable material now termed Bessemer steel.

The chemical reactions of both the Bessemer and puddling processes are compared, and the necessity of using with the former a pure pig-iron free from sulphur and phosphorus clearly demonstrated. The primary reason given by Mr. Mushet for the addition of spiegel was that blown Bessemer metal contained an excess of oxygen in some form or other; and the triple compound of iron, manganese, and carbon was added with the sole object of removing oxygen, a slight excess being added to insure the necessary proportion of carbon. The author appears to have laid sufficient stress on this; the primary cause, according to Mr. Mushet, of the redshortness of the metal; and which is even now a difficulty, for it is known that oxygen cannot be entirely eliminated without the addition in many instances of an injurious excess of spiegel—the addition of silicon, and recently aluminum has been suggested, both favouring the elimination of oxygen.

P. 294. Viewing the Bessemer method as a purely chemical process, it is urged that chemical compounds, or solutions in admixture, will not always arrange themselves in the order of their chemical affinity; where a transfer of constituents can produce a solid compound, such transfer occurs as though the physical attraction of cohesion overpassed that of chemical affinity. Following this general rule, on which all chemical analyses are based, silicon (forming a solid) must go first; carbon follows; the rapid disappearance of manganese is due to its great affinity for oxygen; it also forms a solid silicate of manganese. Sulphur and phosphorus are not eliminated, owing doubtless to the small quantities present. This is hardly conclusive. The author says but little of the rapidity of the chemical reactions; and does not appear to have realized that ordinary chemical reactions may be modified in consequence of the abnormally high temperature attained during the Bessemer blow.

The influence of what may be termed mass has not been noticed; chemical affinities may thus be modified. Of two bodies in solution one may be greatly in excess of the other; on adding a precipitant it will be found that the element in excess is first precipitated, although the chemical affinity may be about the same or even greater for one element than the other. Barium sulphate is slightly soluble in acidified water, and it will be found that either barium or sulphuric acid may be precipitated at will by adding to the solution for the former a slight excess of sulphuric acid; for the precipitate of sulphuric acid it needs only to add a slight excess of a barium salt in lieu of sulphuric acid. As regards phosphorus, there can be no doubt that its presence is objectionable, and it is correct to say it injuriously affects the quality of any kind of steel. Sulphur is not so injurious.

The use of the spectroscope for controlling the blow is practically condemned; the author's experience, however, is not in accordance with that of other metallurgists. The basic process is shortly noticed, and the basic reaction summarized in a few words.

The part played by manganese as a steel improver is thoroughly discussed, the various theories are well ventilated, and the great affinity of this metal for oxygen insisted upon and emphasized. Manganese, however, when alloyed with iron in small quantities, can scarcely improve the quality. Mr. Hadfield's new alloys of manganese and iron cannot strictly be termed steel; the alloy possesses some of the properties of steel, and it may be compared to brass, which is not copper, but is, nevertheless, a substitute for copper, as candidly acknowledged by the author. His views as regards the mischievous action of small quantities of manganese contained in steel cannot be accepted in their entirety: they are certainly contrary to results of every-day practice in Bessemer steel works.

A theory of steel may be accepted as it is written; there can be little doubt as to the existence of a definite carbide of iron which alloys with metallic iron; although we have the alternative of assuming that carbon is simply difficultly soluble in molten or highly heated iron, yet the evidence seems in favour of the existence of the carbide. The properties which distinguish steel from crude iron are marked.

Alluding to the use and value of spiegeleisen, the author, curiously enough, confirms the old, nearly forgotten theory of Mushet, *i.e.* that for the steel manufacture, the triple compound of iron, manganese, and carbon is absolutely necessary. The carbide of iron, Fe_4C, must be more fusible than metallic iron, and some acute observations are made on the part which this fusible compound plays in the heating and cooling of steel under varying conditions. In other words, it is probable that the properties of hardening and tempering are thus conferred on iron, for this compound must be in a semi-fluid or plastic condition, whilst the iron is comparatively infusible. As liquids in cooling contract to a greater extent than solids, it is easy to imagine variations in temper or hardness due to the more or less rapid cooling of the steel. Sudden cooling must produce a violent molecular tension by the resistance of the rigid iron to the greater contraction, and variations in cooling, greater or less, must produce corresponding differences in the hardening or temper of steel. It is noted that, as regards solids, the coefficient of expansion is less than that of liquids; also, that the more fusible solids have a higher coefficient of expansion than the less fusible. This also plays a part in the production of the final product; and steel may be termed a *heterogeneous solid*, not homogeneous as usually assumed. Sir Lowthian Bell and Prof. Abel, however, assert that on heating piles composed of alternate layers of steel and wrought iron, the carbon contained in the former slowly diffuses, and the iron absorbs carbon from the steel. It is, therefore, probable that the heterogeneous solid of the author must, after repeated heatings, become practically homogeneous, and it follows that the so-called carbide, Fe_4C, may thus suffer decomposition.

In conclusion, after discussing the properties of alloys, particularly the alloy of sulphur and phosphorus with iron, the author ventures to state a general law, that the hardness of an alloy does not depend on the mean hardness of its constituents, but is harder than either of them, quoting numerous instances in support of this law. It is difficult to gainsay all this, and we recommend the theory of steel to the careful consideration of metallurgists. Other theories may be broached; for instance, carbon may, as before said, be soluble with difficulty in iron, and the proportion left in solution may depend on the rate of cooling, a portion remaining insoluble, showing its presence in the form of graphite or simply intermixed carbon. Prof. Akerman holds that carbon exists in iron in three different forms which may be distinguished; other well-known metallurgists confirm his views.

The following chapters, on iron *versus* steel for structural uses, and the stability of iron, are apparently ably written, and are recommended for the consideration of experts. The article on occlusion of gases in iron and steel is up to date. The researches of Graham, Deville, and Troost are quoted, and prominently those of Dr. Muller, to which latter the author appears to attach some importance. Iron, however, occludes other elements just as it does hydrogen—such as zinc, cadmium, magnesium, &c.; the same may be said even of carbon during the cementation process. Dr. Muller's method of collecting the gas by drilling gives no information as regards the gas actually occluded, which latter, it is evident, can only be extracted by heating in vacuum, as recommended by Prof. Roberts-Austen, and practised by Graham and Troost, also recently worked by Parry, Stead, and other chemists. JOHN PARRY.

THE THEORY OF LIGHT.

The Theory of Light. By Thomas Preston. (London: Macmillan and Co., 1890.)

MR. PRESTON has written a valuable book on an important subject, one which will, as he hopes, be suited to the reading of junior students, and yet sufficiently full to meet the requirements of many who desire a more special acquaintance with the subject. At the same time it is difficult to avoid expressing the wish that he had carried the mathematical development of some parts of his subject a little further, and, if space required it, had omitted some of the more elementary details; though the work, within the limits laid down, is so well done, that criticism may seem ungenerous.

The historical method adopted in some parts of the book adds greatly to its interest, and the account given of the development of the subject, from the days of the Greek philosophers to the present time, will lead many to study the original sources of Mr. Preston's information with profit to themselves. It is a good thing for us to read how the first masters of the subject expressed themselves; to know what were the difficulties they felt, and what the problems which appeared important to their minds. We, who, thanks to Young and Fresnel, have had the difficulties that surrounded the wave theory in the time of Newton cleared away, are less apt than we might be at recognizing their magnitude, and at grasping the ingenuity and skill with which Newton treated the emission hypothesis, and the marvellous manner in which, in his hands, it was made to explain many of the phenomena of light.

In the earlier chapters of the book, after an explanation of the rectilinear propagation of light, a good deal of space is devoted to the explanation of phenomena usually dealt with under geometrical optics. The ordinary formulæ for prisms and lenses are deduced from the principle that the time from a point to its image is the same by all paths possible for the light—a principle which, in Lord Rayleigh's hands, has led to important results in the theory of optical instruments.

The argument given by Lord Rayleigh in his article in the "Encyclopædia Britannica," for showing that the effect of a wave is equivalent to half that of the first Huyghens zone, and that the phase of the disturbance is a quarter-period behind that from the pole, might with advantage have been given in greater fulness in Article 54 (the reference at the end of that article should be to Art. 154, Ex. 3).

The book is very complete so far as it goes, but the limits imposed by the author on himself do not allow him to show any very great originality in treating his subject, at least until we come to chapter ix., section iii., where he deals with the graphic method of solving problems in diffraction. In this section Cornu's beautiful method is employed, and many problems, usually only solved by analysis, are completely worked out by it.

The analytical solutions are, perhaps, a little hardly dealt with, as the methods of evaluating Fresnel's integrals given by himself, Gilbert, and Knochenhauer, only appear as examples. The theory of the diffraction gratings strikes us as being also rather brief. Rowland's concave gratings are best treated from the consideration that the waves from all the bright spaces arrive in the same phase. Possibly Bessel's functions are outside the limits of the mathematical treatment allowed by the author: if not, a reference to them would improve the treatment of the diffraction problems arising out of the case of a circular aperture.

Fresnel's theory of double refraction is given clearly in chapter xii., and the difficulties of finding a dynamical explanation of it are well stated. It is here, however, and in the chapter on the dynamical theory of reflection and refraction, that we think the limitation of the mathematical development unfortunate. The elementary theory of elastic solids is given sufficiently for optical purposes in several works accessible to students. The author might easily, if he had liked, have introduced a few pages of it in his own book. He would then have been able to give and discuss the theories of refraction and double refraction of both Green and Neumann, or McCullagh, and thus have added greatly to the value of the work.

The book is brought up to date in a satisfactory manner. The last chapter contains an account of the modern work on the electro-magnetic theory of light, including the recent experiments of Hertz.

ENGLISH PATENT LAW.

The Law and Practice of Letters Patent for Inventions; with the Patents Acts and Rules annotated, and the International Convention, a Full Collection of Statutes, Forms, and Precedents, and an Outline of Foreign and Colonial Patent Laws, &c. By Lewis Edmunds, D.Sc., (Lond.), F.C.S., F.G.S., of the Inner Temple, Esq., Barrister-at-Law; assisted by A. Wood Renton, M.A., LL.B., of Gray's Inn, Esq., Barrister-at-Law. (London: Stevens and Sons, Limited.)

THIS is a work of considerable pretensions. We see by his preface that Mr. Edmunds claims to hav produced a comprehensive treatise, dealing exhaustively with Patent law and practice, and when we mention that the book runs, in this its first edition, to upwards of 900 pages, our readers may be disposed to think that the author must have achieved his purpose. On a closer inspection, however, the formidable proportions of the work become greatly diminished. We find that the actual text of the book is only some 425 pages, the remaining 515 pages being supplied by statutes, Patent rules, international regulations, voluminous forms, and an index. We have always understood that a legal text-book ought to be in form as concise, and we might almost say as condensed, as possible, consistently with the importance of the subject-matter. Mr. Edmunds does not appear, however, to pay much regard to this wholesome rule. We rarely remember to have seen a legal text-book more gratuitously padded out than the work now before us. To take one illustration, the author devotes nearly 200 pages to printing the Patent Acts 1883-1888, twice over, for what good purpose we are at a loss to understand. The notes which are appended to what we must, under the circumstances, call the first edition of the Patent Acts 1883-1888, are of considerable value, but we cannot approve the system of cross references, by means of which the author seeks to incorporate, under various sections of the Acts, passages from the preceding text. By this device, Mr. Edmunds seems to have attempted to combine in one volume two inconsistent methods of text writing—the method which constructs a book by noting the sections of an Act, and the method which, relegating the statutes to an appendix, makes the body of the text a continuous treatise. There is much to be said for each method. Mr. Lawson's admirable work on Patent practice is an excellent illustration of the first; and the now old but well-known work of Mr. Hindmarch on Letters Patent is a felicitous adoption of the second. But we do not think a cross between the two can ever be satisfactory. Considering how fully Mr. Lawson's work meets the needs of practice, and how much more convenient it is in point of size than the book now before us, we think Mr. Edmunds would have done better to have devoted himself to the production of a treatise on substantive law only. A new work on Patent practice was not required by the legal profession, but a new work on substantive Patent law has long been a public desideratum; and we think the present author, with his industry and evident ability, might well have supplied that want. We are afraid, however, that that want still remains to be supplied.

Coming to what is the text of the book—Part I., Patent Law and Practice—we notice that Mr. Edmunds gives in his first three chapters an interesting historical account of the origin of English Patent law. But we are disappointed to find that the very important question of subject-matter is but scantily treated in a chapter of thirty-four pages. This in a work of nearly 1000 pages, claiming to be an exhaustive treatise, is a surprising deficiency. In this part of his book, Mr. Edmunds has, in fact, limited his space far too much, and betrayed a tendency to huddle important cases into footnotes—a tendency the more to be regretted considering the size to which the book has otherwise been allowed to grow. In his chapters on specifications and infringement, the author has been much more successful, and these show great care and considerable merit. The chapters on foreign and colonial Patent laws are interesting, but necessarily short, and where a statement of law has to be so condensed its utility must be very doubtful. The table of cases is very complete, and it is a useful addition to the usual citations to add, as Mr. Edmunds has done, the dates of the decisions. The appendix of forms is a very full one, and the index seems to be well compiled. The immense increase in the number of patents granted by the Crown in recent years has given to this department of our law a greatly enhanced importance, and while we have not scrupled to point out what we regard as the defects of Mr. Edmunds's work, we doubt not that the book will have a large circulation amongst those whose professional duties lead them to consult works on this branch of English law.

OUR BOOK SHELF.

Lessons on Health. By Arthur Newsholme, M.D., D.Ph. (Univ. Lond.). (London: W. H. Allen and Co., 1890.)

UP to the year 1889, the Science and Art Department of South Kensington required that candidates for the examination in hygiene should at some previous time have passed the Departmental test in physiology. Since that date, however, the Science and Art authorities have decided that the hygiene paper shall contain questions on physiology, embracing the general structure of the human body, the forms, positions, and uses of the more important organs, more especially the construction and action of the circulatory and respiratory systems, and of the digestive and excretory organs; and that a separate examination in this subject shall be dispensed with. Dr. Newsholme's "Lessons on Health" is a manual designed to cover the requirements of the elementary stage of the hygiene examination under the altered regulations. Writing for elementary readers, the author wisely begins by devoting a chapter to the chemistry of the chief elements which enter into the composition of the body. The next four chapters are taken up with histology and physiology, but here we do not think the author has entered sufficiently into detail to enable beginners to grasp the full meaning of what they are reading. Our objections have special reference to the histology. For example, the author tells us that the tissues, when examined microscopically, are found to consist of cells, which, in the case of muscular and connective tissues, have become transformed into fibres; and that the original appearance of cells is best seen in the cells of connective tissue, brain, and epithelium. No explanation, however, is given as to what is meant by a cell; nor even a brief account of the appearances and structure of the other tissues of the body; so that, when the reader comes to learn such facts as that the stomach is composed of four different coats, or that there are three layers in the wall of an artery, the latter differing from a vein in possessing more elastic tissue, he cannot form any adequate idea as to the meaning of these words. Again, in the description of the skeleton, the sterno-clavicular articulation is mentioned, but no allusion is made to the joint between the clavicle and scapula; the ulna is said to articulate with the humerus, but no mention is made of the fact that the head of the radius enjoys the same privilege.

The matter in the hygiene section of the book, both in arrangement and description, is excellent, and may be cordially recommended for the purpose intended.

J. H. E. BROCK.

Practical Inorganic Chemistry. By E. J. Cox, F.C.S. (London: Percival and Co., 1890.)

THIS is a volume of 51 pages, consisting of "the necessary notes, reactions, and analytical tables constantly required for reference" by students preparing for the elementary stage examination of the Department of Science and Art in practical inorganic chemistry. As only seven bases and four acids are included in the syllabus, and the mixtures given are soluble in water or dilute acids, the scope of the volume is very limited. The author begins by stating the possible number and character of the constituents of mixtures that come within the range of the syllabus, and then gives a list of all the substances available for the examiners to make the mixtures from. Then follow lists of reactions and tables of methods. After these is a quotation from the published description of that part of the examination that consists of questions to be answered, and as the examiners state that "the value of the answers will be greatly enhanced by neatness and clearness of sketches," the author proceeds to give "the sketches required," a series of 21 figures all duly labelled, and which presumably includes every sketch that can possibly be needed. The student is recommended to practice copying the figures until he "can draw the apparatus neatly and accurately."

Notes on Trigonometry and Logarithms. By Rev. J. M. Eustace, M.A. (London: Longmans, Green, and Co., 1890.)

THIS work is not like an an ordinary text-book, but consists of a series of well-arranged notes on the elements of trigonometry and logarithms. The subject is treated so that it may be useful to beginners, and to those working it up by themselves. The book-work will be found fully worked out, and, in each chapter, examples on it are given to demonstrate the methods of solution.

Great care has been bestowed on the explanations of the various manipulations to which logarithms can be applied, and the author has reprinted some pages of the mathematical tables published by Messrs. W. and R. Chambers, giving a full explanatory account of the method of using them, which to a beginner will prove most serviceable. Two excellent chapters on solutions of triangles and heights and distances give the student a good insight into the more common problems that are generally worked out in this way.

Miscellaneous propositions and examples are dealt with in the last two chapters: in the former, such propositions as the nine-point circle, distance between centres of circumscribed and escribed circles of triangles, &c., are discussed; while in the latter we have a series of well-selected examples taken from the usual sources.

Elementary Statics. By the Rev. J. B. Lock, M.A. (London: Macmillan and Co., 1890.)

MANY are the treatises which deal with the subject of elementary statics, but few can rival in clearness the present stereotyped edition of Mr. Lock's work. The alterations that have been made have not necessitated any considerable change in the character of the book. By the addition of some fully worked out illustrated problems, and of a carefully graduated set of interesting examples for the student to solve, the author has slightly enlarged the scope of the treatise. The number of the miscellaneous examples at the end have been greatly increased by the insertion of problems that have appeared in the Cambridge examinations in the last two or three years. The subject throughout is treated in the author's best style, and the book can be cordially recommended for the use of beginners.

Die photographische Retouche in ihrem ganzen Umfange. By Wilh. Kopske. (Berlin: Robert Oppenheim. 1890.)

IN order to remove the defects incidental to photographic pictures, a process of "touching up" has to be resorted to, and the present pamphlet of 80 pages in length offers instructions in this subject, which will be found of use by practical photographers. The amount of valuable information compressed within the compass of the little work before us is quite remarkable, and shows that the author is thoroughly familiar with this branch of his art. We can commend the book to photographic artists.

LETTERS TO THE EDITOR.

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

Photographs of Meteorological Phenomena.

AT the Leeds meeting of the British Association a Committee, consisting of Mr. G. J. Symons, F.R.S. (Chairman), Prof. Raphael Meldola, F.R.S., Mr. John Hopkinson, and myself, was appointed to report upon the application of photography to the elucidation of meteorological phenomena, and to collect and register photographs of such phenomena.

The success with which these instructions can be carried out necessarily depends in a great measure upon the voluntary co-operation of others.

Will you therefore allow us to appeal to photographers through the medium of your columns, and to ask all those who have in their possession negatives of clouds, lightning, hoar-frost, hailstones, or any other meteorological phenomena, or of damage done by whirlwinds, tornadoes, or storms, to communicate with me?

We shall be grateful for copies of any such photographs, but shall especially welcome offers of future assistance in the shape of photographs taken in accordance with some simple instructions which will be supplied on application.

ARTHUR W. CLAYDEN.

Warleigh, Tulse Hill Park, London, S.W., November 18.

Some Habits of the Spider.

THE experiment given by Mr. Boys can be successfully made with a common table-fork. The spider will seize the handle and grapple with it in a ridiculous fashion, but it soon tires of the performance. The prongs will continue vibrating for some little time if struck smartly on a wall.

A curious habit of the spider has perhaps been recorded, but I have never seen it noted. A large, dark spider is sometimes seen in the centre of a strong and regular web. Blow the spider with a slight puff, and if it does not fall or run away, it will shake itself violently for a quarter of a minute. These oscillations are not natural, as the spider will only produce them once or twice, and the natural oscillations are slower. The motion is circular and very rapid, so that the outline of the spider disappears and a blurred appearance three or four times as large as the spider is produced.

This habit is probably protective. Birds would be puzzled rather than frightened, and would find it difficult to make a good shot at the spider. The species of spider is fairly common in gardens and hedges, and is abundant in parts of Norway. It is dark, with a few light spots.

A. S. E.

Newton's Rings.

WHILE arranging some experiments on the interference of light for class illustration at the Working Men's College, Melbourne, with a friend, Mr. Wilfred Kernot, of this city, we came across a method of showing Newton's Rings which I have not seen described, and which may be new to some of your readers, though probably any who have had to arrange the experiments for themselves will have come across it.

The apparatus used was a pair of glass plates, $2\frac{1}{2}$ inches square by $\frac{3}{16}$ inch thick, squeezed by a pair of clamps at the centres of a pair of opposite edges. A beam from an electric lamp (900 candle-power) was sent through the plates so as to be partly reflected and partly transmitted, and the images formed by these two beams were received on a pair of screens about 5 feet from the plates. Holding the plates at an angle of about 10° with the incident beam, the complementary colours are shown with great brilliancy on the screens; by varying the inclination of the plates to the beam the colours can be changed at pleasure.

In this form the experiment is well suited for class illustration; care is necessary to avoid irregular reflection at the edges of the plates; we covered ours with ordinary gum paper.

B. A. Smith.

Working Men's College, Melbourne, October 10.

Mutual Aid among Animals.

Recent discussion of this subject has recalled my attention to an observation made some time ago, while studying the animals of Casco Bay, on the coast of Maine.

Among the specimens brought back from one excursion were four of the common Echini (*E. drobachiensis*). The last one taken had been left exposed to the sun some time before it was noticed and properly cared for.

These four animals were placed alone in a small aquarium, and, as we wished to study the action of the ambulacræ, each was turned mouth up. Soon the action began, with which every naturalist is familiar, and three of the captives slowly rose on edge, and then deliberately lowered themselves into the normal position. The fourth, the injured one, made much less rapid progress: all it could achieve was a slight tipping of its disk. The two nearest Echini, from six to eight inches distant, now moved up and stationed themselves on opposite sides of their disabled comrade.

Fastening their tentacles for a pull, they steadily raised the helpless urchin in the direction in which it had started. As soon as it was possible, one of the helpers moved underneath the edge of the disk on the aboral side, and, when the half-turn was accomplished, the other took station on the oral side, gradually moving back as the object of so much solicitude was very gently lowered to the position nature had made most convenient.

This is the best instance of "giving a lift" I have ever met with among animals of so low a grade. It may not be without interest to others.

Wm. Elder.

Colby University, Waterville, Maine, U.S.A.

The Chrysanthemum.

This being the centenary year of the introduction of the Chrysanthemum into England, a word on the subject from its native place, Peking, may not be out of place. It is not generally known that the Chinese grow the Chrysanthemum as a standard tree especially for selling. They graft them on to a stalk of Artemisia. There is a species of Artemisia that grows wild and covers the waste ground round Pekin; it springs from seed every year, and by the autumn attains to a tree 8 or 10 feet high with a stem 1½ inch thick. The Chinese cut it down, and, after drying it, use it as fuel; the small twigs and seeds are twisted into a rope, which is lighted and hung up in a room to smoulder for hours; the pungent smell of the smoke drives out the mosquitoes. This plant, after being potted, is cut down to about 3 feet and used as the stock, the twigs of Chrysanthemum are grafted round the top, and it quickly makes a fine tree, the flowers grow and open, and as the stock soon withers the whole tree dies, and folks say, "another ingenious fraud of the Chinamen."

A favourite style of growing Chrysanthemums is in the shape of a fan, with eight or ten flowers in different parts of it. If the flowers are not grown on the plant, they are tied on, which also does for selling.

The winters in Peking are very cold, and last about four months, and having no glass houses the Chinese gardeners do not have the chance of producing such a variety or such fine flowers as their European brethren, but in the case of Chrysanthemums they have many curious and beautiful varieties.

Thos. Child.

Dispersal of Freshwater Shells.

I am putting together such instances as I can find of dispersal of freshwater bivalves by closure of their shells so as to cling to the toes of birds, amphibia, water-beetles, &c., and of univalves by adhesion to the wing-cases of water-beetles, &c., and venture to ask for co-operation. Any notes or references which your readers may have the kindness to send to the undermentioned address will be welcomed and carefully acknowledged.

H. Wallis Kew.

5 Giesbach Road, Upper Holloway, N.

The Common Sole.

The post-larval flat-fish obtained in 80 fathoms off the west of Ireland, which in Nature (vol. xlii. p. 520) I referred to as common sole, have turned out, on closer examination to be the fry of *Pleuronectes cynoglossus*, called "white sole" in the Dublin markets.

I shall feel obliged by your finding space for this correction.

Dublin, November 15. W. Spotswood Green.

The Scientific Investigations of the Fishery Board for Scotland.

In the review of the "Eighth Report of the Fishery Board for Scotland," which appeared in Nature (vol. xlii. p. 653), the reviewer, misled by the private information to which he refers, makes an inaccurate and baseless statement, reflecting upon me personally, and which I therefore crave leave at once to correct. In dealing with my report on immature fish, which, by the courtesy of the Secretary for Scotland, was placed in the hands of the delegates of the recent International Fisheries Conference, and which has already been referred to in your columns by Prof. McIntosh, F.R.S., the reviewer states: "We have certain information that the *original discoveries which led to* this report were made" by Mr. T. Scott; and that "it is only fair that the credit which is Mr. T. Scott's due, *and which is denied him there*, should be acknowledged here."

Had your reviewer disregarded his private information, and looked at p. 161 of the paper which he has reviewed, he would have found there the following footnote to the statement that "nearly 13,000 food-fishes" had been "carefully measured, and the condition of the reproductive organ registered," viz., "*This has been mainly done by Mr. Thomas Scott, F.L.S., one of the naturalists of the Fishery Board, and partly by Mr. Peter Jamieson, assistant naturalist.*"

What Mr. Scott and Mr. Jamieson did was precisely what is stated—namely, to measure the length of the fish and record on the form provided whether the milt or roe was mature or not. The subjoined note from Mr. Thomas Scott, which I request you to publish along with this, shows that he considers this acknowledgment sufficient. The study and elaboration of these daily records, nearly 13,000 in number, mainly in my private time, was only a part, and a small part, of many months of labour bestowed on my report on immature fish; and the results occupy less than three pages of the fifty-four devoted to the subject. No other person had any part or share whatever in the conception or composition of that report, and this attempt to deprive me of the credit of my work, solely on the strength of private and erroneous information, is not, I think, either usual or creditable.

The reviewer is equally in error as to what I wrote in the Report for 1887, and which he only partially quotes. The entire sentence is as follows: "We have organized a series of extensive and systematic inquiries into the condition of the reproductive organs of the various kinds of fish throughout the year, with particulars as to their sizes, the nature of their food, &c., which will help to clear up the hitherto obscure problems as to the minimum size of sexually mature individuals, the commencement and duration of the reproductive period, the spawning places, and many other points of great interest." If the reviewer will now peruse p. 8 of the Seventh Report, he will find it there stated that these inquiries were "*devised by Dr. Wemyss Fulton*" (in 1887), which is the fact.

T. Wemyss Fulton.

20 Royal Crescent, Edinburgh, November 3.

14 *Lorne Street, Leith, November* 1.

Dear Sir,—I have read the article in Nature of October 30, and desire to say that I consider the footnote at p. 161 of part iii. of the Board's Report for 1889 a sufficient acknowledgment of my work in connection with the immature fish investigation.

You have always from the first acted towards me in a very friendly manner, and would be the last to detract from any credit belonging to me. Thomas Scott.

Dr. T. Wemyss Fulton, Secretary Scientific Investigations.

Araucaria Cones.

Having been away from home, I have only now seen the Duke of Argyll's letter in Nature of November 6 (p. 8), relating to the cones of Araucaria. Doubtless before this some of your correspondents have answered the Duke's inquiry.

It is not very unusual for the *Araucaria imbricata* to produce cones. The first I myself remember to have seen were on the old tree in the Royal Gardens, Kew, in the summer of 1851 or thereabouts. The female cones are large globular masses, the constituent scales of which are not (superficially) very different from the ordinary leaves. What the Duke describes are evidently the male catkins. The trees are ordinarily diœcious, but I have once seen and figured an example in which male catkins and female cones were borne on the same tree.

London, November 14. MAXWELL T. MASTERS.

IN the garden of the house Bleckley, Shirley Warren, Southampton, there is an Araucaria that for many years past has produced annually a large number of cones. The cones are from 40 to 100 in number, and very large, so that their breaking up and falling on to the lawn is a serious inconvenience, it being difficult to sweep them up. No fertile seeds have been produced by this tree, which from all I have been able to learn is the finest Araucaria in England; the trunk is over 6 feet in circumference some 2 feet above the ground. There is no history of the tree.

Cambridge, November 15. D. SHARP.

IF the Duke of Argyll refers (November 6, p. 8) to ovule-bearing cones, which are spherical and about 7 inches in diameter, these have been plentifully produced in almost every part of the British Isles.

Male or pollen cones (catkins), of cylindrical shape and 3 inches long, are, however, extremely rare, although they have been produced in the Bicton Pinetum and on one of Earl Derby's Kentish properties. A tree at the latter place bears annually, and has done so for some years, a heavy crop of perfectly-developed pollen cones; indeed, so great is the quantity that at a short distance away the tree has quite an unusual and remarkable appearance. A. D. WEBSTER.

Holwood Estate, Kent, November 17.

ATTRACTIVE CHARACTERS IN FUNGI.

THIS subject, which has been introduced by a letter from a correspondent (November 6, p. 9), is one of considerable interest, but it is one also of great mystery and difficulty. In dealing with fungi of the mushroom type we are in contact with a class of plants so different from Phanerogams that it is at once evident that we must not draw the same conclusions from a similar series of initial facts. It is well known that certain fungi possess strong and characteristic odours, and others very conspicuous colours, both of which features are presumed to have some value in the biography of the plant, but *what* influence and *what* value it is not so easy to determine as in the case of plants in which cross-fertilization has to be effected. It is by no means certain that there is any special act of fertilization at all; it is even doubtful if any fertilizing element exists. For nearly a century it has been thought possible to find a fecundating element in Agarics, but all efforts at demonstration have failed.[1] Most of these investigations have been directed to the cystidia, large cells which are recognized as projecting, more or less, on the surface of the hymenium, but these could not be identified with any known process of fecundation.[2] M. de Seynes, after patiently investigating the hymenium of the *Hymenomycetes*, arrived at a negative result, and this has not since been disturbed. "The hymenium," he says, "has not yet offered an organ which we may suppose in reality to be the male organ;" and he adds, "one sole and self-same organ is the basis of it, according as it experiences an arrest of its development; as it grows and fructifies, or as it becomes hypertrophied, it gives us a paraphysis, a basidium, or a cystidium; in other terms, atrophied basidium, normal basidium, hypertrophied basidium: these are the three elements which form the hymenium. Does it develop either outside the hymenium or on the hymenium, at a time, or in a part which has not yet been discovered, organs which yield pollen, spermatia, antherozoids, or any other fecundating agent? This is what remains to be discovered."[1]

Amongst British mycologists Mr. Worthington Smith has been the most persistent in belief that Agarics are subject to hybridism, which implies cross-fertilization, but he has not contributed much towards the establishment of the proposition that fertilization really exists, except perhaps to emphasize the suggestion that the cystidia are male organs. In his paper on the reproduction in *Coprinus radiatus*,[2] he remarks: "I consider it quite possible that the mere contact of the threads (or fluid) from the cystidia with the threads from the unpierced spores may be sufficient for the production of a new plant." In more direct reference to the question of hybridism he writes:—"On a dung-heap, which will produce *Coprinus radiatus*, other species, as *C. nycthemerus*, &c., are sure to appear; and not only do allied species come up in company with *C. radiatus*, but every intermediate form between one and the other may be gathered any morning. These latter plants belong to no species described as such, but are natural hybrids, doubtlessly produced by the spermatozoids of one plant piercing the spores of another. Amongst the larger species of Agarics similar forms are quite common, and they prove sore puzzles for those men who only want *names* for the fungi they find."

No one with any extended experience in field work can gainsay that individual Agarics are often met with which strongly suggest hybridism. These forms are so intermediate between more typical forms, with which they were perhaps growing, that it is difficult to get rid of the idea altogether that they are modifications due to some such influences as in higher plants we attribute to hybridization. It would be very unphilosophical to deny absolutely that they are possibly hybrids; but, on the other hand, it would be as bad to declare them hybrids until some sort of impregnation can be demonstrated.

Admitting that hitherto all efforts to discover any process of fertilization in Agarics, which will stand the test of examination, has failed, the difficulty is increased in speculating upon the "why and wherefore" of the phenomena of odour, taste, and colour, in the larger fungi. Yet, notwithstanding this, we may approach nearer the desired end by endeavouring to collect facts, which may some day, by accumulation, serve as a basis for hypothesis.

Why do certain fungi possess very strong odours, which to our olfactory nerves are agreeable or disagreeable? There is a small whitish Agaric, not uncommon amongst grass in woods, which has such a strong and peculiar odour that it is named *Agaricus* (*Clitocybe*) *fragrans*. It is not more than about an inch in diameter, is mild to the taste, very pleasant to eat when cooked, and the odour remains after the plant has been dried for some time. Some persons detect in it a resemblance to anise, others to melilot, or the Tonquin bean, and others again regard it as an odour peculiarly its own. Two or three other species, to be found in similar localities, might, at a glance, be confounded with it, but that they are destitute of the odour and pleasant flavour. The novice could at once distinguish this fungus from its associates by its odour, but wherefore it should smell so sweet whilst the others do not is at present an unsolved mystery. It is certainly not specially attractive to insects, and we have never found it attacked by slugs; perhaps the odour is disagreeable to them.

Another Agaric may be found amongst dead leaves, which is twice as large, and of a singular pale verdigris-green colour (*Agaricus* (*Clitocybe*) *odorus*). It possesses very nearly the same odour, possibly a little stronger, and the same agreeable taste. This, again, we have always observed to be free from any indication of attacks from slugs. We have failed to detect the same odour, except

[1] De Bary, "Morphologie und Physiologie der Pilze," cap. v.
[2] See *Grevillea*, vol. i. (1873), p. 181.

[1] *Grevillea*, vol. ii. p. 41.
[2] *Grevillea*, vol. iv. (1875), p. 53.

perhaps very faintly in one or two instances, in any other species of Agaric. There is, however, a *Lactarius* which resembles an Agaric in form, but contains a copious supply of white milk somewhat acrid to the taste, and an odour not much unlike but rather more camphoraceous than the two Agarics. This is *Lactarius glyciosmus*, which has a reddish-cream colour when dry, but is more ruddy when moist. In addition we may mention a densely tufted fungus growing on stumps, *Lentinus cochleatus*, with a fainter but similar odour to the *Agaricus odorus*. One species of *Hydnum*, in which the gills of the hymenium are replaced by spines, has but a faint smell of melilot when fresh, but in drying this odour is intensified, and remains persistent for three or four years. This is known as *Hydnum graveolens*, but is somewhat rare in Britain. Finally, we have two species of woody *Trametes*, found growing on trees, which possess an odour of the same type. These are *Trametes suaveolens* and *Trametes odora*, and quite resembling them is *Trametes inodora*, which has no distinct odour at all. The chemical character of this odour has never, to our knowledge, been investigated, but the point now in question is the reason for its existence, and for this all conjectures hitherto offered are weak. In several of the fragrant species it will be remembered that there are similar and allied species which have no perceptible odour; it is possible that this fact may have some value in the investigation.

Passing over other types of odour which prevail in fungi, we will take as a final example a pungent odour as of nitric acid, which is by no means uncommon. It is rather rare with white-spored Agarics, but is often met with in pink-spored species, many of which are either doubtful or poisonous. The majority of instances amongst white-spored species will be found in the sub-genus *Mycena*, wherein the species are small and delicate, such as *Agaricus* (*Mycena*) *alcalinus*, and *Agaricus* (*Mycena*) *ammoniacus*, to which may be added also *Agaricus* (*Mycena*) *metatus* and *Agaricus* (*Mycena*) *leptocephalus*, although in a less degree; but the culminating examples will be found in the *Hyporrhodii*. One of the commonest of woodland Agarics in the autumn is *Agaricus* (*Entoloma*) *nidorosus*, which the nose will always determine if the eyes should fail. It is a pale mouse-coloured species, generally about 2 or 3 inches in diameter, which the odour would be sufficient to deter anyone from feeling desirous of tasting, if it had not also a very suspicious appearance. It may be taken for granted that where this odour prevails the species are not edible, even should they escape being positively poisonous. There is a suggestion of the same odour in *Agaricus* (*Hebeloma*) *elatus*, but a full development of it in *Agaricus* (*Hebeloma*) *nauseosus*. It becomes faint in *Agaricus* (*Pholiota*) *heteroclitus*, as it is also in *Cortinarius nitrosus*; but in all there is more or less of the same pungency, which recalls to mind the fumes of nitric acid. It may be inferred from the name of *Hygrophorus nitratus* that it possesses the same odour, and others might be named which partake of it in a less degree, so that this may be accepted as another type of odour to be found in many species of fungi. Here, again, the same question arises as to what value this peculiarity may be supposed to possess for the plant itself, because it is no symptom of decay, since it is present with the plants named above in their youngest and in their most healthy condition. Nothing that we have observed would suggest protection from, or attraction for, insects or mollusks.

Thus much for odours, which must be taken as suggestive, and not by any means exhaustive. The subject of taste may be passed over as of doubtful value in estimating attraction or repulsion, or at least it is of secondary importance, and should not stand in the way of a few suggestions on the subject of colour. It may be premised that, although such a large number of species of Agarics flourish amongst grass, very few possess a green colour. We have alluded to one which is most commonly found amongst dead leaves; *Russula virescens* is seldom seen amongst grass, and the colour of *Agaricus æruginosus* is not in the least concealed when growing amongst grass, until it has lost the greater part of its green gluten and exhibits the dirty yellow cuticle. Dull-coloured species, of various shades of olive, brown, and grey, are common enough, so as readily to be confounded with the soil, stones, and dead leaves, upon or amongst which they are growing; but what excuse can be made for the bright red and yellow species appearing in such gaudy attire? Reds verging upon deep orange, as in *Agaricus* (*Amanita*) *muscarius*, and passing through all stages of vermilion and carmine to deep purple, are by no means uncommon, especially in the genus *Russula*. And here it may be remarked that the species of *Russula* are to be seen in greatest plenty and perfection during those months when flowers are exhibiting their brightest colours, and before the mass of proper Agarics make an appearance. A red *Russula* in October or November would be a far more conspicuous object than if it occurred in June or July, when *Russula* puts in an appearance. *Hygrophorus*, on the other hand, is a late genus, containing some very bright red and yellow species; but these are small, and commonly so immersed in the grass, on lawns and pastures, that they are not conspicuous. Their "season" is October and November. It is easy enough to comprehend the advantage of coloration to such species as *Hygrophorus psittacinus*, *Hygrophorus conicus*, *Hygrophorus Wynniæ*, and even of *Hygrophorus chlorophanus*, when seen growing amongst autumnal grass. The large species of *Russulæ* would, under the same conditions, be most conspicuous. Out of forty British species there are not less than twenty-five which are of some tint of red, or have varieties of those colours. What protective value can there be in expanded disks of bright scarlet 4 or 5 inches in diameter? If it should be contended that they are attractive, and not protective, then it becomes a question as to what they may attract. Slugs are fond enough of devouring not only red, but white and dull-coloured species, not refusing a meal upon one of the most poisonous (*Russula emetica*), and still it is the top of the pileus they devour, apparently in preference to the gills, so that they cannot be regarded as intelligent workers in the distribution of species.

A careful examination of the plates in any good illustrated work on the Agarics will show that in the whole of the old genus *Agaricus*, adding also *Coprinus* and *Marasmius*, the number of brightly coloured species are remarkably few. In the genus *Cortinarius* the colours are brighter, but they are not conspicuous when growing, because violet is not a demonstrative colour, and pale yellow, or lemon colour, is not observable amongst dead leaves. If space permitted it could be shown that, in a majority of instances, the colours of Agarics are protective, inasmuch as they harmonize remarkably with the matrix that supports them. With *Russula*, *Lactarius*, and *Hygrophorus*, the case is different, for there are many very obtrusive species, notably the red ones, for which we cannot formulate an excuse.

A word or two, in conclusion, on the intermediaries, or agencies, for the diffusion of fungi. It must be understood that in this communication we are confining ourselves to the large, or pileate, fungi, principally of the mushroom type. The agents named in the letter already alluded to are: "Horses, oxen, sheep, foxes, squirrels, moles, birds, snails, and insects." Squirrels are very fond of *Boleti* especially, but they eat the top of the pileus in preference to the pores, or spore-bearing surface; snails and slugs are undoubtedly mycophagous to a considerable extent. Of birds we have no evidence, as far as I am aware; ducks will eat fragments, when thrown to them, of such known virulence as *Agaricus muscarius*, and *Boletus luridus* without subsequent inconvenience, but it is doubtful if birds seek fungi, except to beat them in pieces and pick out the larvæ. Whether horses, oxen, and sheep really *eat* the common mushroom, we venture to call in question, but they *do* eat the grass upon which fungus spores have fallen. We have observed horses, cattle, and sheep eating the grass all around where mushrooms have been growing, and seen them pass on, leaving the mushrooms for us to gather on our own account. This does not show much animal predilection for fungus food, and hardly bears out the paragraph that "horses, sheep, and oxen are all readily attracted by the taste and mealy smell" of the mushroom. Without venturing to throw doubt upon the old faith that the spores of the mushroom are doomed to pass through the entrails of a horse, or that a horse or cow may sometimes even eat a mushroom if one comes in its way, still we have great hesitation in accepting as an article of belief that horses are really so fond of fungi that they seek them out, and devour them bodily, for the sake of the preservation of the species. Mushroom gatherers by preference go into meadows and pastures where horses and cattle are feeding in order to fill their baskets, but this could hardly be the case if the animals themselves were so fond of the delicacy, and hence it may be inferred that it is not wholly true that mushroom spores pass through their host because that host recognizes the mealy smell and pleasant taste of the mushroom itself, but rather that they are swallowed unwittingly with the grass over which they are dispersed.

The general question still remains unanswered: "What can be the service which the presumably attractive characters of fungi induce animals to perform for them?" In the case of the *Phalloideæ* there need be little hesitation in furnishing an answer. The fœtid odour of *Phallus*, *Clathrus*, and their allies, undoubtedly attracts flies in great number, and these latter suck up the slimy mass, which contains the spores, with such avidity that scarce a speck is left. These spores are all most remarkably small,[1] so as to leave no doubt as to their being ingested whole, and probably excreted in the same condition, but how, when, and where, is a mystery still. The inference would be that, if true in this instance, why not similarly in others? and hence the inquiry. Unfortunately the data are too few for generalization, and all we can do is to demonstrate that the subject is worthy of investigation, and, as Mr. Straton has observed, "one that requires the gathering together of much individual observation in all parts of the world." Few people hitherto have considered fungi of sufficient interest or importance for any other effort than to kick them over whenever encountered, but in this respect a reform would be imminent, if, by reiteration of the questions here set down, and a wider distribution of suggestions as to the kind of observations required, a larger number of persons could be interested in looking for and recording them. If there are no sexual elements to be discovered, it is still desirable to ascertain what conditions are requisite to secure the successful germination and growth of the agamospores, and how intervening agents might aid the process. The least glimmer of light is always welcome in a dark place.

M. C. COOKE.

[1] Not more than 3 micromillimetres in diameter.

LUMINOUS CLOUDS.

LUMINOUS clouds, which were first seen in 1885, are now acknowledged to have so much importance that it may be worth while to present a brief survey of the phenomenon and the facts established by the observation of it.

On June 23, 1885, about 9.50 p.m., local time, I noticed an extraordinary brilliance produced by light-clouds in the north-western sky. I had always previously directed great attention to clouds, and on this account these bright clouds appeared to me the more surprising and puzzling. About 9.50 p.m. the north-western and northern sky was covered, to the height of about 20°, with a layer of bright cirrus-like clouds, which reached from about N.W. to N.N.E. In this layer, the lowest part of which was concealed from me by houses and trees, three horizontal zones could be distinguished. The lower zone was without lustre, and had a yellowish appearance; higher up there was a strip, several degrees in breadth, which shone with an extremely beautiful, white-gleaming, silver-like light; above this strip was another like it, but not quite so brilliant, of a bluish tint. The light of the central zone was comparable to the light of the nearly full moon, when it stands at sunset at about 10°, more over the eastern horizon. About 10.30 p.m. the height of the upper limit of the phenomenon had been somewhat lowered; the three zones were still there, but had become —especially the uppermost one—somewhat narrower.

The position of my place of observation—Steglitz, near Berlin—is 52°·5 N. lat.; about 9.50 p.m., local time, the depth of the sun below the horizon was about 9°. It is well known that, at this depth of the sun, ordinary clouds cannot any longer be affected by direct sunlight.

The same phenomenon appeared pretty often in the course of the following weeks; and I had, therefore, repeated opportunities of studying its peculiarities. I have never seen anything of the same kind at the time of sunset. As a rule, the phenomenon began to appear from 15 to 20 minutes—but sometimes 40 minutes, or more—*after* sunset. Several times I remarked that almost the whole sky—with the exception of a segment in S.E. at the height of from 10° to 20°—was covered by the gradually increasing brilliance. In all these cases a gradual, progressive extinction of the phenomenon, proceeding from S.E. to N.W., was observed. The luminous clouds, when they first shone, generally gave forth only a feeble light. As the sun sank deeper, a gradual, but in the end complete, extinction of the phenomenon took place from the south-eastern side; but at the same time the light of the remaining part became steadily stronger, until it reached its highest degree of strength, when the upper limit in the N.W. had a height of about 12°. From that point onwards the strength of the light decreased.

On some evenings the phenomenon was specially striking, less in consequence of the light than in consequence of an occasional want of light. Several times I observed—the sky having been perfectly clear when the sun set—that about an hour after sunset an absolutely impenetrable black wall, like a threatening thunder-cloud, appeared in the N.W., from the horizon to a height of from 5° to 20°. Higher up, on the contrary, the silver-bright shining showed the presence of the phenomenon. Gradually the black shadow disappeared, from above downwards, and gave place to the intense shining.

Towards the end of the month of July 1885 the luminous clouds disappeared, and it seemed as if the phenomenon had come to an end. It was therefore the more surprising when, towards the end of May 1886, the phenomenon again presented itself suddenly. As in the preceding year, it remained visible, with some interruptions, until the beginning of August. The phenomenon has since been repeated from year to year, always at the same season.

As the result of incessant efforts, I have succeeded in establishing that luminous clouds migrate in the atmosphere of the earth in such a way that during the months of December and January they are to be found in the southern hemisphere at the latitude of from about 48° to 60°. No information with regard to the phenomenon in equatorial regions has yet been received. This suggests the possibility that in passing through these regions it is not visible; but when we consider that also in the temperate zone there are extensive districts in which the phenomenon must certainly have presented itself, but from which no record of observations has hitherto come, the fact that it has not yet been observed at the equator will not lead us to conclude that it is not visible there in intermediate times.

The above-mentioned decrease of the apparent height of the upper limit of the phenomenon, coinciding with the deeper sinking of the sun, causes us to recognize that it is due mainly to direct illumination by the sun. Starting from this assumption, we may readily find the principles for the determination of the height of the phenomenon. During the first years, therefore, I frequently made measurements of the apparent height of the loftiest point of the arc which limits the phenomenon towards the S.E.; and, having regard to the time of the measurements, I found that the distance of the phenomenon from the surface of the earth was from about 50 to 60 kilometres.

The knowledge of this extraordinary height excited in me the most intense interest, and my aim now was to determine the height by a more trustworthy method. For the ultimate success of my efforts I am especially indebted to the co-operation of Prof. Förster, Director of the Berlin Observatory. On the evening of July 6, 1887, Dr. Stolze and myself (the former having taken up his position in Berlin, while I observed the phenomenon from the Potsdam Observatory) succeeded in each getting two simultaneous photographs of the luminous clouds. The calculation made in accordance with these photographs gave a height of about 75 kilometres. But this estimate was not perfectly satisfactory, so far as precision was concerned; for, in the first place, the basis of about 26 kilometres was small; secondly, the direction of the basis was such that it formed with the direction towards the luminous clouds too small an angle; and, thirdly, the photographic apparatus employed had not been worked with sufficient exactness.

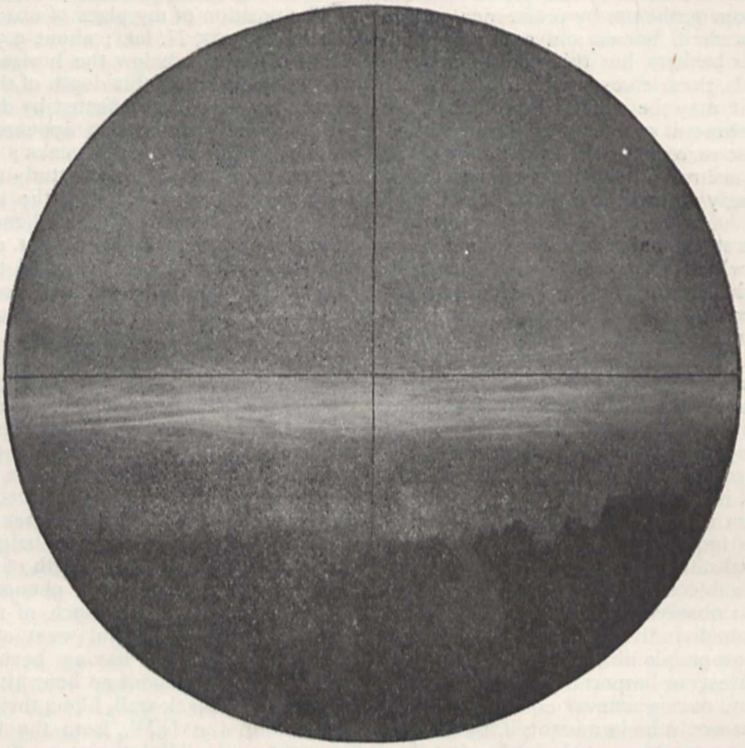

FIG. 1.

In the year 1889 the luminous clouds were at last repeatedly and simultaneously photographed, with improved apparatus, at Steglitz and Nauen, which are distant from one another about 35 kilometres, and lie with regard to one another in the direction from east to west. At Rathenow also, 70 kilometres west from Steglitz, photographs were taken. These were not exactly simultaneous with the others, but the time differed only by a few seconds; and they are useful at least as a means of checking the results obtained from the photographs taken at Steglitz and Nauen.

From these photographs it is inferred with great certainty that the distance of the luminous clouds from the surface of the earth on July 2, 1889, was 81 kilometres, and that it was 82 kilometres on July 31, 1889. For June 12 there is an estimate of 90 kilometres, but this is less certain than the other two.

These results follow from the measurement of 108 different points, corresponding to one another, which are distributed on six pairs of plates; and it is interesting, from the remaining errors of the single groups, to test more closely the question what part is taken in these errors by, say, the thickness of the cloud-layer in a vertical direction.

It is well known that there is a certain law relating to the probability of the distribution of errors in accordance with their greatness. According to this law, it is to be anticipated that errors which lie between the triple and the quadruple value of the mean error, occur *once* among 80 different points which have been measured in the photographs of July 2 (in which the conditions of accuracy were the most favourable); and, further, that of errors which lie between the double and the triple value of the mean error *six* are to be expected. In reality, the calculations agreed very well with the number of observed cases—viz. 2 and 5 respectively.

These figures show very plainly that the differences of the results with regard to the height are essentially a consequence of errors of measurement, and that the thickness of the cloud-layer itself was very small, perhaps only the fraction of a kilometre. With this agrees the almost exactly similar aspect of the phenomenon at the two places of observation.

Figs. 1 and 2 represent the phenomenon as it appeared on July 2, 1889. The photograph reproduced in Fig. 1 was taken in Steglitz at 13h. 21m. 0s., Berlin mean time, and Fig. 2 simultaneously at Nauen. It is interesting to observe the parallactic shifting of the same cloud-points, in the two illustrations, in a fixed direction. In each of the illustrations, two stars, α and β Aurigæ, appear. On account of the enormous distance, the lines of direction, in which one and the same star is seen simultaneously from different points of view, are parallel to one another. Hence the deviation of two corresponding cloud-points, in the illustrations, with regard to one and the same star, gives a measure for the parallax of those cloud-points, on the supposition that the focal distance of the photographic apparatus is known. The focal distance of the two sets of apparatus was precisely determined by the photographing of stars, and proved to be almost exactly 200 mm. In accordance with this the above-mentioned height of 81 kilometres was found.

The following peculiarities, which observation of luminous clouds has firmly established, are of great interest:—

(1) Luminous clouds had in general a very rapid movement from north-east to south-west. In some cases movements also took place in the opposite direction; but these were always much slower—and they were also much less frequent—than those first named.

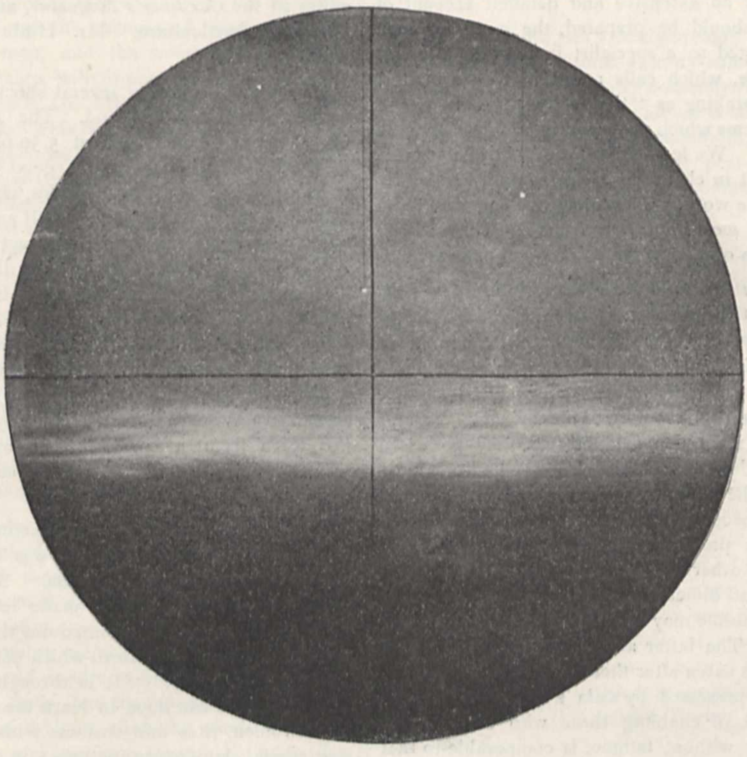

FIG. 2.

(2) Since their first appearance, luminous clouds have to a considerable extent waned. In the year 1890 they have displayed a beautiful brilliance during only about three nights; at other times the light was for the most part very feeble. Very probably we must connect with this decrease of light the fact that the apparent height at which the clouds have been seen, has been very much smaller in the last years than it was formerly.

(3) Luminous clouds present themselves generally much more brightly—therefore are more frequently visible—after than before midnight. While in the first years they appeared before midnight very frequently, they have done so in the last years very seldom. After midnight they still appear pretty often. Whether this distinction existed during the first years, was unfortunately not established, because the regular observations were then usually limited to the time before midnight.

O. JESSE.

NOTES.

THE anniversary meeting of the Royal Society will this year be held on Monday, December 1, St. Andrew's Day falling on a Sunday. The medals are to be given as follows:—The Copley Medal to Prof. Simon Newcomb, for his contributions to gravitational astronomy; the Rumford Medal to Prof. Heinrich Hertz, for his work in electro-magnetic radiation; a Royal Medal to Prof. David Ferrier, for his researches on the localization of cerebral functions; and a Royal Medal to Dr. John Hopkinson, for his researches in magnetism and electricity; the Davy Medal to Prof. Emil Fischer, for his discoveries in organic chemistry; and the first Darwin Medal to Mr. A. R. Wallace, for his independent origination of the theory of the origin of species by natural selection. The anniversary dinner will take place at the Hôtel Métropole.

LORD RAYLEIGH has been appointed an honorary member of the Bavarian Royal Academy of Science.

PROF. J. A. EWING, F.R.S., has been elected Professor of Mechanism and Applied Mathematics at Cambridge, in succession to Prof. Stuart.

MR. WILLIAM LEADBETTER CALDERWOOD, who was for several years naturalist to the Fishery Board for Scotland, has been appointed Director of the Laboratory for Marine Zoology at Plymouth.

SOME time ago the Phi Beta Kappa Society proposed that the four hundredth anniversary of the discovery of America should be signalized by a memorial history of American literature and science. Two prizes of 3000 dollars each were to be offered for the best general survey of American literature and science respectively; and, in addition to this, it was proposed that the preparation of an extensive and detailed account of scientific achievement should be prepared, the work for each department being entrusted to a specialist in that department. The New York *Nation*, which calls attention to the matter, speaks of this last undertaking as "the really serious task, and the only part of the scheme which possessed in a high degree the monumental character." We learn from the *Nation* that a committee having the project in charge is about to meet and confer upon the initiation of the work. The committee consists of the presidents of six of the most important American Universities, together with one or two other gentlemen of equal eminence.

IN the *Kew Bulletin* for November many interesting facts with regard to the cultivation of Liberian coffee are brought together. The same number contains an excellent account of the cola nut (*Cola acuminata*, R. Br.). In early times, cola nuts were supposed to be used merely as a means for rendering water sweet and palatable when drunk before or after meals. "But," says the *Bulletin*, "it was soon evident that they possessed other properties, and that they had been selected as if by intuition on account of the property which undoubtedly they did possess of supplying a necessary stimulus to those who have to endure an occasional or prolonged deficiency of animal food; for in West Africa, as in other parts of the tropics, the flesh of animals is often scarce and difficult to procure. The use of cola nuts to render water palatable may be compared to that of olives in European countries. The latter are well known to enhance the flavour of whatever is eaten after them. On the other hand, the power said to be possessed by cola nuts of staying the cravings of hunger, and of enabling those who eat them to endure prolonged labour without fatigue, is comparable to that ascribed to the leaves of the coca plant of Ecuador and Peru. In fact, cola nuts in Western Africa play the same part that *Erythroxylon Coca* does in South America."

ON Monday, the Master (Sir James Whitehead), the Wardens and Court of the Fruiterers' Company, and others, had an interview with the Lord Mayor at the Mansion House, to seek his aid in a project for the encouragement of the culture of British fruit. Sir James Whitehead, addressing the Lord Mayor, said that, having regard to the great success which had attended the recent exhibition of fruit at Guildhall, the Fruiterers' Company were now proposing to increase their operations in the same direction. Their idea was to have fruit shows in different parts of the country, similar to the annual shows of the Royal Agricultural Society of England, in co-operation with the local horticultural societies. During these shows there would be lectures on various subjects connected with the cultivation of fruit. It would be the aim of the Company to give the warmest encouragement to the various horticultural societies, and to stir up a spirit of emulation among the local and parochial organizations. The Company had arranged that the committee of experts who recently assisted them in connection with the Guildhall exhibition should meet once a month, and receive and answer questions on the subject of fruit culture. It was estimated that to carry out these objects a fund of about £20,000 would be necessary. It was believed that landed proprietors and the City Companies would be willing to aid this effort, and they might even obtain the assistance of a Government grant. What they asked the Lord Mayor to do was, first, to allow a great public meeting to be held at the Mansion House, and, secondly, to organize a Mansion House fund with the view of raising the necessary sum. The Lord Mayor cordially agreed to convene and preside over such a meeting as was suggested, but reserved his decision as to the raising of a Mansion House fund.

MR. SHIRLEY HIBBERD, the well-known horticulturist, died at his residence at Kew on Sunday. He was for many years editor of the *Gardener's Magazine*, and was the author of many works on horticulture. Mr. Hibberd was in his sixty-sixth year.

ON Saturday evening several shocks of earthquake were felt in the north-east of Scotland. The *Daily News* says that the first shock was experienced at 5.50 p.m. in Inverness, and that it lasted about 30 seconds. A good deal of damage was done to property by the falling of gables, chimneys, &c. The inhabitants were very much excited. Half an hour afterwards a second shock was experienced, but was not of so severe a character. About 6 o'clock a sharp shock of earthquake was felt at Forres. The disturbance was accompanied by a rumbling noise, with heaving and convulsion, which lasted from 15 to 20 seconds. It was felt over a radius of several miles. The *Times* says the earthquake was felt at Beauly, Inverness-shire, where many shops and houses were severely shaken, and furniture was thrown down. In Western Lovat a chimney-stack was knocked over. We learn from a correspondent at Nairn that "a slight vibration" was felt there and in the surrounding district "about 6 p.m."

AT the fourth annual general meeting of the Anthropological Society of Bombay, an address was delivered by the retiring President, Mr. Denzil Ibbetson. Speaking of the valuable contributions that might be made to anthropology by native inquirers, Mr. Ibbetson pointed out that sources of information are freely opened to them to which Englishmen can gain access only with difficulty. "It is through their agency alone," he said, "that we can hope to learn the rites and customs particular to women, rites and customs which I believe to possess a very special significance, as being in many cases handed down directly from the aboriginal women of the country, with whom the subsequent immigrants intermarried. And their facilities of communication with the masses are so infinitely greater than our own, that I look forward to the most valuable results so soon as we have a body of native gentlemen intelligently studying the anthropology of India. At present, in Upper India at any rate, a native who is sufficiently educated to understand the nature and object of our inquiries is too often hampered by his religious education, which causes him to describe the religion of the peasantry as it should be rather than as it is, and by his pride of caste, which prevents him from interesting himself in those whom he considers beneath his notice."

A PASSAGE in an appendix to Mr. Scott's last report on the administration of the Northern Shan States shows the extraordinary mixture of peoples and tongues in this region, and shows also what a task there is for the ethnologist of the future to unravel the tangled skein presented to him by the Shan State of Mainglin. The report says the population consists of Shans, Las, Was, Kachins, Shan-Taloks, Myen, and a tribe known as Mutso. The Las men dress like Shans, but their clothes are of black or dark-blue stuff. The women wear black coats and black *tameins*. The Was, both men and women, wear black coats and a striped black and white *lungi*. The Myen wear clothes like Shans, but black, and are said to shave the head, leaving only a pigtail like the Chinese. They are represented as speaking the same dialect as the Chinese Shans. The Mutso tribe is so called by the Shans from their being hunters. They, like the Las and Was, have a separate language, but in every tribe there are a good many men who understand Shan. The Myen tribe are said to be *nat*, or spirit, worshippers, but among the Las and Was there are a good many Buddhists.

IN the September number of the *Bulletin of the Italian Geographical Society*, Colonel C. Airaghi gives an account of an exploration in Dembelas, a region of the plateau of Northern Abyssinia, watered by the River Mareb. The memoir deals with the topography, geology, and natural history of the district, with the aid of diagrams. Considering the proximity to the equator, the climate is very mild, though the changes of temperature are often rapid. A general map, and the notes of his fellow-explorer, Captain St. Hidalgo, will appear in the next issue. The most important paper is Dr. Arthur Wolynski's on the population of the Caucasus. This is estimated at 6,171,400, of whom 1,217,400 are Mongols, mainly Tartars. Of the whites 1,854,000 belong to the native Caucasian races—these are classified carefully; 41,000 are Semites, mostly Jews; the remaining 3,059,000 are Aryans, almost all groups being represented. The Russians number nearly two millions, while Dr. Wolynski estimates the Armenians at 750,000, and the Persian group at 339,000.

THE Meteorological Sub-Committee of the Croydon Microscopical and Natural History Club is doing good work by collecting and publishing daily rainfall values at a number of stations in the counties of Kent and Surrey, together with brief general notes on the weather of each month. The Report for 1889 shows that the year began with a staff of thirty-eight observers, superintending forty-five stations.

IN the *Meteorologische Zeitschrift* for October, M. Nils Ekholm gives an account of a method on trial at the Meteorological Office of Stockholm, which seems likely to throw some light upon what has hitherto been a difficult matter to deal with, namely, the determination of the path taken by storms. He calculates, from the telegraphic weather reports, tables of the density of the atmosphere, and constructs from the data synoptic charts of this element, and finds that they give a better clue to the movements and origin of cyclones than the usual method of a comparison of the isobars and isotherms alone. He finds that storms move in the direction of the warmest and dampest air, parallel to the lines of equal density, leaving the rarer air to the right-hand. A few empirical rules are quoted from about a hundred cases which have been investigated.

MR. T. TUHLIN has recently published in the *Nova Acta* of the Royal Society of Sciences of Upsala, a paper on the nocturnal temperature of the air at different heights up to 24 feet, from hourly observations taken during the winters of 1887 and 1888, in the grounds of the Upsala Observatory. The observations were made mostly while snow lay upon the ground, both with thermometers with and without screens, and were intended to form a sequel to the series made by Mr. H. E. Hamberg during the summer season. The first part of the paper contains a *résumé* of the experiments made since 1778. The following are some of the chief results arrived at in the second part of the paper. The decrease of temperature by radiation from unprotected thermometers over snow remained almost constant at heights above half a metre. During clear nights the temperature increased with height, from two or three hours before sunset until two hours after sunrise, and the lower the temperature, the greater was the increase. During cloudy or foggy nights the temperatures at different heights were nearly equal; but if the clouds were high and thin, the increase of temperature with height was only slightly hindered. The surface of the snow was found to be colder than the surrounding air.

A CORRESPONDENT of *Die Natur* describes the following incident, which he himself observed. On the branch of a tree was a sparrow's nest, in which were some young sparrows, and not far off sat the mother. A male sparrow, coming along that way, was attracted by her, and began to make advances, which were steadily rejected. By and by he rested on a neighbouring branch, and the mother flew away in search of food for her young. No sooner had she departed than the disappointed suitor pounced down upon the nest, caught one of the young sparrows in his bill, went off with it a little way, and then dropped it, apparently rejoicing in its death.

PROF. F. W. PUTNAM lately brought under the notice of the Boston Society of Natural History some fresh evidence of the fact that man was in America contemporaneous with the mastodon and mammoth. This evidence is afforded by a rude figure unquestionably representing a mammoth, scratched on a portion of a Busycon shell found under peat in Clairmont County, Delaware. Around the shell were human bones, charcoal, bones of animals, and stone implements.

ALTHOUGH the adult crab-eater, cobia, ling, or coal-fish (*Elacate Canada*), as the species is variously designated, is well known, the young has escaped notice until recently. In August, 1887, Dr. T. H. Bean caught two specimens in Great Egg Harbour Bay, New Jersey; and these he has described in a Bulletin of the U.S. Fish Commission. Dr. A. K. Fisher, in some notes he has just contributed to the Proceedings of the U.S. National Museum, mentions that, in June 1876, he received a young fish of this species, measuring 95 mm. in length, from a fisherman who caught it in a minnow seine about a mile north of the village Sing Sing, New York, in the broad and shallow cove formed by the expansion of the Croton River as it enters the Hudson. Nothing could be learned of the habits of the young fish except that it was alone. This was true also of Dr. Bean's specimens; "so, presumably, the young must soon separate and lead a solitary life, as the adults are said to do." The subject is of some practical interest, because the crab-eater, in Dr. Fisher's opinion, is "entitled to prominence as a food-fish, not only on account of the delicate flavour of its flesh, but also for its suitable size."

Apropos of our notes on scientific guide-books for Switzerland, Messrs. Wesley and Son send us from their catalogue the titles of the following works:—"Tourist's Guide to the Flora of the Alps," by K. W. v. Dalla-Torre, translated by Bennett, 1886, 4*s*. 6*d*. "Tour of Mont Blanc and of Monte Rosa," by J. D. Forbes, 320 pp. text, with engravings and maps, Edinburgh, 1855, 6*s*. 6*d*. "Flore Analytique de la Suisse," by A. Gremli, Genève, 1885, 7*s*; also in English, 1889, 7*s*. 6*d*. "Flora der Schweiz," by J. Hegetschweiler, edited by Heer, with 8 plates, Zürich, 1840, 4*s*. "Sketches of Nature in the Alps," by F. v. Tschudi, 1856, 2*s*. 6*d*. (Contents: General Characteristics; Vegetable Life; Hunting of the Vulture, Chamois, Lynx, Fox, Wolf, Bear, Alpine Cattle, Glaciers, &c.). "The Tourist's Flora: a Descriptive Catalogue of the Flowering Plants and Ferns of the British Islands, France, Germany, Switzerland, Italy, and the Italian Islands," by J. Woods, with index, 586 pp. and plate, 1850, £2 15*s*.

A SECOND edition of Mr. Frederick E. Chapin's "Mountaineering in Colorado" (Sampson Low) has been published.

There are some most interesting illustrations in this book. With few exceptions, they have been made directly from negatives taken during the author's various expeditions. The reproductions are the work of the Boston Photogravure Company.

WE have received from the publishers, Messrs. Macmillan and Co., a small book of "Illustrations and Diagrams" from the works of Dr. Geikie and others, that has been arranged by Mr. Cecil Carus-Wilson to illustrate, in the Oxford University Extension lectures, the geological courses delivered by him. In order to give elementary lectures on this subject to students, one must have a most liberal supply of diagrams, &c., and they must all be placed so that they may be conveniently seen. Again, when slides are used students have not time to copy them while on the screen, and in this way many important facts which could be remembered by the presence of a diagram are forgotten. By means of Mr. Carus-Wilson's hand-book these disadvantages will disappear, and the student will have good and trustworthy illustrations from which he will be able to draw more comprehensive and accurate conclusions than he could from his own rough-sketches made at the time. The diagrams are printed on excellent paper, and at the foot of each is a short description, with the reference to the work from which it has been taken. The book is sold at cost price.

THE Indian Press, Allahabad, has published a very good series of geographical text-books for Indian schools, by the late Prof. S. A. Hill, of Muir Central College, Allahabad. The series consists of three little volumes, the first two of which have reached a third edition. The third volume, which is new, treats chiefly of mathematical and physical geography.

THE fifth edition of Prof. M. Foster's "Text-book of Physiology" (Macmillan) is being published. Part iii., which has just been issued, deals with the central nervous system. The work has been largely revised.

MESSRS. LONGMANS AND CO. are issuing the tenth edition of Quain's "Elements of Anatomy." The task of editing the work has been entrusted to Prof. E. A. Schäfer and Prof. G. D. Thane. We have received the first part of vol. i., and the first part of vol. ii. The former deals with embryology, and is edited by Prof. Schäfer; the latter with osteology, Prof. Thane being the editor.

THE second edition of "The Fuel of the Sun," by W. Mattieu Williams, has been issued. As the work was originally published twenty years ago, the author contributes a preface to the new edition, giving "a brief outline summary of the bearings of the growth of knowledge upon the subjects of the several chapters."

MESSRS. BAILLIÈRE, TINDALL, AND COX will publish in a few days an octavo volume (360 pages and 52 figures) entitled, "Researches on Micro-Organisms," by Dr. A. B. Griffiths. The work gives an account of recent researches in various branches of bacteriology.

THE Naturalists' Publishing Company, Birmingham, have issued "The Naturalists' Annual and Directory for 1891," edited by the editor of the *Naturalists' Gazette*. It consists of a number of short scientific articles, by various writers, and a directory indicating "the Lepidoptera of the months."

THE University College of Nottingham has published the Calendar for its tenth session. In a supplement the facts relating to the engineering department of the College are brought together.

BENZOYL FLUORIDE, C_6H_5COF, has been prepared for the first time by M. Guenez in the laboratory of M. Moissan at the Parisian École de Pharmacie. It was obtained by the general reaction lately proposed by M. Moissan, heating silver fluoride with the corresponding chloride in a sealed tube. Equal molecular proportions of silver fluoride, AgF, and benzoyl chloride, C_6H_5COCl, were heated together for six hours in a sealed tube to a temperature of 190°. After allowing the tube and contents to cool, the drawn out sealed end was opened at the blow-pipe in order to permit of the escape of gaseous silicon tetrafluoride, which is formed in considerable quantity owing to the energetic action of benzoyl fluoride upon glass. The tube was then drawn out about the middle of its length, and bent over in a V shape; the benzoyl fluoride was thus readily distilled off from the residual silver chloride, the second limb of the V acting as a condensing tube. The product so obtained was found, as might be expected, to contain admixed benzoyl chloride. It was therefore reheated in a second sealed tube with a fresh quantity of fluoride of silver, and the product distilled in the same manner as before. The resulting benzoyl fluoride was found to be practically free from chloride. Benzoyl fluoride is a colourless liquid possessing an odour analogous to that of benzoyl chloride, but much more irritating, the least trace of its vapour producing a copious flow of tears. It boils at 145°, and readily ignites when heated in the air, burning with a flame bordered by a blue halo. It sinks in water, which liquid slowly decomposes it in the cold, with formation of hydrofluoric and benzoic acids—

$$C_6H_5COF + H_2O = C_6H_5COOH + HF.$$

In contact with solutions of caustic alkalies it is rapidly converted into fluoride and benzoate of the alkali, the reaction being almost instantaneous when the temperature is slightly raised. It attacks glass very vigorously, with liberation of gaseous silicon tetrafluoride; benzoic anhydride, containing a deposit of potassium fluoride, is found remaining in the corroded vessel.

$$6C_6H_5COF + K_2SiO_3 = SiF_4 + 2KF + 3(C_6H_5CO)_2O.$$

Benzoyl fluoride appears, therefore, to fulfil the expectations concerning it in resembling very closely its nearest analogue, benzoyl chloride, in properties, the differences being only those due to the more active nature of the halogen fluorine, and to the remarkable affinity of the latter element for silicon.

THE additions to the Zoological Society's Gardens during the past week include an Indian Chevrotain (*Tragulus meminna* ♂) from India, presented by Mr. Greenberg; a Globose Curassow (*Crax globicera* ♂) from Mexico, presented by Mr. R. M. Pryor, F.Z.S.; two Long-eared Owls (*Asio otus*), British, presented by Mrs. Twickline; an Eyed Lizard (*Lacerta ocellata*, var.) from Southern Spain, presented by Mr. Francis Napier; a Black-headed Gull (*Larus ridibundus*), British, presented by Miss Lanze; an Alligator (*Alligator mississippiensis*) from Florida, presented by Mr. C. J. Owen; a Cryptoprocta (*Cryptoprocta ferox*) from Madagascar, purchased; two Crested Porcupines (*Hystrix cristata*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE DUPLICITY OF α LYRÆ.—At the meeting of the Royal Astronomical Society on November 14, Mr. A. Fowler exhibited some photographs of the spectrum of α Lyræ which indicate that it is a spectroscopic double of the β Aurigæ and ζ Ursæ Majoris type. The photographs were taken with the 10-inch refractor belonging to the Royal College of Science, with two prisms of $7\frac{1}{2}°$ each in front of the object-glass, and form part of a photographic study of stellar spectra recently commenced at Kensington by Prof. Lockyer with a special object. The evidence of duplicity of this kind of binary star depends upon the fact that when the two components are moving in opposite directions in the line of sight, the lines that are common in their spectra are displaced towards opposite ends of the spectrum, in accordance with Doppler's principle, and therefore appear double. When the motion is at right angles to the line of sight, there is, of course, no such displacement, and the lines therefore appear single. Hence, during a complete revolution the lines will twice reach a maximum separation and twice appear single. The principal lines in the spectrum of α Lyræ are due to hydrogen. These do not exhibit a duplication, because the separation is less than their thickness. A variation in their width, however, is very obvious. The K line of calcium is the next strongest, and is sufficiently fine and distinct to render the duplicity very apparent. Fourteen photographs of the spectrum have been taken from October 3 to November 4. The maximum separation of the K line was recorded on October 8 as 7·8 tenth-metres. On October 17, 28, and November 1, 8 p.m., the same line appeared single. At 8.30 p.m. and 10 p.m. on the last-named date, the separation was respectively 2·3 and 3·8 tenth-metres. A discussion of the data obtained from all the photographs shows that they are fairly satisfied by assuming a circular orbit, the plane of which passes through the sun, and the remarkably short period of revolution of about 24·68 hours. This period does not appear inconsistent with the relative orbital velocity of 370 miles per second indicated by the photograph taken on October 8, and is confirmed by the three photographs taken at short intervals on November 1. If 370 miles per second be taken as the maximum relative orbital velocity, the distance between the components is about 5,000,000 miles. The total mass will therefore be about 22·5 times that of the sun, and as there is no appreciable difference in the intensity of the K lines, the masses of the components are probably about equal. In the cases of β Aurigæ and ζ Ursæ Majoris, Prof. Pickering found, respectively, periods of 4 and 52 days, and maximum orbital velocities of about 150 and 100 miles per second.

PARALLAXES OF NEBULÆ.—Prof. Holden proposes to determine the parallaxes of nebulæ by taking short exposure photographs of their nuclei, and measuring their positions relative to neighbouring stars, in a similar manner to the method adopted by Prof. Pritchard for the photographic determination of the parallaxes of stars. A short exposure photograph taken at Lick Observatory, of Σ 6 and the stars near it, indicates that the method is one from which good results may be obtained.

CATANIA OBSERVATORY.—Prof. Riccò has been appointed Director of the new Catania Observatory. The work of the Observatory will be principally connected with astronomical physics, celestial photography, meteorology, and seismology.

WASHINGTON OBSERVATIONS, APPENDIX II.—This consists of an account of the work done by Mr. Asaph Hall, on Saturn and its ring, extending over the years 1875–89. Besides giving details of every observation made by him, he sums up afterwards the results obtained, from which we gather the following information. From a series of observations of the white spot on the equator of the planet, he finds the time of rotation of Saturn to be 10h. 14m. 23·8s. ± 2·30s. mean time: this differs slightly from that obtained by Sir William Herschel, who gave 10h. 16m. 0·4s., and said that his result could not be in error by so much as two minutes. The ball of the planet during the fourteen years of observation has undergone very slight changes, with the exception of the white spot which broke out on December 7, 1876. Although a careful examination was made to find if a notch could be seen in the outline of the shadow of the ball on the ring, no such phenomenon was recorded. Of the principal rings, no division was recorded in the inner ring. The Cassini division gave the impression "of not being a complete separation, or that small particles of matter remain in this partly dark space." The Encke division of the outer ring, although specially looked for could not be definitely stated as a "real and permanent division," although a slight marking was seen at times.

In addition to numerous tables of measurements of the ball and of the various rings, the author adds three plates of the planet as it appeared under favourable conditions in the opposition of 1884.

BIOLOGICAL NOTES.

RATE OF GROWTH IN CORALS.—But little is as yet known as to the rate of growth of corals under different conditions. In the third edition of Dana's "Coral and Coral Islands," a *résumé* will be found of all that is known about this subject up to 1890, but some very interesting details have been published by Alexander Agassiz in the August number of the *Bulletin of the Museum of Comparative Zoology at Harvard College.* A series of specimens are figured, which have been taken off the telegraph cable laid between Havana and Key West, in June 1888, from a portion that was repaired in the summer of 1881; so that the growths could not be more than about seven years old. It is to be observed that this portion of the cable was laid at a depth of only from six to seven fathoms, and that the district in which it was laid was most favourably situated as regards food supply to the corals. Some of the specimens belong to species whose rates of growth have not yet been recorded; they are as follows:—*Orbicella annularis*, figured on plates 1 and 2. Verrill mentions that the thickness of this coral formed in sixty-four years was not more than about 8 inches; the specimens from the Havana cable grew to a thickness of 2½ inches in about seven years. *Manicina areolata*, Ehrenb., figured on plate 3, has grown to a thickness of 1 inch; while *Isophylla dipsacea*, Ag., figured on plate 4, shows a still more rapid growth, projecting 2½ inches above the cable. Of course it is quite possible that these corals are of less than seven years' growth, but it is not probable that more than a short time passed before some of the swarms of pelagic coral embryos which must have floated past the cable found a place of attachment thereon.

TUOMEYA FLUVIATILIS, HARVEY.—Over three-and-thirty years ago the late Prof. W. H. Harvey bestowed this name on a rare and curious freshwater Alga sent to him from the United States by Prof. Tuomey, of Alabama. Harvey's description was published in the third part of his "Nereis Boreali Americana," but Harvey, as was his wont, sent a scrap of his plant to Kuetzing, who at once described and figured it as *Baileya americana.* Prof. Farlow gives the priority to Harvey's name, and we believe he is right. The systematic position of this little Alga is a matter of some importance. Harvey says, "The plants referred to Batrachospermeæ naturally group themselves into two sub-orders, distinguished from each other by the habit of the frond, but closely related in structure and fructification, and these seem to me inseparably connected by the genus Tuomeya, which unites in itself the characters of the seemingly so dissimilar genera Batrachospermum and Lemanea;" but the specimens at his command were too imperfect to enable the complete structure to be made out, and until the other day no light was thrown upon the subject. In December 1888, Mr. Holden found the species in some quantity in a brook near Bridgeport, Conn., and since it has turned up in several distant localities in the United States. Mr. W. A. Setchell has lately published the results of a very detailed investigation of the structure and development of this form, as the result of work done in the Cryptogamic Laboratory of Harvard University. It grows on smooth rocks or stones, in brooks or small streams, preferring places where the current is accelerated; in a few rare cases it has occurred upon aquatic grasses; it seems to be easily cultivated, one batch of specimens, even under such treatment, producing the reproductive organs; the plant seldom exceeds 5 cm. in height, and is bushy and rigid, in this latter respect presenting a marked contrast to the larger species of Batrachospermum, which in size, colour, and manner of growth it much resembles, and with which it very frequently grows. When dried, it is non-adherent to paper, resembling in this some of the Lemanea. Each main filament is composed of a single row of cells placed end to end, the apical cell being in a state of active growth, here and there at intervals the older cells of the filament branch out into a di- or trichotomously branched ramellus, of which several may arise from the same node, and the branchlets from these, intertwining as they increase, form a dense mass of cells round the central filamentous axis, and finally make up a hollow cylindrical frond composed of two sets of cells, somewhat resembling the structure seen in some forms of Lemanea. Before, however, this hollow cylinder is fully formed, filaments are given off from the basal portions of the inner cells of the ramelli, which differ from the ramelli cells in being cylindrical and simple. These grow downwards, forming a dense cortical layer around the axis; some, however, grow obliquely outwards, even protruding themselves beyond the outer limits of the frond, and may possibly become detached, forming new plants. Both the antheridia and procarps are to be found on the same plant, but generally on separate portions of the frond; the antheridia in shape, colour, and character of contents exactly agree with those of Batrachospermum; they are borne at the tips of branches which arise from or near the nodes. These mostly pass out horizontally to the surface of the frond. The antheridial branches are at first unbranched; their ends just beneath the outer surface of the frond are two or three times branched in a corymbosely dichotomous fashion; the antheridia are apical, spheroidal; the antherozoids are solitary; for a short time after escape they are of an irregular shape, exhibit slight amœboid motion, but soon become globular and motionless. The female organs are borne upon especially modified procarpic branches; in the axil of one of the ramelli, arise one, sometimes more short branches strikingly different from any of the other outgrowths, made up of broad, stout cells. As these increase in length they generally become spirally twisted, and the cells on their convex sides develop short branches. The terminal cell of the branch produces the procarp, which in Tuomeya consists of a broadly ovoid trichophore, surmounted by a trichogyne several times longer than itself. After fertilization the trichophore begins to bud forth cells, which gradually become arranged in more or less concentric rows upon the surface of the trichophore; the further development was not seen, but it is surmised that strings of spores are then formed, as in Batrachospermum. Unfortunately the germination of the spores has not been witnessed, nor have very young plants yet been seen. Some further investigations as to the structure of cystocarps is also desirable, but we know that Mr. Setchell is continuing his researches, and we trust these will not end until the whole life-history of this very interesting fresh-water Alga is thoroughly understood. (Proceedings of the American Academy of Arts and Sciences, vol. xxv. p. 53, with a plate.)

MARINE ALGÆ OF BERWICK-ON-TWEED.—Mr. Edward A. L. Batters has recently published, from the Transactions of the Berwickshire Naturalists' Club for 1889, a most useful list of the marine Algæ of Berwick-on-Tweed. Many years have elapsed since the appearance of Dr. Johnston's list, and very numerous have been the alterations in nomenclature since those days. This new list is therefore all the more welcome, as it comes as a contribution towards a revision of the British Algæ, which the great advance in our knowledge that has been made since the publication of Harvey's splendid "Phycologia Brittanica" renders absolutely necessary. Mr. Batters's list contains 271 species. Comparing this with a few local lists conveniently at hand, we find in Le Joli's well-known "Cherbourg Algal Flora" 350 species; Debray, "Catalogue of the Algæ found at Dunkirk," gives 189 species; while Flahault's interesting account of his collecting for some six weeks at Croisic details 230 forms. Of those enumerated in the Berwick list no less than 78 species have been added to the British flora since the publication of Harvey's work. One minute form found presenting the appearance of tiny yellow-brown patches has been made by Reinke a new genus, Battersia; it belongs to the Sphacelariaceæ, and has doubtless been often overlooked. From a small encrusting thallus little patches of fruit bearing filaments arise. Several of the Algæ lately described by Bornet and Flahault as perforating species, chiefly in the substance of marine shells, such as *Gomontia polyrhiza* and *Mastigocoleus testaceum*, are recorded. There is an index of genera and also figures of most of the new species.

DR. KOCH ON TUBERCULOSIS.

A SUPPLEMENT to the *British Medical Journal* contains "A Further Communication on a Remedy for Tuberculosis," translated from the original article published in the *Deutsche Medizinische Wochenschrift*, November 14, by Prof. Dr. Robert Koch, Berlin, as follows:—

Introduction.

In an address delivered before the International Medical Congress I mentioned a remedy which conferred on the animals experimented on an immunity against inoculation with the tubercle bacillus, and which arrests tuberculous disease. Investigations have now been carried out on human patients, and these form the subject of the following observations.

It was originally my intention to complete the research, and especially to gain sufficient experience regarding the application of the remedy in practice and its production on a large scale, before publishing anything on the subject. But, in spite of all precautions, too many accounts have reached the public, and that in an exaggerated and distorted form, so that it seems imperative, in order to prevent all false impressions, to give at once a review of the position of the subject at the present stage of the inquiry. It is true that this review can, under these circumstances, be only brief, and must leave open many important questions.

The investigations have been carried on under my direction by Dr. A. Libbertz and Stabsarzt Dr. E. Pfühl, and are still in progress. Patients were placed at my disposal by Prof. Brieger from his Poliklinik, Dr. W. Levy from his private surgical clinic, Geheimrath Dr. Fräntzel and Oberstabsarzt Kohler from the Charité Hospital, and Geheimrath v. Bergmann from the Surgical Clinic of the University.[1]

Nature and Physical Characters of the Remedy.

As regards the origin and the preparation of the remedy I am unable to make any statement, as my research is not yet concluded: I reserve this for a future communication.[2] The remedy is a brownish transparent liquid, which does not require special care to prevent decomposition. For use, this fluid must be more or less diluted, and the dilutions are liable to decomposition if prepared with distilled water; bacterial growths soon develop in them, they become turbid, and are then unfit for use. To prevent this the diluted liquid must be sterilized by heat and preserved under a cotton-wool stopper; or more conveniently prepared with a ½ per cent. solution of phenol.

Manner of using the Remedy.

It would seem, however, that the effect is weakened both by frequent heating and by mixture with phenol solution, and I have therefore always made use of freshly-prepared solutions. Introduced into the stomach, the remedy has no effect; in order to obtain a trustworthy effect, it must be injected subcutaneously. For this purpose we have used exclusively the small syringe suggested by me for bacteriological work; it is furnished with a small india-rubber ball, and has no piston. This syringe can easily be kept aseptic by absolute alcohol, and to this we attribute the fact that not a single abscess has been observed in the course of more than a thousand subcutaneous injections. The place chosen for the injection—after several trials of other places—was the skin of the back between the shoulder-blades and the lumbar region, because here the injection led to the least local reaction—generally none at all—and was almost painless.

Effect of Injections in Healthy Individuals.

As regards the effect of the remedy on the human patient, it was clear from the beginning of the research that in one very important point the human being reacts to the remedy differently from the animal generally used in experiments—the guinea-pig; a new proof for the experimenter of the all-important law that experiment on animals is not conclusive for the human being, for the human patient proved extraordinarily more sensitive than the guinea-pig as regards the effect of the remedy. A healthy guinea-pig will bear two cubic centimetres and even more of the liquid injected subcutaneously without being sensibly affected. But in the case of a full-grown healthy man 0·25 cubic centimetres suffice to produce an intense effect. Calculated by body weight, the 1500th part of the quantity, which has no appreciable effect on the guinea-pig, acts powerfully on the human being. The symptoms arising from an injection of 0·25 cubic centimetre I have observed after an injection made in my own upper arm. They were briefly as follows:—Three to four hours after the injection there came on pains in the limbs, fatigue, inclination to cough, difficulty in breathing, which speedily increased. In the fifth hour an unusually violent attack of ague followed, which lasted almost an hour. At the same time there was sickness, vomiting, and rise of body temperature up to 39°·6 C. After twelve hours all these symptoms abated. The temperature fell, until next day it was normal, and a feeling of fatigue and pain in the limbs continued for a few days, and for exactly the same period of time the site of injection remained slightly painful and red. The lowest limit of the effect of the remedy for a healthy human being is about 0·01 cubic centimetre (equal to 1 cubic centimetre of the hundredth solution), as has been proved by numerous experiments. When this dose was used, reaction in most people showed itself only by slight pains in the limbs and transient fatigue. A few showed a slight rise of temperature up to about 38° C. Although the dosage of the

[1] Dr. Koch here expressed his thanks to these gentlemen.

[2] Doctors wishing to make investigations with the remedy at present can obtain it from Dr. A. Libbertz, Lueneburger Strasse 28, Berlin, N.W., who has undertaken the preparation of the remedy, with my own and Dr. Pfühl's co-operation. But I must remark that the quantity prepared at present is but small, and that larger quantities will not be obtainable for some weeks.

remedy shows a great difference between animals and human beings—calculated by body weight—in some other qualities there is much similarity between them. The most important of these qualities is the specific action of the remedy on tuberculous processes of whatever kind.

The Specific Action on Tuberculous Processes.

I will not here describe this action as regards animals used for experiment, but I will at once turn to its extraordinary action on tuberculous human beings. The healthy human being reacts either not at all or scarcely at all—as we have seen when 0·01 cubic centimetre is used. The same holds good with regard to patients suffering from diseases other than tuberculosis, as repeated experiments have proved. But the case is very different when the disease is tuberculosis: the same dose of 0·01 cubic centimetre injected subcutaneously into the tuberculous patient caused a severe general reaction, as well as a local one. (I gave children, aged from 2 to 5 years, one-tenth of this dose—that is to say, 0·001 cubic centimetre; very delicate children, only 0·0005 cubic centimetre, and obtained a powerful but in no way dangerous reaction.) The general reaction consists in an attack of fever, which, generally beginning with rigors, raises the temperature above 39°, often up to 40°, and even 41° C.; this is accompanied by pain in the limbs, coughing, great fatigue, often sickness and vomiting. In several cases a slight icteric discolouration was observed, and occasionally an eruption like measles on the chest and neck. The attack usually begins four to five hours after the injection, and lasts from twelve to fifteen hours. Occasionally it begins later, and then runs its course with less intensity. The patients are very little affected by the attack, and as soon as it is over feel comparatively well, generally better than before it. The local reaction can be best observed in cases where the tuberculous affection is visible; for instance, in cases of lupus: here changes take place which show the specific anti-tuberculous action of the remedy to a most surprising degree. A few hours after an injection into the skin of the back—that is, in a spot far removed from the diseased spots on the face, &c.—the lupus spots begin to swell and to redden, and this they generally do before the initial rigor. During the fever, swelling and redness increase, and may finally reach a high degree, so that the lupus tissue becomes brownish and necrotic in places. Where the lupus was sharply defined we sometimes found a much swollen and brownish spot surrounded by a whitish edge almost a centimetre wide, which again was surrounded by a broad band of bright red.

After the subsidence of the fever the swelling of the lupus tissue decreases gradually, and disappears in about two or three days. The lupus spots themselves are then covered by a crust of serum, which filters outwards, and dries in the air; they change to crusts, which fall off after two or three weeks, and which, sometimes after one injection only, leave a clean red cicatrix behind. Generally, however, several injections are required for the complete removal of the lupus tissue. But of this more later on. I must mention, as a point of special importance, that the changes described are exactly confined to the parts of the skin affected with lupus. Even the smallest nodules, and those most deeply hidden in the lupus tissue, go through the process, and become visible in consequence of the swelling and change of colour, whilst the tissue itself, in which the lupus changes have entirely ceased, remains unchanged. The observation of a lupus case treated by the remedy is so instructive, and is necessarily so convincing, that those who wish to make a trial of the remedy should, if at all possible, begin with a case of lupus.

The Local and General Reaction to the Remedy.

The specific action of the remedy in these cases is less striking, but is perceptible to eye and touch, as are the local reactions in cases of tuberculosis of the glands, bones, joints, &c. In these cases swelling, increased sensibility, and redness of the superficial parts are observed. The reaction of the internal organs, especially of the lungs, is not at once apparent, unless the increased cough and expectoration of consumptive patients after the first injections be considered as pointing to a local reaction. In these cases the general reaction is dominant; nevertheless, we are justified in assuming that here, too, changes take place similar to those seen in lupus cases.

The Diagnostic Value of the Method.

The symptoms of reaction above described occurred without exception in all cases where a tuberculous process was present in the organism, after a dose of 0·01 cubic centimetre, and I think I am justified in saying that the remedy will therefore, in future, form an indispensable aid to diagnosis. By its aid we shall be able to diagnose doubtful cases of phthisis; for instance, cases in which it is impossible to obtain certainty as to the nature of the disease by the discovery of bacilli, or elastic fibres, in the sputum, or by physical examination. Affections of the glands, latent tuberculosis of bone, doubtful cases of tuberculosis of the skin, and such like cases, will be easily and with certainty recognized. In cases of tuberculosis of the lungs or joints which have become apparently cured we shall be able to make sure whether the disease has really finished its course, and whether there be not still some diseased spots from which it might again arise as a flame from a spark hidden by ashes.

The Curative Effect of the Remedy.

Of much greater importance, however, than its diagnostic use is the therapeutic effect of the remedy. In the description of the changes which a subcutaneous injection of the remedy produces in portions of skin changed by lupus I mentioned that after the subsidence of the swelling and decrease of redness the lupus tissue does not return to its original condition, but that it is destroyed to a greater or less extent, and disappears. Observation shows that in some parts this result is brought about by the diseased tissue becoming necrotic, even after one sufficient injection, and, at a later stage, it is thrown off as a dead mass. In other parts a disappearance, or, as it were, a melting of the tissues seems to occur, and in such case the injection must be repeated to complete the cure.

Its Action on Tuberculous Tissue.

In what way this process occurs cannot as yet be said with certainty, as the necessary histological investigations are not complete. But so much is certain, that there is no question of a destruction of the tubercle bacilli in the tissues, but only that the tissue enclosing the tubercle bacilli is affected by the remedy. Beyond this there is, as is shown by the visible swelling and redness, considerable disturbance of the circulation, and, evidently in connection therewith, deeply-seated changes in its nutrition, which cause the tissue to die off more or less quickly and deeply, according to the extent of the action of the remedy.

To recapitulate, the remedy does not kill the tubercle bacilli, but the tuberculous tissue; and this gives us clearly and definitely the limit that bounds the action of the remedy. It can only influence living tuberculous tissue; it has no effect on dead tissue, as, for instance, necrotic cheesy masses, necrotic bones, &c., nor has it any effect on tissue made necrotic by the remedy itself. In such masses of dead tissue living tubercle bacilli may possibly still be present, and are either thrown off with the necrosed tissue or may possibly enter the neighbouring still living tissue under certain circumstances. If the therapeutic activity of the remedy is to be rendered as fruitful as possible this peculiarity in its mode of action must be carefully observed. In the first instance, the living tuberculous tissue must be caused to undergo necrosis, and then everything must be done to remove the dead tissue as soon as possible, as, for instance, by surgical interference. Where this is not possible and the organism can only help itself in throwing off the tissue slowly, the endangered living tissue must be protected from fresh incursions of the parasites by continuous application of the remedy.

The Dose.

The fact that the remedy makes tuberculous tissue necrotic, and acts only on living tissue, helps to explain another peculiar characteristic thereof—namely, that it can be given in rapidly increasing doses. At first sight this phenomenon would seem to point to the establishment of tolerance, but since it is found that the dose can, in the course of about three weeks, be increased to 500 times the original amount, tolerance can no longer be accepted as an explanation, as we know of nothing analogous to such a rapid and complete adaptation to an extremely active remedy. The phenomenon must rather be explained in this way—that in the beginning of the treatment there is a good deal of tuberculous living tissue, and that consequently a small amount of the active principle suffices to cause a strong reaction; but by each injection a certain amount of the tissue capable of reaction disappears, and then comparatively larger doses are necessary to produce the same amount of reaction as before. Within certain limits a certain degree of habituation may be perceived.

As soon as the tuberculous patient has been treated with increasing doses for so long that the point is reached when his reaction is as feeble as that of a non-tuberculous patient, then it may be assumed that all tuberculous tissue is destroyed. And then the treatment will only have to be continued by slowly increasing doses and with interruptions, in order that the patient may be protected from fresh infection while bacilli are still present in the organism.

Whether this conception, and the inferences that follow from it, be correct, the future must show. They were conclusive as far as I am concerned in determining the mode of treatment by the remedy, which, in our investigations, took the following form.

The Treatment Applied to Lupus.

To begin with the simplest case, lupus; in nearly every one of these cases I injected the full dose of 0·01 cubic centimetre from the first. I then allowed the reaction to come to an end entirely, and then, after a week or two, again injected 0·01 cubic centimetre, continuing in the same way until the reaction became weaker and weaker, and then ceased. In two cases of facial lupus the lupus spots were thus brought to complete cicatrization by three or four injections; the other lupus cases improved in proportion to the duration of treatment. All these patients had been sufferers for many years, having been previously treated unsuccessfully by various therapeutic methods.

The Treatment Applied to Tuberculosis of the Bones and Joints.

Glandular, bone, and joint tuberculosis was similarly treated, large doses at long intervals being made use of; the result was the same as in the lupus cases—a speedy cure in recent and slight cases, slow improvement in severe cases.

The Treatment applied to Phthisis.

Circumstances were somewhat different in phthisical patients, who constituted the largest number of our patients. Patients with decided pulmonary tuberculosis are much more sensitive to the remedy than those with surgical tuberculous affections. We were obliged to lower the dose for the phthisical patients, and found that they almost all reacted strongly to 0·002 cubic centimetre, and even to 0·001 cubic centimetre. From this first small dose it became possible to rise more or less quickly to the same amount as is well borne by other patients.

Our course was generally as follows:—An injection of 0·001 cubic centimetre was first given to the phthisical patient; on this a rise of temperature followed, the same dose being repeated once a day, until no reaction could be observed. We then rose to 0·02 cubic centimetre, until this was borne without reaction; and so on, rising by 0·001, or at most 0·002, to 0·01 cubic centimetre and more. This mild course seemed to me imperative in cases where there was great debility. By this mode of treatment the patient can be brought to bear large doses of the remedy with scarcely a rise of temperature. The patients of greater strength were treated from the first, partly with larger doses, partly with rapidly repeated doses. Here it seemed that the beneficial results were more quickly obtained.

The action of the remedy in cases of phthisis generally showed itself as follows:—Cough and expectoration generally increased a little after the first injection, then grew less and less, and in the most favourable cases entirely disappeared; the expectoration also lost its purulent character, and became mucous.

As a rule the number of bacilli only decreased when the expectoration began to present a mucous appearance; they then from time to time disappeared entirely, but were again observed occasionally until expectoration ceased completely. Simultaneously the night sweats ceased, the patients' appearance improved, and they increased in weight. Within four to six weeks patients under treatment for the first stage of phthisis were all free from every symptom of disease, and might be pronounced cured. Patients with cavities, not yet too highly developed, improved considerably, and were almost cured; only in those whose lungs contained many large cavities could no improvement be proved objectively, though even in these cases the expectoration decreased, and the subjective condition improved. These experiences lead me to suppose that phthisis in the beginning can be cured with certainty by this remedy.[1]

[1] This sentence requires limitation in so far as at present no conclusive experiences can possibly be brought forward to prove whether the cure is lasting. Relapses naturally may occur; but it can be assumed that they may be cured as easily and quickly as the first attack. On the other hand, it seems possible that, as in other infectious diseases, patients once cured may retain their immunity. This, too, must, for the present, remain an open question.

Effect in Advanced Cases of Phthisis.

In part this may be assumed for other cases when not too far advanced; but patients with large cavities, who almost all suffer from complications caused, for instance, by the incursion of other pus-forming micro-organisms into the cavities, or by incurable pathological changes in other organs, will probably only obtain lasting benefit from the remedy in exceptional cases. Even such patients, however, were benefited for a time. This seems to prove that, in their cases, too, the original tuberculous disease is influenced by the remedy in the same manner as in the other cases, but that we are unable to remove the necrotic masses of tissue with the secondary suppuration processes.

The thought suggests itself involuntarily that relief might possibly be brought to many of these severely afflicted patients by a combination of this new therapeutic method with surgical operations (such as the operation for empyema), or with other curative methods. And here I would earnestly warn people against a conventional and indiscriminate application of the remedy in all cases of tuberculosis. The treatment will probably be quite simple in cases where the beginning of phthisis and simple surgical cases are concerned; but in all other forms of tuberculosis medical art must have full sway by careful individualization, and making use of all other auxiliary methods to assist the action of the remedy. In many cases I had the decided impression that the careful nursing bestowed on the patient had a considerable influence on the result of the treatment, and I am in favour of applying the remedy in proper sanatoria as opposed to treatment at home and in the out-patient room. How far the methods of treatment already recognized as curative—such as mountain climate, fresh-air treatment, special diet, &c.—may be profitably combined with the new treatment cannot yet be definitely stated, but I believe that these therapeutic methods will also be highly advantageous when combined with the new treatment in many cases, especially in the convalescent stage.[1] The most important point to be observed in the new treatment is its early application. The proper subjects for treatment are patients in the initial stage of phthisis, for in them the curative action can be most fully shown, and for this reason, too, it cannot be too seriously pointed out that practitioners must in future be more than ever alive to the importance of diagnosing phthisis in as early a stage as possible. Up to the present the proof of tubercle bacilli in the sputum was considered more as an interesting point of secondary importance, which, though it may render diagnosis more certain, could not help the patient in any way, and which, in consequence, was often neglected. This I have lately repeatedly had occasion to observe in numerous cases of phthisis which had generally gone through the hands of several doctors without any examination of the sputum having been made. In future this must be changed. A doctor who shall neglect to diagnose phthisis in its earlier stage by all methods at his command, especially by examining the sputum, will be guilty of the most serious neglect of his patient, whose life may depend on this diagnosis, and the specific treatment at once applied in consequence thereof. In doubtful cases medical practitioners must make sure of the presence or absence of tuberculosis, and then only the new therapeutic method will become a blessing to suffering humanity, when all cases of tuberculosis are treated in their earliest stage, and we no longer meet with neglected serious cases forming an inextinguishable source of fresh infections. Finally, I would remark, that I have purposely omitted statistical accounts and descriptions of individual cases, because the medical men who furnished us with patients for our investigations have themselves decided to publish the description of their cases, and I wish my account to be as objective as possible, leaving to them all that is purely personal.

ON THE INCUBATION OF SNAKES' EGGS.[2]

MOST Reptilia are oviparous, but certain of the Lacertilians, and many Ophidians, especially vipers and sea-snakes, are ovo-viviparous—that is to say, the eggs are hatched within the mother, or, as sometimes occurs, during the process of parturition. This is the case with the English viper.

[1] As regards tuberculosis of brain, larynx, and miliary tuberculosis, we had too little material at our disposal to gain proper experience.

[2] By Walter K. Sibley, M.B., B.C., B.A. Camb., Assistant Physician to the North-West London Hospital. (Substance of a paper read before the Biological Section of the British Association at Leeds, September 1890.)

There has not been much written on the hatching of snakes' eggs. Almost the first literature of the subject appears to be some observations of M. Valenciennes made in 1841, at the Jardin des Plantes in Paris, and published in the *Comptes rendus*, on a Python (*Python bivittatus*) which was about 10 feet long. This reptile, in the beginning of May, deposited fifteen eggs: it coiled itself up over them for fifty-six days, after which period eight of the eggs hatched, and the young snakes came out, each measuring about half a metre in length. With regard to the temperature of the mother, he says, there was a marked increase of temperature during the whole period of incubation, which was highest at the commencement, and gradually diminished till the close.

In 1862, Sclater, in the Proceedings of the Zoological Society, described a Python (*Python sebæ*) which incubated her eggs, one hundred in number, for eighty-two days, at which period they were removed, none having hatched, and on examination it was found that five or six contained embryos. With regard to the temperature, he states that, in every observation, the female was several degrees warmer than the male; both being kept under similar conditions. Double observations were always made, one with the thermometer placed on the surface of the body, and the other by placing it between the folds. The differences in the temperature of the snake's body and of the surrounding air was higher by from 2°·8 to 12°·4 F., taken on the surface of the animal, and from 6°·8 to 20°·0 F., taken between the folds of the skin.

In the same year Colonel Abbott recorded that he had in his possession in India a female boa, which incubated her eggs, forty-eight in number, for three months, at the end of which period, on opening one of the shells, a live fully-formed young one was found.

In 1880, Forbes carried on some investigations with the eggs of *Python molurus* in the Zoological Society's Gardens. The snake was some 12 feet long, and on the night of June 5–6, deposited about twenty eggs, and then coiled herself around them, almost completely concealing them from view. She continued to cover the eggs for a period of six weeks, never eating during the whole time, and apparently only once leaving the eggs for a few hours one morning early in July.

On July 18—that is, forty-three days after—the eggs revealing evidences of decomposition they were removed, and one or two were found to contain embryos.

From June 14—that is, nine days after the eggs were laid—till they were removed on July 18, careful temperatures were taken every two or three days between the hours of 12 and 2 p.m. The temperature was taken both of the incubating female and also of the male, which was kept under similar circumstances in the next cage, the same methods being employed as in Sclater's experiments just described. The temperature was always found to be highest when that of the air in the cages was also highest. The temperature of the female was higher and more constant than that of the male. The greatest difference between that of the snake and that of the air was 8°·3 F. for the male, and 9°·6 F. for the female, taken on the surface; and 11°·6 F. for the male, and 16°·7 F. for the female, taken between the coils of the skin. It will be noticed that Valenciennes, who kept his snakes much colder,[1] records a difference of as much as 38°·7 F. (21°·5 C.), and some of his eggs hatched, which was not the case with Forbes's; also the later observer does not record a steady fall of the temperature throughout the incubation as did the former.

The common English snake (*Natrix torquata*) lays its eggs, varying in number from about fifteen to thirty, principally in manure-heaps, but also in holes and crevices between or under stones. It is usually stated they are laid in the autumn, but I have frequently found them towards the end of July, and one snake I had in confinement laid them as early as the 11th of that month. The shells being very thin and soft they require very delicate handling, the eggs being readily injured.

When laid under stones or in crevices, they are protected from the immediate pressure of the earth, and when deposited in manure which is much bound together by leaves and straw, &c., they are not individually subjected to much pressure. It must also be noticed that the eggs are usually found very close to the surface, and if laid deep in the manure heap, they, as a rule, do not hatch, although if examined late in the season the young snakes are found in them often completely formed, but dead. When first laid, the eggs are swollen out and full, and many or all the eggs are firmly bound together by adhesive medium. The egg-shell, if examined with the microscope, is found to consist of peculiar glistening fibres arranged in many separate layers. Between the outer layers only a small quantity of calcareous matter is present, and these fibres appear to be closely fitted together. There are seen in fresh, or better in specimens hardened in chromic acid, ten or more layers laid very closely one upon the other. The outer layers differ from the others in that they contain many rather club-shaped bodies of very different thicknesses and appearances placed between the other fibres.

The eggs are at first of a whitish straw colour. As time goes on, they become somewhat darker and then of a brown colour, and finally very dark; but these colour changes do not occur evenly over the whole shell, but in patches, and to a very varying extent. At the same time the regular outline is gradually lost, the shell shrivels, loses its original elasticity, and so at this stage impressions made upon the surface remain permanent. The diminution in actual bulk of the egg is probably due to evaporation of water from its substance. It is chiefly the extreme delicacy of the eggs, also the difficulty of keeping them in the requisite amount of moisture, that makes them so very hard to hatch artificially. But all these difficulties may with care be overcome, as I will proceed to describe.

On July 22, 1889, I found, in the manure of a cucumber-frame in Surrey, some seventy snakes' eggs in two masses, close together, and probably deposited by at least two snakes. The eggs were apparently of recent date, but showed great differences in the stage of their development—even those which were clearly laid by the same female. After removing some eggs for immediate examination, the rest were covered up again by the manure and left.

On September 8 they were again uncovered, and some were removed and taken to London. One of the eggs being opened at this period, the embryo snake was fairly well formed, and movements were visible but feeble. The eggs were brought to London on September 8, and on the 9th some were placed in an ordinary bacteriological incubator regulated for a temperature of 32° C. (89°·6 F.). The eggs were placed in open glass dishes with a small quantity of dung laid both at the bottom of the dish and also partially covering the eggs. Some of the dishes were left open, and others were protected by a piece of glass loosely laid over, but allowing the air to freely circulate, and were kept perpetually moist by cotton wool soaked in water. At the same time some eggs were placed under similar conditions in the atmosphere of the room, the temperature of which was maintained at about 17° C. (62°·6 F.). On September 17, the incubator leaked and had to be repaired, and during this period the eggs from it were left in the room temperature—namely, about 17° C.; the eggs being replaced in the incubator again on September 25.

On September 27, two of the eggs which had been kept all the time in the room temperature, showed signs of hatching—that is, the heads of the young snakes had broken through the shells, temperature 19° C. (66°·2 F.). These were noticed at 10 p.m. The next morning at 10 a.m., the hatching eggs presented the same appearances—that is, the heads only were out of the shells. The dish with these eggs was then placed on the top of the incubator at about a temperature of 24° C. (75° F.). At 1 p.m. the condition was unchanged, and at 10 p.m. both snakes were quite out of their shells.

On the same day, that is, the 28th, at 10 p.m., the head of one of the snakes inside the incubator was seen; at 10 the next morning this snake was quite free from its shell.

During the next few days several more eggs hatched, both those inside and those outside the incubator.

Some eggs, which were kept in a tin of manure in the room atmosphere of about 18° (64°·4 F.) since September 8, were on the 25th placed outside the window. During the night the temperature registered a minimum of 1°·5 C. (35° F.). On the 26th, they were brought inside again, and on the 27th they were placed in a temperature of 26° C. (78°·8 F.). In the course of time some of these eggs hatched with the others. The eggs in the incubator were placed at first on their sides, but on the 28th some were placed on their ends, and in both positions they appeared to hatch equally well.

The period of incubation of the eggs was thus about seventy-five to ninety days; the python, as described by Valenciennes,

[1] The extreme temperatures of the air recorded by Valenciennes, who took his observations when the cages were coldest, *i.e.* before the fresh hot water was put in, were 17°, and 23° C. (62°·6 and 73°·4 F.) respectively. The temperature of the two cages in which the animals were kept was only on three occasions less than the highest in Valenciennes' series.

being fifty-six days. It was noticed that many days often elapsed between the hatching of the eggs of the same lot—even those kept under similar circumstances. The differences in the actual stage of development of the eggs when first laid may possibly explain the apparent differences in the dates of hatching.

On July 11, 1890, a snake I had in confinement laid eighteen eggs. Some of these were placed at a temperature of 16°–20° C. (61°–68° F.): at the end of October, not being hatched, they were opened, and found to contain fully-formed young ones, but these were all dead. Other eggs from the same lot, which was laid on July 11, were sent into the country and placed in a manure-heap; on September 9, an egg being opened, the embryo snake was nearly formed, but there were no movements visible; on September 24 these eggs began to hatch—that is, after an incubation of seventy-five days.

From the first set of experiments it did not appear that the actual temperature influences to any great degree the period of incubation, or at least not after the first few weeks. (In the cases described it would appear that the eggs had been deposited some seven weeks before they were removed, and then kept artificially from three weeks to a month before they hatched.) Also, that exposure to the atmosphere does not destroy their vitality, provided they are kept fairly moist, some having hatched after several days' full exposure to the air of the room; and that they may be exposed to rather low temperatures, at least for a few hours, and yet finally hatch. As might be expected, some eggs which were placed in small glass pots and hermetically sealed did not hatch.

The process of hatching was very interesting to watch. At first a slit appeared in the uppermost part of the egg, whether the egg was placed on the side or on one end; most usually the slit rapidly became a V-shaped one, which in shape and position corresponded to the snout of the young reptile—that is to say, the apex of the V corresponding to the tip of the lower jaw. The snakes would often remain for some hours in this position, with just their snouts out, and, when disturbed, would withdraw these into the shells again. In a state of nature I have seen them when completely out of the shell, retreat into it again when disturbed. When first out of the shell, the young snakes were very smooth and velvety to the touch; there was usually some opacity about the cornea, which disappeared after a few hours; the yellow ring on the neck was well marked from the very first. They were about 15 cm. (6 inches) in length, and weighed about 3 grammes (45 grains); the eggs themselves weighed about 6 grammes (80 to 90 grains). One cast its skin within a few days after birth, and died. Occasionally they were hatched with the yolk-sac adherent, and in these instances always died. From the first the snakes were very lively, and within a very few days produced the characteristic hissing noise when provoked.

Many problems in connection with the subject of the incubation of eggs might be mentioned. It would be interesting to ascertain definitely what are the maximum and minimum temperatures at which the vital processes can take place in an incubating egg. There is probably an optimal temperature, or one at which the process proceeds most rapidly or most favourably. So also it might be asked, Is the optimal temperature the same for all kinds of eggs—those, for instance, of various forms of birds and those of snakes and lizards? Is the increase of temperature, both of the incubating bird and of the incubating python, essential to the hatching of the eggs? What is the reason of the differences in the incubation periods between different birds? Why, for instance, do pigeons' eggs hatch in fourteen days, hens' three weeks, turkeys' a month, and swans' six weeks?

We know that if a hen's egg be maintained for some twenty-one days at a temperature of about 40° C. it will hatch; but I am not aware of any experiments to ascertain if they will hatch at a temperature considerably under or much over this, and what is the minimum temperature at which they will hatch at all? In the case of many of the micro-organisms, bacteriologists have found the actual limits of temperature within which the various species grow, and also that most of them have an optimal temperature—that is, one at which these lowest forms of vegetable life grow most luxuriantly.

Literature.—Valenciennes, *Comptes rendus de l'Académie des Sciences*, 1841; Sclater, Proceedings of the Zoological Society, London, 1862; Abbott, Proceedings of the Zoological Society, London, 1862; Lataste Fernand, Paris, 1877; Forbes, Proceedings of the Zoological Society, London, 1880; Fisher, *Der Zoolog. Garten*, Bd. 26, 1886.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Among the lectures which are being delivered this term, we notice the following:—Electricity, Prof. Clifton; Physical Optics, Mr. Walker; Ureas and Uric Acid, Prof. Odling; Surfaces of the Second Order, Prof. Sylvester; Disturbed Elliptic Motion, Prof. Pritchard.

In the Morphological Department Prof. Ray Lankester is giving a general course on Animal Morphology, and Mr. Minchin, who has been appointed Junior Demonstrator, is lecturing on the Porifera.

The arrangements for the instruction of medical students in physiology have been considerably improved.

The Burdett-Coutts Geological Scholarship has been awarded to Mr. F. W. Howard, of Balliol.

In the Report of the Visitors of the University Observatory it is stated that Prof. Pritchard will shortly publish an enlargement of his lectures on Disturbed Elliptic Motion.

The following examiners have been appointed for next year:—Physics, Mr. Baynes and Mr. H. G. Madan; Chemistry, Prof. Tilden; Animal Morphology, Mr. Poulton and Mr. Bourne; Physiology, Mr. F. Gotch.

The statute respecting the admission of women to examinations in medicine, which has formed the subject of a good deal of controversy, has been rejected in Congregation by 79 votes to 75.

SCIENTIFIC SERIALS.

THE *Quarterly Journal of Microscopical Science* for August contains:—On the origin of vertebrates from Arachnids, by W. Patten (plates xxiii. and xxiv.). As a full description of the author's observations could not be published without considerable delay in this article of sixty pages, he gives a short account of the facts bearing directly on the subject, and at the same time presents his theoretical conclusions. Recognizing the "Annelid theory" as sterile, the author thinks that since vertebrate morphology reflects, as an ancestral image only, the dim outlines of a segmented animal, but still not less a vertebrate than any now living, it is clear that the problem must be solved, if at all, by the discovery of some form in which the specialization of the vertebrate *head* is already foreshadowed. While, since of all invertebrates, concentration and specialization of head segments is greatest in the Arachnids, it is in these, on *a priori* grounds, that we should expect to find traces of the characteristic features of the vertebrate head. Finding, from time to time, confirmation of this preconceived idea, as the unexpected complexity of the Arachnid cephalothorax revealed itself, he feels justified in formulating a theory that *Vertebrates are derived from the Arachnids*.—On the origin of vertebrates from a Crustacean-like ancestor, by W. H. Gaskell, F.R.S. (plates xxv. to xxviii.). This paper is but chapter one of a very important memoir, which approaches the subject of the ancestry of the vertebrates from a different standpoint from that of Dr. Patten. In previous papers the author had pointed out that the vertebrate nervous system is composed of nervous material grouped around a central tube which was originally the alimentary canal of the invertebrate from which the vertebrate arose, and that the physiology and anatomy of this system both best fit in with the assumption that the invertebrate ancestor was of the Crustacean, or at least of a proto-Crustacean type. In both these papers the author promised to point out the confirmation of this theory, which is afforded by the study of the lowest vertebrate nervous system, viz. that of the Ammocœtes form of Petromyzon. This promise he redeems in this paper, in which, to bring out as prominently as possible the theory, he discusses the nervous system of the Ammocœtes in terms of the Crustacean. Taking separately the prominent features of the alimentary canal and central nervous system of a Crustacean-like animal, he indicates how each one exists in the nervous system of the Ammocœtes. In a second chapter it will be pointed out how the present alimentary canal arose by the prolongation of a respiratory chamber.—On the development of the atrial chamber of Amphioxus, by E. Ray Lankester, F.R.S., and Arthur Willey (plates xxix. to xxxii.). The period of development was that before Hatschek's well-known work stops short. Series of sections were prepared in order to ascertain the mode in which the atrial chamber takes its origin, and the subsequent history of the gill-slits, viz. as to how the slits on the left side of the pharynx originate. The relation of the larval to the adult mouth, and the details of the curious process of the movement of the mouth from a unilateral to a median position, were also included in the scope of the author's inquiries.

American Journal of Science, November 1890.—Further study of the solar corona, by Frank H. Bigelow. The author has made a series of measures upon photographs of coronal streamers taken in 1878, July 29, by Prof. Asaph Hall. This has been done with a view of testing the validity of the equation that he has assigned to the coronal curves in a discussion of them by spherical harmonics.—Superimposition of the drainage in Central Texas, by Ralph S. Tarr.—A description of the "Bernardston Series" of metamorphic Upper Devonian rocks (continued from October), by Prof. B. K. Emerson.—Analysis of rhodochrosite from Franklin Furnace, New Jersey, by P. E. Browning.—A re-determination of the atomic weight of cadmium, by Edw. A. Partridge.—On the occurrence of nitrogen in uraninite, and on the composition of uraninite in general; condensed from a forthcoming Bulletin of the U.S. Geological Survey, by W. F. Hillebrand. It is found that nitrogen exists in uraninite in quantities up to over 2·5 per cent., and seems generally to bear a relation to the amount of UO_2 present. This is the first discovery of nitrogen in the primitive crust of the earth.—Anthophyllite from Franklin, Macon County, North Carolina, by S. L. Penfield.—Pre-glacial drainage and recent geological history of Western Pennsylvania, by P. Max Foshay.—On the so-called perofskite from Magnet Cove, Arkansas, by F. W. Mar.—Experiments upon the constitution of the natural silicates (continued from October), by F. W. Clarke and E. A. Schneider.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, November 4.—Prof. W. H. Flower, F.R.S., President, in the chair.—The Secretary read a report on the additions that had been made to the Society's Menagerie during the months of June, July, August, September, and October, 1890, and called special attention to several of them. Among these were a young male example of the Wild Cattle of Chartley Park, Staffordshire, presented by Earl Ferrers; a Water-Buck Antelope (*Cobus ellipsiprymnus*) from the Somali Coast, presented by Mr. George S. Mackenzie; an example of the Horned Screamer (*Palamedea cornuta*), obtained by purchase; and a young female of Speke's Antelope (*Tragelaphus spekii*), presented by Mr. James A. Nicolls.—The Secretary exhibited, on behalf of Dr. A. B. Meyer, a coloured photograph of a singular variety of the Rose-coloured Pastor (*Pastor roseus*), with a red head, obtained near Sophia; and read a note from Dr. Meyer on this subject.—Mr. G. A. Boulenger made some remarks on an early reference to the Syrian Newt (*Molge vittata*) in Shaw's "Travels," published in 1738.—Mr. J. J. Lister gave an account of his recent visit to the Phœnix Islands, Central Pacific, and exhibited specimens of the birds and eggs obtained there.—Mr. Smith Woodward exhibited and made remarks upon the calvarium of an adult male *Saiga tatarica* from the Pleistocene deposits of the Thames Valley. The specimen had been obtained by Dr. J. R. Leeson from recent excavations in Orleans Road, Twickenham, and was the first trace of this Antelope discovered in Britain.—Mr. W. T. Blanford read a paper on the Gaur (*Bos gaurus*) and its allies, with especial reference to the exhibition of the first living Gaur ever brought to Europe in the Society's Gardens. He described the characters and geographical range of the three allied species of flat-horned taurine Bovines—the Gaur or Sladang (Bison of Indian sportsmen), the Gayal or Mithan (*Bos frontalis*), and the Banteng (*Bos sondaicus*); and he discussed the question whether *B. frontalis* is ever found in the wild state.—A communication was read from Dr. A. B. Meyer, containing the description of a new species of Squirrel from the Philippine Islands, which he proposed to call *Sciurus cagsi*.—Mr. R. Lydekker read a paper on a Cervine jaw from Pleistocene deposits in Algeria, which appeared to indicate the former existence in that country of a large Deer allied to *Cervus cashmirianus*. For this form Mr. Lydekker proposed the name *Cervus algericus*.—A communication was read from Dr. A. Günther, F.R.S., on the skull of the East African Reed-Buck. In this paper Dr. Günther described the skull of an Antelope obtained by Mr. H. C. V. Hunter in Masai Land, which he identified with *Cervicapra bohor* (Rüppell) from Abyssinia. He pointed out the differences from the skull of the South African species, for which the name *Cervicapra redunca* (Pallas) is generally employed.—Mr. P. Chalmers Mitchell described a graphic formula, designed for the purpose of representing geographical distribution. The regions were indicated by lines, the sub-regions by symmetrically placed numbers. This formula could be drawn rapidly, and printed without engraving.—Mr. W. L. Sclater read the description of a Jerboa from Central Asia, which he proposed to refer to a new genus and species of Dipodinæ under the name *Eucoreutes naso*.

Entomological Society, November 5.—The Right Hon. Lord Walsingham, F.R.S., President, in the chair.—Lord Walsingham announced the death of Mr. Atkinson, of the Indian Museum, Calcutta.—Mr. A. H. Jones exhibited a number of Lepidoptera collected in June last near Digne, Basses Alpes, including *Papilio Alexanor*; *Parnassius Apollo*, larger and paler than the Swiss form; *Anthocharis tagis*, var. *Bellezina*; *Leucophasia Duponcheli*; *Thecla spini*; *Thecla ilicis*, var. *cerri*; *Lycæna argiades*, var. *corretas*; *Melitæa deione*; and *Argynnis Euphrosyne*.—Mr. W. E. Nicholson also exhibited a collection of Lepidoptera, formed near Digne last June, which included very large specimens of *Papilio Machaon*; *P. Podalirius*; *Thais rumina*, var. *medesicaste*, larger and redder than the Mediterranean specimens; *Apatura ilia*, var. *clytie*; *Argynnis adippe*, var. *cleodoxa*; *A. Daphne*; *Melanargia galatea*, var. *leucomelas*; and many others.—Mr. C. O. Waterhouse exhibited the wings of a large species of *Attacus*, split in halves longitudinally so as to show the upper and lower membranes.—Dr. D. Sharp, F.R.S., exhibited a photograph he had received from Prof. Exner, of Vienna, showing the picture obtained at the back of the eye of *Lampyris splendidula*. He stated that this picture is continuous and not reversed, and shows the outlines of lights and shades of objects at a distance as well as of those closer to the eye.—Mr. H. Goss exhibited a specimen of *Zygæna filipendulæ*, var. *chrysanthemi*, which he had taken at Rhinefield, in the New Forest, on July 15 last. Dr. P. B. Mason said this variety was known on the continent of Europe, and was figured by Hübner in his "Sammlung," a copy of which work he exhibited. He added that he possessed a similar specimen of this variety taken in Wyre Forest, Worcestershire. Colonel Swinhoe stated that he possessed a similar variety of a species of *Syntomis*.—The Rev. Dr. Walker exhibited seven varieties of *Melanippe thuleana*, nine of *Coremia munitata*, and a few of *Noctua conflua*, illustrating the varied forms of these species occurring in Iceland. Dr. Mason said that the only British specimens of *N. conflua* which he had seen resembling the Iceland form of the species were taken at Wolsingham, Durham.—Mons. A. Wailly exhibited and remarked on a number of Lepidoptera from Japan. The collection comprised about thirty species, eleven of which, it was stated, were not represented in the British Museum collections.—Mr. A. C. Horner exhibited a number of rare species of Coleoptera, including *Homalota crassicornis*, Gyll., *H. humeralis*, Kr., and *Euryporus picipes*, Pk., collected at Church Stretton, Shropshire; and also *Amara nitida*, Sturm., *Oxypoda amæna*, Fair., *Homalota testaceipes*, Heer, and *Lithocharis apicalis*, Kr., from the neighbourhood of Tonbridge.—Herr Meyer-Darcis exhibited a specimen of *Termitobia physogastra*, Gangelb., a new genus and species of *Brachelytra* obtained in a white ants' nest from the Congo. Dr. Sharp commented on the interesting nature of the exhibition.—Colonel Swinhoe exhibited a collection of moths from Southern India, which comprised about forty species. He also read a paper, describing these species, entitled "New Species of Moths from Southern India."—The Rev. T. A. Marshall communicated a paper entitled "A Monograph of British Braconidæ, Part IV."—Lord Walsingham read a paper entitled "African Micro-Lepidoptera," containing descriptions of seventy-one new species, and of the following nine new genera, viz. *Autochthonus* (type *A. chalybiellus*, Wlsm.), *Scalidoma* (type *Tinea horridella*, Wkr.), *Barbaroscardia* (type *B. fasciata*, Wlsm.), *Odites* (type *O. natalensis*, Wlsm.), *Idiopteryx* (type *Cryptolechia obliquella*, Wlsm.), *Microthauma* (type *M. metallifera*, Wlsm.), *Lienocera* (type *L. lyonetiella*, Wlsm.), *Oxymachæris* (type *O. niveocervina*, Wlsm.), and *Micropostega* (type *M. æneofasciata*, Wlsm.). Several European and American genera were recorded as new to the African fauna; and the occurrence of one Australian and two Indian genera was also noted.

Linnean Society, November 6.—Prof. Stewart, President, in the chair.—Mr. E. M. Holmes exhibited and made remarks on some little-known seaweeds, including *Monostroma Blythii* and *Capsosiphon aureolus*, collected at Taymouth, *Oscillaria Corallinæ* from Weymouth, and *Schizothrix lardaica* from Paignton. Mr. Holmes pointed out that *Spermothamnion intricatum* gathered near Swanage showed gradual transition to *S. Turneri*, of which it should henceforth be considered only a vegetative form. —Mr. George Murray exhibited and described the peculiarities of some galls of *Rhodymenia* formed by a crustacean.—Prof. G. B. Howes exhibited a specimen of *Lima hians*, with a byssus "nest" which it had spun in 21 days in a vessel of sea-water in which it had been placed. Although constantly watched by day and night, the act of spinning had not been observed.—On behalf of Mr. J. W. Willis Bund, Mr. Harting exhibited and made some remarks upon a South Pacific Petrel (*Œstrelata torquata*, Macg.), which had been shot in Cardigan Bay in December last.—On behalf of Prof. Martin Duncan, who was unable to be present, Mr. P. W. Sladen exhibited two microscopic preparations of the ambulacral ampullæ of Echini, showing that each ampulla is supplied by one offshoot from the main ambulacral water-vessel.—Mr. Harting exhibited a specimen of the Baltimore Oriole (*Icterus Baltimore*), which had been lately obtained at Balta Sound, Shetland.—A paper was then read by Rev. Prof. Henslow, entitled "A Contribution to the Study of the Relative Effects of Different Parts of the Solar Spectrum on the Assimilation of Plants." The paper was illustrated by diagrams, and a discussion followed, in which the President, Prof. H. Marshall Ward, Dr. D. H. Scott, and others took part.

PARIS.

Academy of Sciences, November 10.—M. Hermite in the chair.—New researches upon the synthesis of rubies, by MM. E. Fremy and A. Verneuil (fourth communication). The anthors have succeeded in producing rubies on the large scale, and of greater size than heretofore. The artificial stones are as good as the natural rubies for the purposes of the watchmaker. —Study on the fluor-spar of Quincié, by MM. Henri Becquerel and Henri Moissan. The following conclusions concerning the fluor-spar from this locality, long considered of special interest on account of the peculiar odour it evolves on being broken into fragments, have been formulated in this paper: (1) that the fluor-spar from Quincié contains an occluded gas, which is seen to be disengaged when fragments of the spar are broken under the microscope; (2) that all the reactions furnished by the fluor-spar from Quincié may be explained simply by the presence of a small quantity of free fluorine in the occluded gas.—On the approximate representation of a function by rational fractions, by M. H. Padé.—On the analysis of hypophosphorous, phosphorous, and hypophosphoric acids, by M. L. Amat. These acids or their salts may be analyzed either by means of mercuric chloride or potassium permanganate, provided the conditions given are adhered to. The most precise method is that in which mercuric chloride is employed, but the time required is much greater. —Combinations of mercuric cyanide with salts of cadmium, by M. Raoul Varet. Bodies having the following formulæ have been described—

(1) $HgCy_2, CdCy_2, HgI_2, 7H_2O$.
(2) $2HgCy_2, CdBr_2, 4{\cdot}5H_2O$.
(3) $HgCy_2, CdBr_2, 3H_2O$.
(4) $HgCy_2, CdCl_2, 2H_2O$.

—On the preparation and properties of benzoyl fluoride, by M. E. Guenez.—Synthesis of citric acid, by MM. A. Haller and A. Held.—Experimental study of the *rôle* attributed to lymphatic cells in the protection of the organism against the *Bacillus anthracis*, and in the mechanism of adventitious immunity, by M. C. Phisalix. It is shown that the lymphatic ganglion plays both a mechanical and chemical *rôle*: it is an organ that arrests and considerably modifies the form and virulence of the *Bacillus anthracis*.—Experimental production of white tumours in the rabbit by the inoculation of attenuated cultures of Koch's bacillus into the veins, by MM. J. Courmont and L. Dor. The experiments indicate: (1) primitive local tuberculosis appears to be due to the action of an attenuated tubercular virus; (2) after having penetrated directly into the blood, no effect may be observed for some months; (3) the articular synovials, at least in young subjects, favour the implantation of the attenuated tubercular virus more (but without local traumatism) than the visceral organs.—On the development of *Dondersia banyulensis*, by M. G. Pruvot.—New researches on the spores of *Myxospongial* (structure and development), by M. P. Thélohan.—Observations of Norwegian salmon, by M. J. Kunstler.—The Coleopterous parasites of Acridia: the metamorphoses of Mylabrides, by M. J. Kunckel d'Herculais.—On the means (1) of recognizing sections of felspar parallel to the 010 plane, in thin slabs of rocks; (2) of utilizing their optical properties, by M. A. Michel Lévy.

AMSTERDAM.

Royal Academy of Sciences, October 25.—Prof. van de Sande Bakhuyzen in the chair.—Mr. van Diesen, having referred to his note of January 27, 1872, concerning the disturbances to which the River Maas is liable in times of flood, explained the plan by which it is proposed that the river shall be directed through a new mouth in the Amer, the present mouth near Woudrichem being closed. This work, which is now in full progress, will diminish the said disturbances. He gave a general view of the details of the scheme, and compared it with the project proposed, in 1822, by General Krayenhoff, whose plan for the separation of the Rivers Waal and Maas will be executed more thoroughly than he intended.

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