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RECENT RESEARCHES IN ELECTRICITY AND MAGNETISM.

Notes on Recent Researches in Electricity and Magnetism, intended as a sequel to Prof. Clerk Maxwell's Treatise on Electricity and Magnetism. By J. J. Thomson, M.A., F.R.S., &c., Professor of Experimental Physics in the University of Cambridge. (Oxford: at the Clarendon Press, 1893.)

THE supplementary volume to Maxwell's "Electricity" which it was announced the present occupant of Maxwell's chair in the University of Cambridge had in preparation, was looked forward to with keen interest by all electricians. It was sure, of course, to be a work of great scientific importance; but it was awaited with all the more impatience because certain promises and allusions in the new edition of Maxwell's treatise, lately published under Prof. Thomson's editorship, had led to pleasant anticipations that the supplement would be more or less of a commentary on the treatise, and would deal with some of the outstanding difficulties of Maxwell's electromagnetic theory. One promise in particular, made in the notes on the Electricity, we looked forward to seeing fulfilled in the supplementary volume, that of further discussion of the Maxwellian stress in the electromagnetic field. It is just here that the greatest difficulties of Maxwell's theory present themselves to some at least, and that a commentary such as the author could have written would have been particularly valuable.

Any little disappointment which may be felt at first as to the contents of the volume vanishes when their solid scientific value becomes apparent, and it is felt that perhaps the author has done the right thing after all by preferring to give a full account of the great work which has been done in recent years, in confirming and verifying Maxwell's theory, and in answering the questions it has suggested.

The book opens with an account of Prof. J. J. Thomson's method of regarding electric and magnetic phenomena as produced by the motion of Faraday tubes of electric force. This method is fully explained, and applied to the discussion of various physical phenomena, such as electrolysis, the action of a galvanic cell, and so forth. These show, perhaps, to the best advantage the power of the method, which certainly enables a mental image of what goes on in such cases to be more easily and clearly formed.

These tubes, according to Faraday's idea, start from positive and end on negative electricity, and the positive and negative electricities at the extremities of a tube, being merely the two aspects or surface manifestations of the state of strain existing in the medium within the tube, are complementary and equal.

According to Prof. Thomson's specification, a tube is either closed or terminated by atoms. When it has a length of the same order of magnitude as the distance between two atoms in a molecule, the atoms are in chemical combination; when the length is of a higher order of magnitude the atoms are chemically free.

These tubes move through the field when electrical changes take place, and by their motion produce magnetic force, which is proportional to the velocity of the tube moving at the point considered, and at right angles to the plane defined by the tube and the direction of motion. When a tube as a whole reaches a conductor, it shrinks to molecular dimensions.

To account for a steady magnetic field, which occurs without dielectric polarisation, and therefore apparently without the presence of tubes in the field at all, it is supposed that there are passing through a given small area just as many positive as there are of negative tubes, (that is, there is a distribution of oppositely directed tubes throughout the field, such that there is nowhere any preponderance of one kind over the other), but that these two sets of tubes are moving with equal velocities in opposite directions, so that the magnetic forces which they produce reinforce one another.

A quantity which the author calls the polarisation of the medium is defined, for any given direction at a given point, by the excess of the number per unit of area of positive over negative tubes passing through a small plane surface drawn through the point at right angles to the given direction. When the dielectric is not air, the unit area is supposed taken in a narrow crevasse cut in the medium with its walls at right angles to the given direction. Thus the dielectric polarisation is exactly analogous to the magnetic induction in the magnetic field as ordinarily defined.

The momentum of the tubes per unit volume of the field at any point is a directed quantity which is normal to the plane defined by the magnetic induction and the polarisation, and its components are proportional to the rates of transference of energy, according to Poynting's theory, in the directions of the axes across unit area held at right angles to each of them.

When the electric intensity of the field is due solely to the motion of the tubes, they move at right angles to their own directions with the velocity of light.

This theory gives a clear idea of why both polarisation and conduction currents and the motion of charged bodies produce magnetic effects. Everything is due to the motion of Faraday tubes, and in all three cases the Faraday tubes are moved through the field.

It is questionable whether this theory will ever successfully compete in electromagnetic discussions with the reciprocal method, that of the motion of tubes of magnetic force. Both were given by Faraday, who speaks most unmistakably in his "Experimental Researches," in the language of the modern theory of the induction of currents by the motion of tubes of magnetic induction across conductors situated in the field. It is well to have both, and their use will serve to emphasise what is of very great importance, the reciprocal character exhibited very strikingly in the modification of Maxwell's electromagnetic equations, given by Heaviside and Hertz, of the relations between the electric and the magnetic forces.

After these preliminary discussions comes an account of the phenomena accompanying the passage of electricity through gases. This reviews and coordinates to a considerable extent the experimental researches of Crookes, Spottiswoode and Moulton, Hittorf, and others in this field. This part of the work has a value enhanced by the contributions made to our knowledge of this department of electrical science by the author himself, both as regards the actual experimental facts and their theoretical explanation. The action of a magnet upon discharges in tubes or bulbs without electrodes is peculiarly interesting. The discharge being oscillatory in such a case is separated into two distinct portions, consisting of the discharges in the two opposite directions. Thus a ring discharge in a horizontal plane has one part raised, the other lowered by the action of a horizontal magnetic field. Further, as has been observed by the author, the discharge is rendered more difficult when it has to pass across the lines of force of a magnetic field, while it is facilitated when it has to pass along the lines.

The explanation suggested by the author is ingenious. The gas breaks down along the line of maximum electromotive intensity, and a discharge occurs which gives a supply of dissociated molecules, which readily convey subsequent discharges. The magnetic field, when at right angles to the line of discharge, acting on the molecules taking part in the discharge, removes them from the line of maximum electromotive intensity, and thus the instability of electric strength which the discharge tends to set up is continually being annulled by the magnetic action.

In the other case it is suggested that if branching of the discharge from the main line takes place, the dissociated molecules there formed will be brought into the line by the magnetic action, and would thus increase the facility of the discharge, beyond that which would exist if there were no field.

This, as Prof. Fitzgerald has suggested, has an important bearing on the nature of the aurora, and probably explains the streamers which form so remarkable a feature of auroral displays. These may be simply more than averagely bright discharges along the electrically weaker lines of magnetic force in the rarefied air of the upper parts of the atmosphere.

A chapter is next devoted to Conjugate Functions in their applications to the solution of electrical problems. This method is very serviceable for the solution of problems of electrical flow in two dimensions, but it can hardly be applied in a systematic manner to the various problems which present themselves.

The theory of functions of a complex variable has been greatly advanced since Maxwell wrote, and there is certainly much, as has been pointed out, more especially by Klein, that has direct application to the solution of electrical problems. Prof. Thomson has therefore done well to include some of the general transformations of this theory, with their applications to such problems as the effect of the gap between the plate and guard-ring in Lord Kelvin's absolute electrometer or guard-ring condenser, different arrangements of piles of plates, and the like. This theory of the condenser he has himself made use of in his determination of v.

It may be objected that some of the problems solved by the indirect method employed in this chapter have no very distinct practical application; but there can be no question of the value of such a discussion. It places within the reach of students who are able to follow it processes ready to hand by which problems quite unassailable by ordinary methods are discovered and solved; and who can tell when such problems may not become of great practical importance, in the present rapidly advancing state of the science?

We are taken next to the subject of electrical waves and oscillations, which in some form or other is the theme discussed in the remainder of the book. The problem of periodic disturbances is very fully treated in a large number of practically important cases. Throughout the analysis the method of representing a simply periodic function in the form $Me^{(mz+pt)i}$ where $i = \sqrt{-1}$ is adopted. This tends greatly to condensation, and the results are always interpretable at will by properly "realising" the solution.

First is taken the extremely important case of waves along a cylindrical wire surrounded by a coaxial coating of dielectric, outside which again is an infinitely extending cylindrical conductor; and this is treated with special fulness. The solutions are expressed in terms of Bessel's functions; and this part of the book ought to lead to a more general study of the properties of such functions, and their applications to physical problems. They had their origin in a physical problem, and their importance to physicists has gone on increasing with the development of physical mathematics which has been brought about by the problems disclosed by scientific progress in recent times.

The theoretical solution of the problem of waves along wires is mainly due to Lord Kelvin, Mr. Oliver Heaviside, and Prof. J. J. Thomson. The solution given long ago by Lord Kelvin of the more limited problem which was then the practical one, appears as a particular case of the general solutions which these physicists have since obtained. The conclusions they have reached are of the utmost interest in connection with telephony, and seem likely to point the way to a more extended use of telephonic communication than has hitherto seemed possible. Lord Kelvin's early solution, it is not too much to say, gave for the first time light on the vexed question of the conditions of success in signalling through submarine cables and, together with the marvellously delicate and simple instruments which he also invented, rendered signalling through such cables commercially possible. Even now the question of ocean telephony has come to the front, and if it succeeds (and who will venture to say its difficulties will not be overcome?) it will be in great measure a result of the patient researches of men like Lord Kelvin, O. Heaviside, and the author of the work before us.

The complex variable treatment is adhered to, and contributes greatly to brevity of expression. The treatment of the subject is very complete, and though it involves some rather complicated work seems very accurately printed. The author has apparently pressed forward from point to point, taking the path which presented itself at the time, and hence, to one coming after, it is possible to suggest some shortening and smoothing of the way. For example, the values of the electromotive and magnetic intensities are perhaps more compactly investigated by first specialising the fundamental equations for the case of symmetry round an axis, noting that the electromotive intensity reduces to two components, one P along the axis, and the other R at right angles to the axis, in a plane through the axis and the point considered, while the magnetic force H, say, has a single component perpendicular to the plane. Thus two differential equations are got connecting P, R, and H, from which (P having first been found from the differential equation involving P alone) R and H are found at once in the forms $M\partial P/\partial r$, $N\partial P/\partial r$ where M and N are multipliers, and r is the radius drawn from the axis to the point considered.

It is to be noted also that the sign between the two groups of terms into which $K_0(x)$ is divided in (2), p. 263, should be the same as that before log x in the first group in brackets and that C should be taken with the same sign as log x, and log 2 with the opposite sign. This involves a correction likewise in the table of approximate values of the functions given lower down on the same page. Again, the same constant C, which has the value

$$\underset{n=\infty}{\mathrm{Lt}}\left(\Sigma_n^1 \cdot \log n\right)$$

is called Gauss's constant at p. 263, while the quantity $\gamma = e^C$ is called Euler's constant at p. 430. The established usage seems to be to call C Euler's Constant from its discoverer, who gave its value (to sixteen places of decimals) in his *Institutiones Calculi Differentialis*.

The "throttling" of the current in wires subjected to rapidly alternating electromotive forces is fully considered for a cable with inner and outer coaxial conductors, and for two flat strips in parallel planes with a stratum of insulating material between them. In this connection the author first introduces Mr. Oliver Heaviside's word *impedance*. Writing E for the external electromotive force, I for the total current, and R and L for the effective resistance and self-inductance, we have (p. 272)

$$E = L\frac{\partial I}{\partial t} + RI.$$

R is called by Prof. Thomson the impedance. According to Heaviside's proposal it is $\sqrt{R^2 + n^2L^2}$ that should be called the impedance, where $n = 2\pi/T$, T being the period of the alternation.

The manner in which the damping out of the vibration is taken account of by the complex analysis is well worth remarking. The eating up of the energy and consequent tapering off of the amplitude according to an exponential function of the distance from the starting end by the impinging of the oscillations in the dielectric on the conductors bounding it, and the lowering of speed of propagation of phase in the dielectric below the natural speed, that of light, all come out in the most beautiful manner.

Mr. Heaviside's careful synthetical explanations of such phenomena are well worth reading in this connection.

The author next passes to his own most valuable investigations regarding the effect of subdivision of iron on the dissipation of energy in the iron of a transformer, to electrical oscillations on cylinders and on spheres, and other problems of the greatest interest to all students of the later developments of Maxwell's great theory carried out by Hertz, now, alas, to be continued entirely by other hands.

The concluding portion of the book consists of a most valuable account of the work of Hertz, and forms the most appropriate supplement to Maxwell's great work that could have been written. The idea of Faraday tubes is well applied to picture the action of a Hertzian resonator in its different positions relatively to the vibrator in the experiments on direct radiation, and those on waves along wires. Not only is Hertz's own work fully described and explained, but the vast amount of fine work that has been done at Dublin, Liverpool, at Cambridge, and on the continent, is discussed, and much of it submitted to careful mathematical analysis.

Space does not permit of even a summary of the topics here treated, and we can only say that the reader who wishes to know these things well, and who shrinks from the labour of digging them out of *Proceedings*, *Annalen*, and *Berichte*, here, there, and everywhere, ought to read Prof. Thomson's work. Such a work is worthy not only of the author, but of the researches of the master and his great disciple who have passed away. A. GRAY.

GREENHILL'S ELLIPTIC FUNCTIONS.

The Applications of Elliptic Functions. By Alfred George Greenhill, F.R.S., Professor of Mathematics in the Artillery College, Woolwich. (London: Macmillan and Co., 1892.)

IT would be difficult to exaggerate the part which the study of elliptic functions has played in the pure mathematics of the present century. And this was to be expected; for whether we regard natural science as the application of common sense to the material needs of life, or as the outcome of the need for expansion in the mental world, and whether we consider mathematics as that exact basis without which progress was not permanently possible, or esteem it to be those higher Alps—

> Where we can ever climb, and ever
> To a finer air—

in either case we must see that a development of integral calculus—a development which was competent to fill so large a part of Legendre's life, which suggested such magnificent algebra as we find in Jacobi's Fundamenta, which promised, too, in Abel's hands such generalisations as are not even yet brought to perfection, such a theory, surely, was well worthy of persevering pursuit. And if we attribute the present extent of the theory of curves and of the theory of functions to the day when Riemann stood best man to the ideas of Cauchy and the suggestions of hydrodynamics, we must admit it was because his methods were employed upon the materials left by Abel that such results have come.

The importance of the present work lies in its recognition that the theory of elliptic functions arose as a development of integral calculus, and as such may be expected to supply a formulation of the solution of many problems of physics otherwise regarded as unfinished. Prof. Greenhill is well known to be a man who has not allowed his unwearied application to such problems to destroy his sympathy with pure mathematical speculation; on the contrary, he has sought, by every means in his power, to fill the difficult position of apostle to the Gentiles in this respect, by making as many of the results of analysis as are susceptible of application to physics, easily intelligible to students of that subject. The present book, addressed, we are told, to the trained mathematical student, is stated to be primarily a collection of problems (mostly in dynamics and electric flow) whose solutions are expressible by elliptic functions; and it is intended that the properties of these functions should be suggested by, and developed simultaneously with, the problems in hand. Really, of course, it is much more. In fact, the student who works completely through the book will meet with a good many of the formulæ of common occurrence in the elementary part of the subject, and will, moreover, learn to manipulate them for himself; and whether he be interested most in the motion of tops, or the stability of ships, or the biquadratic form, he will probably be surprised at the amount of information condensed here.

The book opens with a consideration of the motion of the common pendulum. The fact that in this motion the angular displacement depends uniquely upon the time, suggests the inversion of the elliptic integral; the existence of a real period of the functions thus obtained, is suggested by the periodic motion of the pendulum. The functions are then immediately used to express the solution of Euler's equations for a body moving about a fixed point under no forces. Then follow seventy pages devoted to the expression of elliptic integrals in terms of the functions, in the course of which, beside a vast variety of examples collected from Legendre and elsewhere, are found a consideration of Watts' Governor, of the Elastica, of the Sumner lines on a Mercator chart, of the Catenoid, of quadrantal oscillations, and of other things—the notation being sometimes Jacobian and sometimes Weierstrassian. It is needless to say that here is a mine of wealth for the examiner. It is only in chapter iv., when we are a third of the way through the book, that the addition theorem of the functions becomes necessary. And while this is proved by a pendulum view of Jacobi's two-circle method, space is found for a thorough examination of Legendre's method and a detailed account of the porism of the in- and circum-scribed polygon for two circles, the diagrams being of the most painstaking character. Then follow sixty pages which will be perhaps the least interesting of the book—at least to the students for whom Prof. Greenhill writes—devoted to an algebraic exposition of the addition theorems for the three kinds of integrals. They contain an examination of the theorems of Fagnano and Graves for the ellipse and hyperbola. They are followed by an account of the tortuous elastica, succeeded by a resumption of the motion of a body about a fixed point under no forces, wherein the author introduces a very full account of the herpolhode. In the hundred pages remaining, the book may be said to be drawing to a conclusion, the double periodicity is considered, Cartesian ovals being introduced in connection with the expression of functions of a purely imaginary argument; a chapter is devoted to the factor expressions of the functions, here suggested by hydrodynamical considerations; and the last chapter is a summary of the earlier part of the theory of transformation, characterised, however, like the rest of the book, by the utmost particularity, numerical and otherwise.

This summary will show to some extent the scope of the work. It is essentially a student's book, written in a concise conversational style; but whether the student have more sympathy with physical or pure mathematics, he cannot fail to find much that is new to him, and be surprised at the detail with which it is given; and the air of practical reality which pervades every page, and the skill and originality with which the results are obtained, will atone for the tentative nature of many of the demonstrations.

It is, in fact, in this regard that the reader may be most unfair to the author. It is no part of his plan to develop any demonstration beyond the nearest point at which it suggests the formula required, or to use any more general method of enquiry than is absolutely necessary, or to regard the subject in any other way than as a collection of formulæ. To forget this is to wish for many things to be differently stated—is, indeed, to wish for a quite different book. A few instances will suffice. The author frequently makes the remark that the present state of the theory is due to Abel's brilliant idea in inverting the elliptic integral of the first kind. One fears that the reader may enquire whether the inverse function is a one-valued function of its argument for all the values of the latter, or may forget that the expansion of p. 202 is not valid for all values of the quantities involved. He may even wish to invert the integral of the second kind, notwithstanding that it is here expressed in terms of the integral of the first kind. Or, again, the statement on p. 266, that ϕ and ψ "satisfy the conditions required of the potential and stream functions," may lead to misconception, for it is not sufficient that ϕ be infinite at A and C; it must be infinite in the neighbourhood of A like a multiple of the logarithm of the distance from A. And in the same way, on p. 281, in attempting to realise how a "uniform streaming motion parallel to the vector *ma*" is consistent with the motion in the strips which is represented by the other factors, we are liable to desire a proof that functions whose equality is not identical, but, as here, the result of proceeding to a limit, necessarily represent the same fluid motion. The fact is that the two functions considered here are not equal for $z = \infty$, where sine z has a most essential singularity. Or, again, we may wish that the signs had received more attention; as, for instance, on p. 24, or throughout chapter ii., and in many other places. And this the more that Jacobi himself is known to have printed a mistaken sign (for $cn\,(K+iK')$). And this wish is not allayed by the fact that in the reservation of these difficulties, made on page 45, poles and branch points are mentioned together, as if similar singularities. While, lastly, if we forget the object of the book, we shall most devoutly wish a better recognition of the fact that the Jacobian functions and the Weierstrassian functions are not the fundamental fact of the theory. Underlying both is the same algebraic irrationality, now expressed by a binodal quartic, and now by a cubic curve—from either of which both these functions and many others can be constructed, the distinguishing mark being only the number and position of the poles. One does wish indeed that Prof. Greenhill had found occasion to state somewhere that the algebraic method he adopts throughout, fascinating as it certainly is, is also, in the strict sense employed by him, of only antiquarian interest, in view of the descriptive methods that are available. It is, moreover, essentially incompetent, and therefore unsatisfactory.

But if we pass over such considerations as these, fundamental as they are from some points of view, recognising that in practical life we often count it a saving of time to exhaust the logical consequences of a belief, before painfully verifying the grounds of that belief and recognising that in a new subject it is always the most elementary method that furnishes the easiest introduction, we shall find very much for which to value the book before us—beside the excellent diagrams, index, printing, &c.

Note 1.—The result of carrying out in detail the work mentioned at the end of § 194 seems worth introducing into a new edition. The result is partly given in Math. Tripos. Part II. 1892. It seems a pity, too, that the expressions for the Jacobian $Z(u)$ in terms of the Weierstrassian $\zeta(u)$ are not given.

Note 2.—The example 15, p. 351 (though taken from Math. Tripos, Part II.), is wrong. The result should be

$$3\frac{a - mc}{1 + m^3} = \frac{1}{m}(x_1 + x_2 + x_3) = \frac{x_1 - x_2}{y_1 - y_2}(x_1 + x_2 + x_3)$$

where $y = mx + c$ is the final position of the line.

Note 3.—The example 2 (i.), p. 140, is misprinted.

H. F. BAKER.

THE DISPERSAL OF SHELLS.

The Dispersal of Shells: an Inquiry into the Means of Dispersal possessed by Fresh-water and Land Mollusca. By Harry Wallis Kew, F.Z.S. With a Preface by Alfred Russel Wallace, LL.D., F.R.S. With Illustrations. Pp. xi. 291. International Scientific Series, Vol. lxxv. 8vo. (London: Kegan Paul, Trench, Trübner and Co., 1893.)

IT is strange that we have had to wait so long for a manual on dispersal. Many books have been written on the geographical distribution of animals and plants; and islands and even continents have been raised or lowered to account for the strange anomalies. Yet comparatively little attention has been paid to a study that must be undertaken before we are qualified to express an opinion on geographical distribution. Darwin and Lyell, however, thoroughly recognised the importance of the subject, and the former made many experiments on the vitality of seeds under trying circumstances—such as being immersed in sea-water, or eaten by birds. Direct observation of the species in transit, under natural conditions, has been less attended to, except in the case of flying animals and of certain plants. The cause of this neglect is easy to understand: dispersal, in the groups that are not specially modified to assist the process, is mainly the result of the accumulation of rare accidents, such as would only occasionally be noticed by some naturalist engaged in quite different observations. It is useless to go into the field on purpose to watch the dispersal of snails; the entomologist, ornithologist, fisherman, or sportsman may once in a season obtain a direct observation, and it is to such observers that we must principally trust.

In certain respects the land and fresh-water mollusca are peculiarly valuable for the study of geographical distribution; they are essentially sedentary animals; some of them can float, but scarcely any except *Dreissena* have an active free-swimming larval stage. Few of the species are specialised for dispersal; though we do not think that there is such a complete absence of specialisation as would at first appear. The study of the dispersal of the mollusca becomes, under these circumstances, of great importance to the naturalist; for if snails or their eggs can cross rivers and straits, it is probable that other sedentary groups can do so also.

The system on which Mr. Kew has worked is to collect all the facts relating to the dispersal of land and fresh-water mollusca, giving the authority for each statement. He has thus gathered into one small volume an enormous amount of information, much of which will be quite new to naturalists. Beginning with the fresh-water shells, he treats first of the anomalies in their local distribution, such as their occurrence in perfectly isolated ponds. Then follow chapters dealing with the means of dispersal; and it is surprising how varied these are. Not only are the animals transported down stream on various floating objects, but the author can quote an actual instance in which a number of fresh-water mollusca (*Anodon*) were carried by a whirlwind and fell with the rain. Another interesting case of transportation over dry land is that mentioned by Canon Tristram, who found the eggs of some mollusc, probably *Succinea* attached to the foot of a passing mallard shot by him in the Sahara, a hundred miles from water. A few instances are noted in which birds on the wing have been shot with bivalves adhering to their toes; but there seems to be no recorded case of the occurrence of molluscs or their eggs in the bits of water-weed that so often catch on the feet of aquatic birds. It is probable that this means of transport is common; but being less striking than the other modes, it has not yet been observed. Insects also lend their aid, and a water-beetle (*Dytiscus marginalis*) has twice been captured on the wing with *Sphærium* attached to its legs; another specimen was caught with *Ancylus* attached to its wing-case. Various other aquatic insects have often been found with mollusca attached to them, though they were not actually caught on the wing.

As regards the land-shells, there is a singular dearth of direct evidence. Mr. Kew is able to mention various ways in which they *may* have been transported; but the only cases in which the process has actually been observed were some live *Helix caperata* found in a wood-pigeon three days after it had been shot, and an operculated land snail which had caught the foot of a bumble-bee, and was being dragged along. We cannot help thinking, however, that the dispersal of land-shells is a much rarer process than the carrying of fresh-water species. An isolated dew-pond after an existence of ten years will generally yield several species of fresh-water mollusca, and a mediæval fish-pond has quite a large fauna. A church or castle built of limestone, but surrounded by non-calcareous desert, is, for a large group of land snails, the equivalent of an isolated pond; but it is only on very old buildings that one finds colonies of the special limestone species. We have never come across an isolated colony of this sort on a building less than a hundred years old, and have never noticed more than two or three species on a single ruin under such circumstances.

The rest of Mr. Kew's book is devoted to the dispersal of shells by human agency, and to a discussion of the claims of certain species to be considered native in Britain. This part is very good, and, like the rest of the book, is commendably free from bias, though we do not always agree with the author's conclusions. Mr. Kew in a future edition should add a counterbalancing chapter on human agency as preventing the dispersal of snails. We cannot help thinking that the making of fences and the extermination of the larger mammals in Britain has largely stopped the transportation of land-shells. Any one who has noticed the masses of earth that adhere to the flanks of an ox that has slept in a damp meadow, must realise that in the days of the shaggy-haired mammoth, bison, Irish elk, and wolf, dispersal both of animals and plants may have been far more rapid than at present. Lyell has pointed out that seeds may often be carried long distances by a hunted animal, and the same reasoning applies to any small mollusca or their eggs that may be entangled in the long hair. Even the coarsely masticated grass in the paunch of a deer or bison torn to pieces by the wolves might contain living snails, for many of the dry-soil species habitually cling in great profusion to grass stems. Migrating animals, especially the bison, may have greatly assisted in the carrying of both land and fresh-water shells for long distances.

We must congratulate the author on the publication of this excellent manual. It will undoubtedly lead to the accumulation of numerous observations, and we hope soon to welcome a new edition, in which more of the suggested modes of dispersal may be confirmed by actually observed cases. We hope also that the publishers will see their way to the inclusion in the International Scientific Series of volumes on the dispersal of other groups, for the transportation of species from country to country is certainly a subject that should be fully dealt with in a series claiming to be international.

CLEMENT REID.

OUR BOOK SHELF.

The Wilder Quarter-Century Book. A Collection of Original Papers, dedicated to Prof. Burt Green Wilder at the close of his twenty-fifth year of service in Cornell University (1868–93), by some of his former Students. (Ithaca, N.Y., 1893.)

UNDER the above somewhat fanciful title we have a royal octavo volume of just 500 pages, and twenty-eight plates, which contains some fifteen papers written by former pupils of Dr. B. G. Wilder, Professor of Physiology, Vertebrate Zoology, and Neurology in Cornell University, and dedicated to him as a testimonial of the writers' appreciation of his unselfish devotion to the university, and in grateful remembrance of the inspiration of his teaching and example. Following the practice of some of the German universities, Cornell has been the first among those of the New World to present the teacher with the results of what he has taught; and the idea seems so commendable that a notice, rather than a criticism, of this volume seems all that is demanded at our hands. As a frontispiece to the volume there is a portrait of Dr. Wilder, engraved on wood, by John P. Davis, the secretary of the American Society of Wood Engravers, which is an excellent piece of artistic work. A mere enumeration of the contents of the volume must suffice: Dr. D. S. Jordan, on temperature and vertebræ, a study in evolution, being a discussion of the relations of the numbers of vertebræ among fishes to the temperature of the water and to the character of the struggle for existence; Susanna P. Gage, on the brain of *Diemyctylus viridescens*, from larval to adult life, and comparisons with the brains of Amia and of Petromyzon; Dr. G. S. Hopkins, on the lymphatics and enteric epithelium of *Amia calva;* S. H. Gage, on the lake and brook lampreys of New York, especially those of Cayuga and Seneca Lakes; L. O. Howard, on the correlation of structure and host relation among the Encyrtinæ; J. H. Comstock, evolution and taxonomy, an essay on the application of the theory of natural selection in the classification of animals and plants, illustrated by a study of the evolution of the wings of insects, and by a contribution to the classification of the Lepidoptera; Dr. E. R. Corson, on the vital equation of the coloured race, and its future in the United States; Dr. T. Smith, the fermentation tube, with special reference to anærobiosis and gas fermentation production among bacteria; Dr. H. M. Biggs, a bacterial study of acute cerebral and cerebro-spinal lepto-meningitis; Dr. V. A. Moore, the character of the flagella on the *Bacillus choleræ suis* (Salmon and Smith), *B. Coli communis* (Escherich), and the *B. typhi abdominalis* (Eberth); Dr. W. C. Krauss, muscular atrophy considered as a symptom; P. A. Fish, on brain preservation, with a *résumé* of some old and new methods; W. R. Dudley, on the genus Phyllospadix; Dr. J. C. Branner, observations upon the erosion on the hydrographic basin of the Arkansas River above Little Rock.

Machine Drawing. By Thomas Jones, M.I.Mech.E., and T. Gilbert Jones, Wh.Sc. (Manchester: John Heywood, 1893.)

THIS book contains properly finished and complete drawings of machinery details taken from recent practice, the authors being of the opinion that the best way to encourage the student to make good drawings is to place good ones before him as copies. Exercises are given which require the student to test his power of making original drawings, by deducing from the complete views given, others which are not given.

One of the authors, being engineering master at the Central Higher Grade Board School, Manchester, has necessarily had much experience in teaching machine drawing, &c., and the present book was designed by him to take the place of the older specimens of drawings, with the intention of placing before the student actual mechanical drawings for copies. This is a step in the right direction, for the nearer mechanical drawing, as taught in the technical school, approaches the real thing in the engineer's office, the better it is for the students. Taken as a whole these drawings represent modern practice, and are good examples. A locomotive coupling-rod is represented on plate xxiv. fitted with a bush keyed in position and retained on the crank pin by a washer and nut of the same diameter as the external diameter of the bush. Bushes in time always get loose in the rod, and in this example there is nothing to prevent the rod coming off the bushes and causing an accident. The nut and washers are screwed on the pin only; these ought to be retained in position by a taper or split pin as well.

The authors give much sensible and good advice on the subject of drawing generally, which if carefully followed by the student will make the drawing a creditable one. The book contains forty plates and many perspective illustrations; it is nicely got up, and should prove of value in our technical schools and colleges.

Hydrostatics and Pneumatics. By R. H. Pinkerton, B.A. (London: Blackie & Son, Ltd., 1893.)

THE application and non-application of the integral calculus seems to be a bar which divides many text-books into two main divisions. In the present work, although the notation of the integral calculus has not been used, yet the method of integration has been explained, and, in fact, applied to the solutions of some problems, such as those of finding moments of inertia, centres of pressure, &c. The treatment of the subject-matter on the whole has, however, been developed by very simple mathematical methods, and although the book is published in the "Advanced Series," it should not for that reason be reckoned as of too high a standard for elementary readers. Indeed the author has inserted several useful introductory chapters to prepare such readers as those who have only an elementary knowledge of the mechanics of solids; thus we are treated to chapters on units, principles of statics, uniform, circular, and harmonic motions. In these chapters, and also in the others dealing with the mechanics of fluids, the author seems to be especially clear in his explanations, and his remarks are in many cases accompanied with diagrams and illustrations, which are always of great help to the reader studying the subject for the first time.

In a work of this kind a student can best obtain a good grasp of the subject by supplementing his study of the text with the working out of numerous typical examples. Those here inserted should be specially useful in this direction, and in many cases they have been divided into two series, the second being of a more difficult type than the first; many of the examples are taken from such sources as the examination papers set at South Kensington, and those for the Civil Service and the Universities.

As a text-book for science schools, and suitable for those wishing to get a thorough insight into the subject, the book will be sure to find favour.

How to Manage the Dynamo. By S. R. Bottone. (London: Whittaker and Co.)

IN this book the author gives, in thirty-five short pages, a few practical directions for the installation and management of a dynamo. The instructions given are intended for the use of engineers who have no knowledge of electrical work, but are called upon to undertake the management of a dynamo. It is hardly possible in such circumstances to frame directions which can be intelligently carried out. The dynamo attendant, like every other person in charge of machinery, must really learn by an experience which no manual can replace. The instructions in the text are, however, plainly and simply stated, and deal with some of the more important points connected with the care of dynamos.

An appendix is devoted to the explanation of technical terms used in electricity, and makes up about twelve of the total forty-seven pages of the book. It can hardly be regarded as satisfactory, either in point of accuracy or extent. It is more of a series of detached explanatory statements than a "table of definitions," as the author calls it in the preface.

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.*]

The Cloudy Condensation of Steam.

(1) THE fault I have to find with Mr. Bidwell (NATURE, December 28, p. 212, 1893) and others who are aiming to revive the chemical hypothesis tentatively broached by the late R. von Helmholtz (*Wied. Ann.* xxxii. p. 1, 1887. *cf.* p. 7 *et seq.*), is that these gentlemen are abandoning a tried theory when its capabilities are far from exhausted. To begin at once with the most recent contribution to our knowledge of the subject, Mr. Bidwell's observation, let a series of excessively small condensation nuclei be enclosed in a vessel without further interference. They were active before being put there; but after remaining imprisoned for a sufficient length of time, Mr. Bidwell finds them shorn of their power to produce condensation in supersaturated steam. Now, I ask, is it at all probable that these particles will remain distinct throughout the whole time of confinement? I think not. Take the familiar case of fine clay suspended in water. What goes on during subsidence is an agglomeration of particles. This process may be enormously accelerated by small additions of acid or almost any other foreign matter to the water. In ether the speed of agglomeration is so marked, that the (dry) mud which may be suspended in water for weeks, or even months, falls out of ether like so many grains of sand. Witness, furthermore, the case of any chemical precipitate. Those little solid corpuscles were originally all but molecular in size; yet they grew with such enormous rapidity to so enormous a bulk (relatively speaking), that the formed precipitate subsides quickly (in most cases) even in water. Think of those monstrous clots of fresh chloride of silver; think, too, that they were being built up of individual molecules in an instant and before one's very eyes. Then why should condensation nuclei be so good as to remain distinct indefinitely?

In brief, it is not probable that the condensation nuclei[1] if once produced can subsist in their original degree of comminution; for whatever the nature of the acting forces may be, this finely divided matter is in a highly potentialised state relatively to coarser matter, and there will be dissipation of energy by mere mechanical agglomeration even when chemical action is excluded.

(2) Let us look for further confirmation at the size which these active nuclei must necessarily have, remembering that the condensation in question, when properly viewed, always appears coloured.[2] Such condensation presupposes droplets nearly all of the same size; of a size, moreover, which we can reasonably conjecture to lie somewhere between ·000,004 centimetre and ·000,040 centimetre, depending on the colour selected. This implies that the nuclei which induce coloured condensation must all be of the same size (certainly an improbable condition), or that they must be small even when compared with the small droplets stated. If it were not so, large drops would condense on large nuclei, and small drops on small nuclei (keeping in mind that the whole process of condensation is virtually instantaneous), and there could be no prevailing dimension, and consequently no intense colour.

But it will be asked, will these excessively small particles meet the Kelvin conditions of condensation? Assuredly. One may estimate that pure, dust-free, unconfined steam at 100° would require a pressure of the order of ten or more atmospheres to condense it. Add to this dust particles less than ·000,001 centimetre in diameter, and the pressure sinks to 15 centimetres of mercury; in case of particles ·000,010 centimetre in diameter, to one or two centimetres of mercury; in other words, to pressure increments[3] certainly met with in steam jets. The fact that nuclei of a few hundred molecular diameters are needed is the very feature of these experiments, and explains why smoke and other coarse material is useless, and why the condensation-producing dust must be so highly specialised.

(3) Nuclei, it is true, are often equally active if derived from liquids, the mixture obtained by passing air over very strong sulphuric acid being a notable example. Let us remember, however, that these active liquid bodies (acids all of them, while ammonia is not active) may form sulphate of ammonia in contact with atmospheric air. But if this view of the case be unsatisfactory, is there anything in Lord Kelvin's well-known equation connecting vapour tension and curvature which asserts that the nuclei *must* be solid?

(4) I have equally great difficulties in submitting to the diverse electrical hypotheses put forth, and I cannot understand why so astute and sound-minded an investigator as Mr. Aitken should hazard his birthright for that mess of electrical pottage. It is certain that air passing across an active spark gap will produce condensation; but it is equally certain that no electric field will

[1] It must not be forgotten that the imprisoned nuclei are mixed with the nuclei normally present in air. Whether the mixture is pronounced active or not, depends on the sensitiveness of the test applied. Thus there is room for an error of judgment. I recur to this in § 6.

[2] I here include the opaque field mentioned in Mr. Aitken's and in my own articles, since it obeys clean cut colour laws.

[3] Pressures between 1 and 80 centimetres above the atmosphere were necessary in my work.

be wafted down a metallic tube three or more metres long by a draught of air—a crucial test which I believe to have been the first to make, though Mr. Bidwell does not affirm it. If charged particles, dissociated particles, and the like are sucked down there, I must insist that the said charged or dissociated particle—whatever befall it—is a particle still! If it is not small enough, it will fail to stimulate condensation in any case or theory. If it is small enough, it *must* produce nuclear condensation *per se*, no matter how the particle is otherwise conditioned.

Aside from this, the electrical theory becomes more seriously entangled by the fact that the jet itself is no mean generator of electricity. I made a few tests on this point in the line of Faraday's classical researches, and obtained marked charges from the jet, increasing with its intensity.

(5) I cannot claim much indulgence for my experiments in air filtration, though I went through them laboriously enough. But the work taught me, at least, the extreme elusiveness of such a thing as "dust-free" air. Naturally I am biassed, therefore, in regard to arguments, in the present case, based on filtration. Suppose an oxyhydrogen flame burning in filtered air is an active dust producer. The question at once arises on what kind of hearth is the flame kindled: if it burns from a glass tube, then sodium is probably volatilised; if from a metallic tube, then the metal is similarly in danger; if from no base at all, then where is the flame? In what does the remarkable activity of flames really consist? Most reasonably, it seems to me, in this, that particles therein entrapped are (as a rule) at once *volatilised*, so that for each single particle we have now a whole cloud of active nuclei precisely the kind wanted in § 2; *i.e.* myriads of them, all in that extreme degree of tenuity which best promotes condensation. In my work, glowing smokeless charcoal often did better service than flames. Alkalies are here ready for volatilisation. In general, hot flames are more active than colder flames (Helmholtz), and they should be where disgregation is needed.

Finally, a word with regard to red-hot platinum. "Here," says Mr. Bidwell, "there can be no nuclei formed of products of combustion, for there is no combustion, simply ignition and incandescence." Is it possible that Mr. Bidwell is not aware that red-hot platinum is particularly remarkable for scattering small solid particles from its surface? If so, he has narrowly escaped being overwhelmed by the literature of the subject. Aside from this, what may be the nature of platinum dissociated at red heat?

(6) To conclude: I cannot discern that the proof of anything beyond condensation of supersaturated steam, induced by mere "inert" nuclei, has yet been given. Nothing is even said of atmospheric air, which indoors or out, stagnant or fresh, is always active; nor is it even hinted at that the effect of dust is merely an *accentuation* of the effect produced by such air; that dust-stimulated condensation differs merely in degree, by no means in kind, from jet condensation in air. Air nominally purified needs only a higher degree of supersaturation to evoke condensation running through the whole gamut of colours. There are no hard drawn lines. I wish there were. Indeed, I wish the proof in question could or had been adduced, for, together with my colleague Prof. F. H. Bigelow, I am well aware of the important meteorological consequences to which this result would lead. But before I can break away from the time-honoured point of view, so safely trussed by the Kelvin formula, the experimental evidences forthcoming must be as rigorously "dust-foll" as the clear conscience with which I am disposed to admit them.

CARL BARUS.

The Smithsonian Institution, Washington, D.C., U.S.A.

The Origin of Lake Basins.

THE question of the origin of lake basins has again been raised, and, unfortunately, there is even now the same diametrical opposition between the views of the glacialists and their adversaries. Though the old lines of argumentation, perhaps, have not been followed out with sufficient perseverance, new starting-points certainly seem desirable. I should therefore like to challenge the criticism in your columns on a demonstration of the glacial origin of the greatest fjord basins in Norway.

On the western coast of Norway we have the well-known series of great fjords, generally of enormous depth, about 400 fathoms in Hardangerfjord, 600 in Sognefjord, and 300 in Nordfjord, to take only the greatest. The heads of the innermost branches are nowhere at a greater distance than some twenty miles from the watershed of the country, and the necks between them nowhere as much as forty miles. When for some reason, change of climate or rise of land, the snow began to gather on the neighbouring plateau, the highest in Scandinavia, glaciers would creep down the steep slopes and valleys, and immediately get to the deep fjords. But here the glacier ends must needs be carried away or dissolved as fast as they came on. By the necessarily slow growth of the narrow névés, it is impossible that the glaciers could advance at once with so great dimensions that the fjords were not able to master them successively. Over the narrow necks between them an ice cap certainly might push farther out, but as there is less than twenty miles to draining outlets on either side, this cap could attain no considerable thickness, and bring no great ice flow westwards from the high land behind. On the lower foreland, near the coast-line, there is nowhere sufficient gathering basin for a great névé, and the small fjord branches could easily drain their eventual surplus. My opinion is, then, that no great inland ice could possibly advance farther west in Norway than to the close set row of fjord-heads.

It may be said that the whole country in the great Ice Age was so much elevated that the fjords were only dry valleys. But no amount of elevation could ever drain fjord troughs generally 300 to 600 fathoms deep, and only 100 to 150 wide at the brim. And an adequate differential lift of the inner side of the troughs would give the old palæozoic mountains in Norway the height of the youngest mountain ranges, and is on the face of it impossible. It may be further said that ice from the high land behind the watershed might have contributed to the supply, and that the glaciers then would be large enough. But even in this case they must needs commence as small ice tongues, which would be cut off successively; and the boulders show that no transport from any distance behind the watershed took place during the great Ice Age.

The idea I have put forward is capable of maintaining itself by its own power, but its position is greatly strengthened by direct facts. It can be demonstrated that a great inland ice *has* tried to advance from the high land westward beyond the fjord heads, and signally failed. This was the case in the last Ice Age, of which we can trace all the prominent signs. As the ice cap was not able to build itself up to any great dimensions near the western precipices to the fjords, its greatest height was piled up farther to the south-east, and the ice shed was drawn in the direction of the eastern margin, down the eastern valleys. From this time we find boulders transported up the eastern slope from a distance up to eighty miles from the watersheds, and these boulders can be followed in great heights in the western valleys only to the fjord-heads, when they suddenly drop down to the old sea beach. This shows, beyond all doubt, that the glaciers from the second inland ice which far away to the south-east laid up the upper till in Prussia, on the north-western side, only reached the fjord-bottoms, and were not able to fill the fjords. We have in this an empirical proof of my idea. An inland ice is really not able to advance beyond a close set row of deep depressions as the Norwegian fjords.

But yet we have unquestionable proof that the exterior part of the west coast was extremely glaciated. Just in the mouth of the great Sognefjord itself we have the Sulen Isles with rock scorings and eastern erratics (but none from behind the watershed) up to 1800 feet above sea level, 5400 feet above the fjord bottom. How can these boulders have been transported across this abyss when no inland ice could ever have advanced beyond the fjord head, and no local glaciers from the peninsula on either side could ever have crossed the deep channels, or piled itself up to sufficient height here only a few miles from the steep slope to the Atlantic Ocean basin? I cannot see any way to account for these facts other than by the supposition that the fjords or depressions of the same kind and depth did *not* exist when the first great inland ice was forming, but were quite completed when the second (and last) commenced. *Ergo*, the Norwegian fjords are of early glacial or interglacial origin.

At this point of my reasoning comes in the conclusive series of arguments which puts any other origin than glacial erosion quite out of question for this peculiar flat troughs in old solid azoic and palæozoic country. I wish to lay especial stress upon the fact that Norwegian geologists for many years have laid great weight upon the really marvellous circumstance of lake-distribution only in glaciated districts, as one of the best of the many indirect proofs of the glacial origin of rock basins. I should think, however, that when the origin in glacial time of the grand Norwegian fjords is sufficiently proved, their origin by glacial forces will be more easily granted. The same may certainly be said of the far smaller lake basins in Norway, for which an analogous demonstration can be given. That the fjords now must really be of pleistocene origin is the point I wish to make in this letter. Only if anyone can, in a simple manner, explain how an inland ice could be able to pass the close set row of fjord heads, is it possible to dismiss my argument.

ANDR. M. HANSEN.

University Library, Kristiania, January 29.

A FEW words are due from me in reply to the kindly criticisms of my suggestion regarding the erosion of rock basins that have appeared in NATURE since its publication on November 9, 1893.

In the first place, I must apologise to Sir H. Howorth for having misunderstood his remarks on the plasticity of ice in his letter of July 13, a misunderstanding due, of course, to my not having had an opportunity of reading the chapter devoted to the subject in his book. Unfortunately the libraries of our small outlying stations in India do not as a rule provide us with works of scientific interest, and the conditions of life of most of us who take an interest in such subjects out here force us to content ourselves with the possession of very few books of the kind, and only those that are absolutely necessary for our work. Provided that it is admitted that the plasticity of glacier ice is sufficient to allow motion in the upper layers of a glacier, even when it rests on a nearly level surface, it does not matter, so far as my hypothesis is concerned, whether the bottom layers move or not, for a movement of the upper layers alone is required to enable the "moulins" to transfer their action from place to place, and in time to exert their force on every part of the rock surface beneath that portion of the glacier.

That the action of the "moulins" is not so restricted as would appear from Prof. Bonney's letter in NATURE of November 16, 1893, can, I think, hardly be doubted by any one who has traversed a Himalayan glacier of the kind I have described, on a hot summer's day. Hundreds of them may be seen in action in every direction, and, given sufficient time, their aggregate effect in wearing down the rock surface must be very large. I have noticed the dry shafts mentioned by Prof. Bonney in front of an active "moulin," but do not see why they should not be accounted for by the opening of a new crevasse, without having to suppose that the new crevasse was in the same position as the old one. The crevasses to which I refer are mostly very narrow, easily stepped across in many cases, and do not appear to extend far down into the glacier, so that they are probably due to some other cause than an unevenness of the rocky floor, which would cause them to form in succession at the same point, and their number would give the "moulins" plenty of opportunity to attack the whole surface in course of time. Besides, the wearing away of any inequality that did exist, would surely cause the crevasse to open at some other point, if it were due to that cause, and the "moulin" would thus be enabled to shift its point of attack. The very rarity, too, of such collections of "giant's kettles" as that at Lucerne would seem to show that it is seldom that the "moulins" keep working at one point for any length of time. I did not mean to suggest, of course, that any lake basin had been due to the action of one "moulin"; the hollow ultimately produced need not bear any relation in form to the individual "giant's kettles" that gave rise to it; indeed, there is no necessity that a real "giant's kettle" should be formed at any one point. Just as in the case of a drill moved over the surface of a piece of wood, the pattern ultimately produced need bear no relation to the form of the drill.

If we except the doubtful action of the ice itself, I do not know of any agent that will produce a rock-enclosed hollow in the course of a river channel, but falling water, aided by boulders and sediment. Such a hollow may be seen at the foot of any waterfall, even of moderate height.

In calling attention to the rarity of true rock basins in the Himalayas, an expression that Mr. Oldham takes exception to, I should have said lake basins, that is, lakes lying in true rock basins. As I pointed out, any hollows that may have been formed beneath a pre-existing glacier have been filled with *débris*, but it is very likely that such hollows do occur beneath the extensive flats found at the foot of the larger glaciers, as in the case of the one shown in the view given in my paper. Of course, where such hollows occur in positions where it is impossible that glaciers ever existed, as in eastern Baluchistan, they must be accounted for in other ways. My suggestions were not intended to account for all rock basins, but merely to apply to those which occur in now or formerly highly glaciated regions, where it seems possible that there is an intimate connection between the excavation of the basins and the existence of glaciers.

Sukkur, January 10. T. D. LATOUCHE.

A Plausible Paradox in Chances.

IT seems worth while to record the following pretty statistical paradox as a good example of the pitfalls into which persons are apt to fall, who attempt short cuts in the solution of problems of chance instead of adhering to the true and narrow road. It is true that the paradox would excite immediate suspicion in the mind of any one accustomed to such problems, but I doubt if there are many who, without recourse to paper and pen, could *distinctly* specify off-hand where the fallacy lies. It will be easy for the reader to make the experiment of his own competence to do so after reading to the end of the second of the two following paragraphs.

The question concerns the chance of three coins turning up alike, that is, all heads or else all tails. The straightforward solution is simple enough; namely, that there are 2 different and equally probable ways in which a single coin may turn up; there are 4 in which two coins may turn up, and 8 ways in which three coins may do so. Of these 8 ways, one is all-heads and another all-tails, therefore the chance of being all-alike is 2 to 8 or 1 to 4.

Against this conclusion I lately heard it urged, in perfect good faith, that as at least two of the coins must turn up alike, and as it is an even chance whether a third coin is heads or tails; therefore the chance of being all-alike is as 1 to 2, and not as 1 to 4. Where does the fallacy lie?

It lies in omitting one link in the chain of the argument as being unimportant, whereas it is vital. This omitted link is distinguished by brackets and is numbered (3) below. The reasoning then stands:—

(1) At least two of the coins must turn up alike,

(2) It is an even chance whether *a* third coin is heads or tails.

[(3) Therefore, it is an even chance whether *the* third coin is heads or tails. (Here is the error).]

The true state of the case is seen by writing out the eight several events, as in the table below.

The eight equally probable events. h = heads, t = tails.	The two letters that are alike in each case.	The third letter in each case.
h h h	*h h*	*h*
h h t	*h h*	*t*
h t h	*h h*	*t*
h t t	*t t*	*h*
t h h	*h h*	*t*
t h t	*t t*	*h*
t t h	*t t*	*h*
t t t	*t t*	*t*

No. 2 in the argument is justified by the total number of the *h*'s in the third column being equal to that of the *t*'s, while No. 3 is obviously not justified. In the particular 8 events with which we are concerned, an *h h* is associated with a *t three* times as often as with an *h*, and a *t t* is associated with an *h three* times as often as with a *t*. Hence as the combination *h h h* is one-third as frequent as that of any 2 *h*'s and 1 *t*, and as *t t t* is one-third as frequent as any combination of 2 *t*'s and 1 *h*, and, lastly, as the two classes of combinations are equally frequent, it follows that the frequency of the all-alike cases is to that of the remainder as 1 to 3, or to that of the total cases as 1 to 4, which is the result first arrived at.

I amused myself with testing the theoretical conclusion by making 120 throws of dice, 3 dice in each throw; the odd numbers counted as heads, the even numbers as tails. The 120 throws were divided into 3 groups of forty in each, and gave the results of all-alike 8, 12, 8, total 28; as against not all-alike 32, 28, 32, total 92. The most probable expectation having been 30 to 90. FRANCIS GALTON.

Clerk Maxwell's Papers.

I DO not know whether the Clerk Maxwell Memorial Committee have ceased from their labours, but I cannot help thinking that more might be done towards rendering the work of Maxwell more readily accessible to students. The pair of ponderous volumes issued by the Committee are very well in their way, but they are certainly bulky, and the chronological order of papers, though eminently suited to their purpose, is not so suited to the practical needs of students.

For instance, the papers on the kinetic theory of gases seem to me far and away better than much that has been written since, and it would be very convenient to be able to procure them separately.

My suggestion is, then, that with the aid of a moderate subsidy a publisher be induced to issue Maxwell's papers on special subjects in cheap, handy, separate volumes, which might run somewhat as follows:—

On Colour and Optics.
On Graphical Statics.
On the Kinetic Theory of Gases.
On Dynamical Problems.
On Electro-dynamics.
Lectures and Addresses.
Articles and Reviews.

Under one or other of these heads almost all the papers could be included; there would be no need to include anything that did not seem likely to be of frequent use. The series of small books would be a boon to students, and a knowledge of the work of their great author would be more widely spread.

OLIVER J. LODGE.

Abnormal Eggs.

THE occurrence entitled "A Curiosity in Eggs," related in NATURE for February 1, is by no means as unusual as your correspondent imagines. It occurs in domestic poultry from over-stimulation of the system by generous feeding. The explanation of the production of one egg within another is very simple. The ovum or yolk when mature is received into the upper part of the oviduct, a tube nearly two feet in length in the domestic fowl, and in its descent is clothed successively with the layers of albumen or white, the lining membrane of the shell, and finally, on arriving at the calcifying portion of the oviduct, is enveloped in the shell. In the ordinary course of events the mature egg is then expelled, but in the case of the production of a double-yolked egg, a reverse action of the oviduct occurs. In place of being expelled, the egg is carried back again to the upper portion of the oviduct, where it meets with another mature ovum, and the two descend together, both being surrounded with a second investing series of albumen, membrane, and shell.

Some of the occurrences connected with abnormal eggs are very remarkable. I had one forwarded to me during the last month, which was alleged to contain a marble. On examination I found that the supposed marble was a small abortive yolkless egg, which in colour and form, but certainly not in weight, closely resembled a common clay toy marble. It is not unfrequent for persons to allege the occurrence of various foreign bodies in eggs. The most common substance said to be found in an egg is a horse-bean, which is closely simulated by a mass of hard coagulated blood which has escaped from the ovarium into the oviduct, and is included along with the yolk in the investing structures. I need not further allude to such circumstances as a horse-hair in an egg, or a small coin not unfrequently found at the breakfast-table, inasmuch as these are merely the result of practical joking, and require no further explanation. There is, however, one circumstance that may interest some of your physiological readers, and that is the extreme rarity of the hatching of any egg the shell of which is in the slightest degree malformed. In my own experience I have rarely, if ever, found an egg the shell of which was in the slightest degree unsymmetrical, that has been channeled at one end, or having an irregular zone around the middle, to produce a chicken. The occurrence of two ova in the same egg is by no means uncommon. It results from excessive feeding, and rarely, if ever, occurs in a state of nature. I have known two perfect birds, both chicken and pigeon, produced from such an egg, but the more general result is that the two ova, being developed together, coalesce, possibly from want of room to develop in the confined space, and thus arises the presence of two-headed, or six or eight-limbed monsters, which are much more frequent in fowls than in any other animals whatever. I have from time to time forwarded specimens of these abnormalities to the museum of the College of Surgeons, where they may be seen by those who are interested in the subject. W. B. TEGETMEIER.

North Finchley.

ON two occasions fully shelled eggs of about the size of those of the thrush have been found by myself within ordinary hen eggs, one of which is still in my possession. Several times I have hatched twin chickens from double-yoked eggs, and once a monstrosity having four legs.

Shirenewton Hall, Chepstow. E. J. LOWE.

THE PLEIADES.

AMONG the many constellations and star clusters which attracted the attention of our early ancestors, few, indeed, were so constantly observed as that small bunch of twinkling brilliants known as the "Pleiades." From a very early date, when our forefathers were not so well acquainted with the divisions of the year as we are to-day, they needed some means by which they could tell when to sow their corn, and make arrangements for other agricultural pursuits which could only be done properly in their right seasons. That they could, at any rate, get a rough approximation of such divisions of the year by means of the positions of the heavenly bodies, they soon found out, and they were thus led to observe sometimes stars, sometimes groups of stars, near the rising or setting of the sun, and even certain stars, or groups of stars, at their times of rising and setting.

That they should have chosen that group of sparkling stars, the Pleiades, to serve their purpose, does not seem at all astonishing if one considers how easily they can be recognised in the sky, and also their important position in more remote times.

The different relative positions of the sun and the Pleiades had no doubt first attracted special attention to this group of stars, and we know how important a *rôle* they played in ancient times for calendar purposes?

Let us just consider the several positions of the Pleiades as a result of the earth's rotation and revolution round the sun. Commencing about the end of May, we find that the Pleiades are altogether invisible, as they rise and set together with the sun. As time goes on, they will appear above the horizon before the sun, the difference in the time of rising of these two objects gradually increasing. In August the Pleiades cross the meridian about the time the sun rises, and by the end of November they are visible throughout the whole night, their upper culmination taking place at the same time as the lower culmination of the sun. As November draws to a conclusion, they set earlier and earlier, and by the end of February are visible only for a short time, disappearing altogether for a time after the middle of May.

Owing, however, to a slight movement of the axis of the earth, which makes a revolution round the pole of the ecliptic once in about 25,800 years, the point of intersection of the ecliptic with the equator is not fixed but movable; thus we can understand that the positions of all heavenly bodies as regards their right ascensions and declinations suffer a continual but slow alteration.

This slow movement explains the reason why the Pleiades have not always been invisible at the end of the month of May, and we have only to form a simple calculation to become acquainted with the fact that about 2000 years ago this period of invisibility occurred nearly a month earlier.

A very interesting point relating to the Pleiades is the great number of different names which have been applied to them, and also the curious myths which have arisen from time to time. A most interesting account of these has recently been published by M. Richard Andrée,[1] who has brought together a mass of matter relating to both names and myths. First, with regard to the names which were used when referring to the cluster. The general words defined them as a heap, troop, host of dancers, sieve, &c.; sometimes the simple word "many" was adopted. One finds them spoken of as herds, or hosts of animals, birds, such as hen with chickens, parrots, doves, &c. The simplest expressions really used meant "mass," and an examination of the records confirms this view.

In observing the Pleiades anyone would remark how closely they are packed together. This closeness led early peoples, no doubt, to refer to them as a host or herd of animals, and hence the well-known name, "the hen with her chickens."

Among many foreign names for this, we have in German, Der Glucke mit ihren Küchlein; in Danish, aftenhöne (evening hens); in French, la poussinière; in Italian, gallinette, &c. Instead of a host of animals, we have a host of people referred to, such as, for instance, in the Solomon Islands, where they are called "togo ni samu," meaning a company of maidens. The North American Indians have also known them under the name of "dancers."

It may be thought that a natural name by which they would be known would give some idea of the number of stars in the group; this was often the case, only with different names, for a very good pair of eyes could distinguish seven stars, while generally only six were counted. The word for the Pleiades, for instance, in old high German was "thaz sibunstirri" (seven stars), while that of the South Americans, "cajupal," meant six stars. Again, in Cook's Islands the word "Tau-ono" (six) was used, while the Greeks had a special name for *each* of the seven stars.

Seeing that so much importance has been attached to the Pleiades by peoples of all countries, it is natural to find that the number of myths is by no means few; this is shown to be the case by examining the records of the ancient Greeks, the peoples from East Asia, South Sea Islands, America, &c.

To describe a few briefly, let us refer first to that which we owe to the Greeks. The Pleiades in this myth were the daughters of Atlas and Pleione, each one of which bore a separate name. The Hyades, for sorrow at the death of their sisters, or, as others say, at the destiny of their father, Atlas, killed themselves and became fixed as a constellation in the heavens. Another myth, by Pindar, describes them as the comrades of Artemis, who were turned into doves, and eventually into stars.

A myth of much interest is that of the Dyaks, and the Malays of Borneo. They say the Pleiades were six chickens followed by their mother, who remained always invisible. At one time there were seven chickens in all. One chicken paid a visit to the earth, and there received something to eat, at which the hen got so angry as to threaten to destroy both the chicken and the people on the earth. Fortunately the latter were saved by the constellation of Orion, leaving only six chickens in the brood. At that period of the year when the Pleiades are invisible, the Dyaks say that the hen broods her chickens, while at the time of visibility "the cuckoo calls."

The South Sea islanders have a myth which has some originality about it. It is to the effect that the Pleiades were originally a single star, which shone with such a clear lustre as to incur the envy of the god Tane, who was in league with the stars Aldebaran and Sirius, and followed the Pleiades. Trying to save himself in a stream, the course of which Sirius had so diverted as to bring him close to Tane again, he was broken up into six bright stars by Tane himself, who hurled Aldebaran at him.

The blacks of Victoria, Australia, have a myth in which the Pleiades are considered a host of young wives who play with the young men. The myth of the Kamilaroi blacks is as follows: The Pleiades were once pretty maidens on the earth, who were followed by some young men called the Beriberi. To get away from the latter the girls climbed trees, and thence sprang into the heavens, where they were transformed into shining bodies; one maiden who remained behind was termed "gurri gurri," the shy one, and she is represented by the least bright star in the group. The Beriberi were eventually placed in the heavens, where they appear in the girtle and boomerang in the constellation of Orion.

These and many other myths, all of great interest, are mentioned by M. Andrée. They inform us to a certain extent of the characters of the different nations. Much might be learnt also about the origin of the various tribes of people, by seeing if the different myths can be traced back to an initial one. Those of the North American tribes, for instance, seem to have a common origin. In some instances the Pleiades were undoubtedly looked upon as a god who, besides regulating the year and looking after the fruitfulness, was the ruler of all meteorological and astronomical appearances. Hesiod refers to the rising of the Pleiades as the time for harvest, while the period about which they disappeared for some time he termed ploughing time. Forty days and nights were they invisible, appearing again only as soon as the sickle was sharp. Another very well-known use made of the visibility and invisibility of the Pleiades was the regulation of the traffic of ships in Greece, hence probably the Greek word for to sail, πλεειν. The rising of this group of stars was the commencement, so to speak, of the shipping season, their disappearance denoting its conclusion. At Rome, also, the same practice was in vogue.

Enough has been said to attract the reader's attention to some of the numerous interesting references about this group of stars. The nineteenth century has already seen the end of many a myth which has been solidly upheld; but as science advances, facts take the place of myths, and although much of the romance may appear to be lost, one always looks back at them with delight. Few stars, perhaps, have been so shrouded in myth as the Pleiades, and the unravelment of these myths has been the source of pleasure to many.

[1] See *Globus*, Bd. lxiv. No. 22, "Die Plejaden im Mythus und in ihrer Beziehung zum Jahresbeginn und Landbau."

NOTES.

A MEETING of the International Meteorological Committee has been arranged to take place at Upsala, commencing August 20. Since the meeting at Munich in 1891, four new members have been added to the committee—Mr. William Davis, Cordoba; Mr. John Eliot, Calcutta; Mr. R. L. J. Ellery, F.R.S., Melbourne; and Dr. A. Paulsen, Copenhagen. The last named has replaced Dr. Lang, Munich, who died last year.

THE arrangements for the sixth session of the International Geological Congress have now been made. The meeting will be held at Zurich, from August 29 to September 2. The president is Prof. E. Renevier; Prof. A. Heim is vice-president, and Prof. H. Golliez, of Lausanne, is secretary. The subscription is twenty-five francs, which should be sent to M. Casp. Escher-Hess, Bahnhofstrasse, Zurich. In addition to the ordinary work of the congress, special meetings will be held for the discussion of questions relating to (*a*) general geology, tectonics, &c.; (*b*) stratigraphy and palæontology; (*c*) mineralogy and petrography. Numerous excursions have been planned; six, before the congress, to different parts of the Jura, and six, after the congress, to various districts of the Alps; three supplementary excursions are also proposed. Mr. W. Topley (28, Jermyn-street, London), who acted as general secretary to the London Congress in 1888, will be glad to receive subscriptions or to give information.

A MEETING to consider the question of raising a memorial to the late Prof. Arthur Milnes Marshall, F.R.S., was held at the Owens College on Friday last. Mr. Edward Dormer (deputy-treasurer of the College) presided, and there were present, amongst others, Principal Ward, Profs. Boyd Dawkins, Osborne Reynolds, Schuster, Weiss, Leech, Herdman, and Dixon, Dr. Hurst, Messrs. R. D. Darbishire, Forbes Carpenter, R. Assheton, F. W. Gamble, and W. E. Hoyle. The meeting was addressed by Principal Ward, Mr. Darbishire, and others, and it was decided to form a committee to formulate a scheme, and submit it to a future meeting. Although no definite decision as to the nature of the memorial was arrived at, the general sense of the meeting seemed to be in favour of a fund to maintain Prof. Marshall's library, which has been generously presented to the College by his family.

H.R.H. THE DUKE OF CAMBRIDGE has accepted the presidency of a committee which has been formed to present a testimonial to Dr. W. H. Dickinson on his retirement from the office of senior-physician to St. George's Hospital, of which his Royal Highness is a vice-president. Among the members of the committee are the Duke of Westminster, the Earl of Cork and Orrery, Mr. Shaw Stewart, and Colonel Haygarth, vice-presidents of the hospital; Mr. J. R. Mosse, treasurer; Sir Henry Acland, Admirals Sir George Willes and Sir W. Houston Stewart, Sir George Humphry, Sir Francis Laking, Surgeon-General Cornish, and a number of Dr. Dickinson's past and present colleagues, and pupils and former students of the St. George's Medical School.

THE death is announced of Brigadier-General J. Ammen, who for some years held the Chair of Mathematics in Bacon College, Georgetown, Kentucky, and that of Jefferson College, Mississippi.

THE Right Hon. Sir Harry Verney, whose death, at the age of ninety-two, occurred on Monday last, was the "father" of the Royal Agricultural Society of England—an institution which he assisted to establish in 1838.

LORD PLAYFAIR has selected "The Modern Needs of Scientific Teaching" as the title of his address to the students of the London Society for the Extension of University Teaching, at the Mansion House, on Saturday, March 10.

MR. HOLBROOK GASKELL having contributed £1000 to complete the endowment of the Chair of Botany at Liverpool University College, the college council have decided to confer the professorship upon Mr. R. J. Harvey Gibson, who has held the lectureship in botany during the last five years.

THE Council of the Royal Meteorological Society have arranged to hold an exhibition of instruments, photographs, and drawings relating to the representation and measurement of clouds, next April. The Exhibition Committee invite co-operation, as they are anxious to obtain as large a collection as possible of such exhibits. The committee will also be glad to show any new meteorological instruments or apparatus invented or first constructed since the exhibition of 1892, as well as photographs and drawings possessing meteorological interest.

AMONG the documents in the possession of the Anthropological Institute are a considerable number of MS. vocabularies, in many cases unique in their character. As it has never come within the scope of the Institute to devote a large portion of its *Journal* to the publication of such material, a fund is being raised by subscription, independently of the Institute, to deal with these documents. The subscription is one guinea, payable in alternate years, and the first vocabulary to be published will be one of the Ipuriná Language (Upper Purus River), South America, by the Rev. J. E. R. Polak.

WE learn from the *Kew Bulletin* for February that an excellent portrait of Prof. Oliver, F.R.S., the late keeper of the Herbarium and Library of the Royal Gardens, Kew, has been painted by Mr. J. Wilson Foster (who also painted the portrait of the present keeper, Mr. J. G. Baker, F.R.S., exhibited at the Royal Academy in 1893). Prof. Oliver's portrait was commissioned by a number of his scientific and other friends, who have presented it to the Herbarium of the Royal Gardens—the scene of his labours from 1858 to 1890.

AN appeal for assistance has been issued by the committee of the Bethnal Green Free Library, there being a deficit of £200 on the last financial year, while the outlay of the present one is calculated to reach £1,000. The work that this institution is doing is an excellent one, and the fact that no less than 50,000 persons attended the library and classes, &c. in connection with it, and 27,000 the Gilchrist Educational Trust Lectures, tells it is filling a real want. It will be a pity if such a good work should languish for want of funds, subscriptions towards which may be sent to Mr. G. F. Hilcken, the secretary and librarian, Bethnal Green Free Library, London, E.

THE *Academy* says that the Hon. Walter Rothschild proposes to publish a periodical in connexion with his Museum at Tring, under the title of *Novitates Zoologicae*. It will contain papers on mammals, birds, &c., and also discussions on general questions of zoological or palæontological interest. Descriptions of new species will be confined almost entirely to those of which the types belong to the Tring Museum; and the other articles will, for the most part, be founded on work carried on at that museum, or on specimens sent by Mr. Rothschild's collectors.

MR. LLOYD BOZWARD, writing to us from Worcester, says that on the 6th instant, shortly after noon, he saw a large meteor of great brightness near the zenith. At the time of the occurrence, the sun was brilliantly shining in a clear blue sky. A remarkable feature was the intensity of the light of the meteor. According to Mr. Bozward, this, if not exceeding the radiance of the sun, was certainly equal to it. The meteor was also seen at Birmingham, several observers comparing its light to that given by the electric arc, while others say that it was of a vivid green colour.

THE Royal Society of New South Wales offers its medal and £25 for the best communication (provided it be of sufficient merit) containing the results of original research or observation upon each of the following subjects, to be sent in not later than May 1, 1894:—On the timbers of New South Wales, with special reference to their fitness for use in construction, manufactures, and other similar purposes; on the raised sea-beaches and kitchen middens on the coast of New South Wales; on the aboriginal rock carvings and paintings in New South Wales. To be sent in not later than May 1, 1895:—On the silver ore deposits of New South Wales; on the physiological action of the poison of any Australian snake, spider, or tick; on the chemistry of the Australian gums and resins. To be sent in not later than May 1, 1896:—On the origin of multiple hydatids in man; on the occurrence of precious stones in New South Wales, with a description of the deposits in which they are found; on the effect of the Australian climate on the physical development of the Australian-born population. The competition is in no way confined to members of the Society, nor to residents in Australia, but is open to all without any restriction whatever, excepting that a prize will not be awarded to a member of the Council for the time being; neither will an award be made for a mere compilation, however meritorious in its way. The communication, to be successful, must be either wholly or in part the result of original observation or research on the part of the contributor. The successful papers will be published in the Society's annual volume. Competitors are requested to write upon foolscap paper, on one side only. A motto must be used instead of the writer's name, and each paper must be accompanied by a sealed envelope bearing the motto outside, and containing the writer's name and address inside. All communications to be addressed to the honorary secretaries, Messrs. T. W. E. David and J. H. Maiden, at the Society's House, Sydney.

A VERY severe gale reached the coast of Ireland from the Atlantic on the evening of Sunday the 11th instant, the centre of which passed over Scotland; much snow fell there during the passage of the storm, and the barometer reading was as low as 28·2 inches. The force of the gusts reached 10 to 11 of the Beaufort wind-scale (0–12), and owing to the steepness of the barometric gradients the storm was felt over all parts of England, and caused much damage both at sea and on land. At Greenwich, which was about 300 miles from the centre of the disturbance, the anemometer registered a pressure of more than 35 lbs. on the square foot, being equal to an hourly velocity of about 85 miles. In connection with these values it may be interesting to state that in the gale of December 12 the wind at Greenwich attained a pressure of 37 lbs. on the square foot; but in the great storm of November last it did not there exceed 17 lbs. By Monday, the 12th instant, the centre had passed over the North Sea, and the barometer near Christiania had fallen below 28 inches, gales being experienced from the coast of Ireland to the Baltic. In the rear of the disturbance the temperature, which had been unusually high for the time of year, fell considerably, frost occurring in many parts of Great Britain on Monday night.

WITH reference to the above gale, Dr. Buchan writes that at Edinburgh a remarkable fall of the barometer commenced at 5 a.m. on Sunday last, and 2 a.m. on Monday the low reading of 28·319 inches at 32° and sea-level was registered. An unusually rapid rise then set in, and in the one hour from 4 to 5 a.m., pressure rose 0·307 inch, as recorded by Richard's barograph, controlled by readings with the mercurial barometer. The traced line of the barograph was clear and distinct, giving little if any indication of "pumping." Consequent on a change of wind from east-south-east to south-west, Richard's thermograph registered a rise of temperature from 37°·5 to 48°·0, or 10°·5 in the seven minutes ending 1.10 p.m. on Sunday. The fluctuations of Richard's hygrograph early in the morning of Monday were equally striking.

AN exceptionally heavy storm was experienced in America from Sunday to Tuesday last. At Chicago the velocity of the wind was estimated at seventy-five miles an hour, and the streets were blocked with snow; while at New York the snowfall is reported as the heaviest this season. The Atlantic coast was also swept by a fierce wind.

THE Meteorological Council have published, as an Appendix to the *Weekly Weather Report* for 1893, a summary of rainfall and mean temperature for twenty-eight years, 1866–1893. The values are given for each of twelve districts, together with the means for the easterly, or principal wheat-producing districts, for the westerly, or principal grazing, &c., districts, and for the whole of the British Islands generally. These summaries have been published regularly since 1868, and, although chiefly intended for sanitary and agricultural purposes, they furnish a very easy and trustworthy means of comparing the climatological statistics of different periods or districts. A glance at the rainfall values for the year 1893 shows that they were below the average in every district except the north of Scotland, where the rainfall was as much as 13 inches above the normal amount, being higher than in any year since 1868, and chiefly owing to the areas of low barometric pressure taking a somewhat more northerly course than usual. The greatest deficiency—viz. 9·5 inches—was in the south-west of England, while the deficiency for the whole of the kingdom was 5·9 inches, which is greater than in any year since 1866, except the Jubilee year, 1887, when the deficiency was 9·2 inches. The temperature was above the mean in all districts; the excess over the whole kingdom was 1°·4, and it was fairly equally distributed over all districts; the excess has not been equalled since 1868, when it was 2°·0 above the normal value available at that date.

THE first sheet of the "Geologic Atlas of the United States" has recently been issued. It is called the "Hawley Sheet," and comprises the north-west part of Massachusetts, with the Green Mountain Region. The geology is by B. K. Emerson. The scale of the map is 1 : 62,500, or slightly more than one inch to one mile. The complete map of the United States on this scale will be 240 feet long and 180 feet high. Contours are drawn at twenty feet intervals, reckoned from mean sea-level. Three copies of the map are given:—(1) Topography, with streams in blue, contours in brown. The hundred-feet contours are deeply engraved, the intermediate lines being only faintly marked. This gives the appearance of hill-shading over the mountainous ground, but each contour can be traced with the aid of a pocket lens. (2) Areal geology, in which the formations are coloured over the brown, blue, and black of the topographical map. (3) Economic geology, which appears, so far as this sheet is concerned, to differ from the other geological map only in having the tints less pronounced, and in having a sign for mines and quarries. The fourth sheet is entitled "Structure Sections": here strips of the map are reproduced, but without contours, and sections along the edge of each strip are drawn on the natural scale. Three sheets of text are given, one, introductory, setting out the purpose and plan of the Atlas, the others descriptive of the geology of the "Hawley Sheet." All the rocks consist of crystalline schists of Cambrian and Silurian age, no igneous rocks which can be recognised as such occur. Probably the Silurian "Hawley schist" is largely composed of eruptive material, but the rock is so much altered that its original character cannot be made out. The drift deposits, which in the south-eastern part greatly obscure the geology, are described, but are not shown on the map.

THE proposals which have lately been made for the renewal of Antarctic research have been very widely echoed, and several geographical journals have given considerable space to the matter. Dr. Neumayer, the greatest continental authority on the subject, devotes the first place in the *Annalen der Hydrographie* to a review of the facts. He translates the abstract of Dr. Murray's paper, given in NATURE for November 30, 1893, and expresses hearty approval of the scheme of an Antarctic expedition there set forth. The *Scottish Geographical Magazine* for February contains a further account of last year's Dundee Antarctic expedition.

AUTHENTIC information as to the reported high latitude (84° N.) attained by the American whaler *Newport* is at last available in the new number of the *Bulletin* of the American Geographical Society. A quotation from a letter written by Prof. George Davidson, of San Francisco, runs: "The captain has been in to see me, and has given me some graphic descriptions of his actual experience in those waters. . . . But he reached only 73°, and is dreadfully annoyed that the newspaper reporter made such an erroneous statement when he had the truth before him." It is unfortunate that the news agency which cabled the invention to this country did not consider it worth while to give notice of the correction, for the record of farthest north has been altered in some books of reference, and there is now no chance for the sober truth being accorded a tithe of the publicity given to the sensational report.

AT the meeting of the Royal Geographical Society, on Monday evening, a paper on Johore was read by Mr. Harry Lake, who for three years has been engaged in exploring and surveying the interior of this little-known State. Johore occupies the southern extremity of the Malay peninsula, and the interior consists of low tropical jungle and swamp, diversified occasionally by undulating or mountainous country. The rainfall is excessive, but the great lake of Bera or Tasek, which was represented in former maps, turned out to be merely a vast swamp. The Blumut Mountains in the interior formed one of the most interesting features of the exploration, and the primitive people of the interior, the Jakuns, have been studied with some care. Under its present Sultan, Johore has made great strides in political and economic progress. The chief exports are gambier and pepper, which are cultivated by Chinese labour.

THE question whether "beats" due to the interference of two nearly equal sounds can originate in the brain instead of in the air outside, is discussed by Karl L. Schaefer in the *Zeitschrift für Psychologie und Physiologie der Sinnesorgane*. It is well known that two tuning-forks producing beats continue to produce them when one fork is held to the right, and the other to the left ear, in such a manner that the sound cannot reach the other ear through the air. Wundt himself, in his *Philosophische Studien*, declared the direct cerebral origin of beats to be possible, and connected it with the recently proved possibility of a direct stimulation of the auditory nerve-trunk. Herr Schaefer, on the other hand, does not think that such an origin of beats can be deduced from the experiment quoted. He looks upon conduction by the bones of the skull as the cause of the phenomenon observed. This is confirmed by the fact that even the faintest sounds are capable of propagation from one ear to the other by conduction through the bones. It is generally acknowledged that this is the explanation of beats produced by strong notes. Whether the same applies to faint notes can only be finally decided by determining, with more delicate instruments than any hitherto used, whether beats continue to be heard after conduction through the bones has ceased.

AT a recent meeting of the Société Francaise de Physique, M. Hurmuzescu showed several instruments which he has employed in his experiments on static electricity, the insulating medium being a new material to which he has given the name dielectrine. This substance consists of a mixture of paraffin and sulphur, and is preferable to either of these insulators, as it is harder and has a higher melting-point than pure paraffin, and is less hygroscopic and brittle than sulphur. By means of a special method it is possible to obtain dielectrine in homogeneous masses which are very hard, and can be easily worked either in the lathe or with a file. One of the instruments shown was an electrophorus, the handle of the metallic plate and the disc which is electrified being composed of dielectrine. With this instrument sparks 2 c.m. long were obtained even when the air was moist, while the charge was retained for a very long time. This new substance, which experiment has shown to be very unalterable, will be of great use as an insulator, particularly in damp situations.

HAVING carried on an elaborate series of experiments on the rotary dispersion of quartz in the infra-red part of the spectrum, M. G. Moreau is now investigating the magnetic rotary dispersion of carbon bisulphide for the same part of the spectrum. He has also measured the refractive index of carbon bisulphide for the infra-red rays, so that he may be able to compare his experimental values for the magnetic rotary dispersion with those obtained by the formula deduced by Maxwell's electro-magnetic theory. The magnetic field used in the experiments was produced by the large coil which Verdet used in his classic researches in this subject, its intensity being measured by the rotation produced in carbon bisulphide for sodium light. In the infra-red observations a thermopile and delicate galvanometer were employed. The author has succeeded in measuring the rotation for wave-lengths between 0·8 and 1·4 $\mu\mu$; the absorption of the CS_2 preventing any measurements being made for greater wave-lengths. The paper in which the above results are given will be found in the *Annales de Chimie et de Physique* for February.

THE annual report of Prof. Alexander Agassiz, as director of the Museum of Comparative Zoology at Harvard College, for 1892–93 has just been received; from it, amid many other interesting details, we learn that Prof. A. Milne-Edwards has in hand a final memoir on the Crustacea of the *Blake*, that Prof. Ludwig's monograph on the holothurians of the *Blake* will soon be published, the last plate of the nineteen being in the hands of Werner and Winter. As to Prof. Agassiz's own work we read: "For nearly thirty years since the publication of the catalogue of North American acalephs I have every summer, and frequently during the winter months, also, paid a good deal of attention to the jelly-fishes of our coast. An immense amount of drawings and of notes have thus been accumulated," and we have the hope expressed that during the coming year he may be enabled to arrange this valuable material for publication. We would join our hopes to his, and sincerely trust that the fascinations of fresh voyages of discovery may be for a time resisted, in order that the scientific world may not lose the record of so much important work, a record which Prof. Agassiz alone can give. The various reports of the various assistants are interesting, and show the large resources of the museum, which, large though the building is which contains it, now urgently calls for more space.

THE February number of *Nature Notes*, with which is now incorporated *The Field Club*, contains a note by Mr. W. M. E. Flower, on a tortoise or "gopher" that he brought over from Florida, last July, in a case of palmettoes and other plants. When the cold weather set in, the gopher made a burrow, in which it has lived until now, but whether it will survive the winter remains to be seen. It will be just as well perhaps if the English climate proves to be unfavourable to the animal, for in Florida gophers do an immense amount of damage to plants and crops, and thousands of pounds have been spent in destroying the pest.

PROF. BYRON HALSTED describes in the *Bulletin* of the Torrey Botanical Club for December 1893, the Solandi process of sun-printing and its application to botanical technique. The process consists briefly in exposing the subject, necessarily somewhat translucent, to the sunlight in a printing-frame in common use by photographers, with a sheet of sensitised paper at the back of the subject, in the same manner as a print is taken from a negative of the ordinary sort. The sun-print thus obtained becomes, after it has been toned, the negative from which the positive picture is printed. The negative is saturated with kerosene for the purpose of clarifying.

MR. G. NICHOLSON, the curator of the Royal Gardens, Kew, contributes to the February number of the *Kew Bulletin* a report on horticulture and arboriculture in the United States. It contains accounts, among others, of visits to the following gardens:—Holm Lea, near Brooklime, Mass., the residence of Prof. C. S. Sargent; the Arnold Arboretum, of Harvard University, at Jamaica Plain, Mass.; the Missouri Botanical Garden at St. Louis; the Horticultural Exhibition at Chicago; the Mount Hope Nurseries at Rochester, N.Y.; and Meehan's Nursery, Germantown, Philadelphia. The paper also contains notes on railway gardening, and on the native flora of the districts passed through.

AN interesting paper on the possible transmission of the tubercle bacillus by cigars, has appeared in the current number of the *Centralblatt für Bakteriologie*. Dr. Kerez, in the preface to his experiments, points out that ample opportunity is given for the infection of cigars with tuberculous material, as so many of the people employed in tobacco manufactories are known to suffer from consumption. The manner in which the cigars may become infected is apparent when it is remembered that by force of habit and convenience the tobacco-workers prefer to use their saliva for getting the leaves to adhere in cigar making, instead of the materials supplied to them for this purpose. In this way the tubercle bacillus is easily conveyed to the cigar. Dr. Kerez has, therefore, imitated in every detail on a small scale the manufacture of cigars, using saliva containing tubercle bacilli for the moistening of the leaves. After being dried and packed away in boxes, cigars preserved for different lengths of time were carefully unrolled, the leaves washed with water, and the infusion inoculated into guinea-pigs. In all cases where the infected cigars had only been kept for ten days, the animals treated with the tobacco infusion died of tuberculosis, but when the cigars were kept for longer periods the animals suffered no ill-effects, indicating that during this time the tubercle bacilli had either been destroyed or deprived of their virulent character. As long, therefore, remarks Dr. Kerez, as the cigars, presuming them to have been infected in the course of making, are kept for a sufficiently long time in the manufacturer's hands before distribution, this possibility of spreading consumption may be ignored.

A CATALOGUE (No. vi.) of works on geology offered for sale by Messrs. Dulau and Co. has just been issued.

A CHEAP edition of "The Religion of Science," by Dr Paul Carus, has been published by the Open Court Publishing Company, Chicago.

MESSRS. HORNE AND THORNTHWAITE have published a new descriptive catalogue of astronomical telescopes and other optical instruments.

A SECOND edition has been published of the catalogue of the Camera Club Photographic Library, compiled by Messrs. L. Clark and W. Brooks.

MESSRS. BLACKIE AND SON have published a guide to the examinations in elementary agriculture of the Department of Science and Art, and answers to the questions set in the subject from 1884 to 1893.

"A SHORT HISTORY OF ASTRONOMY," compiled by Mr. George Knight, and published by Messrs. G. Philip and Son, is a little book of twenty-seven pages, in paper covers, containing a sketch of the growth of astronomy suitable to beginners, and likely to create a desire for fuller knowledge.

THE first edition of Mr. Bowen Cooke's work on "British Locomotives" being nearly exhausted, the publishers announce a second and revised edition as almost ready for issue. The same publishers (Whittaker and Co.) announce a work on "Surveying and Surveying Instruments," by Mr. G. A. T. Middleton.

WE announced towards the end of last year that the *British Naturalist* would be discontinued after the December number. General regret having been expressed at the proposed discontinuance of that useful magazine, the opinions of some well-known naturalists were obtained, and with the result that arrangements were eventually made for carrying on the publication. The first number of the new series is before us, and its contents will be appreciated by the student of natural history and collector. Edited by Messrs. J. Smith and L. Greening, and with the assistance of the late editor, Mr. J. E. Robson, and others, the magazine should have a wide circulation among naturalists in all parts of the country.

MESSRS. MACMILLAN AND CO. will publish immediately a volume of "Essays in Historical Chemistry," by Prof. Thorpe, based on lectures and addresses delivered during the last twenty years. The list of subjects includes Boyle, Priestley, Scheele, Cavendish, Lavoisier, Faraday, Thomas Graham, Wöhler, Dumas, Kopp, and Mendeleef.

MR. HENRY LOUIS has prepared, and Messrs. Macmillan and Co. are about to publish, a "Handbook of Gold-Milling," in which the subject is treated for the first time in a form at once scientific and practical. It is hoped that the book may be found useful not only for the technical instruction of mill-men, but also for the guidance of managers and managing directors of gold-mines. The work begins with an account of the physical and chemical properties of gold, and also of mercury; stamp-mill construction is considered in detail, the mechanical principles underlying the design of each part being throughout elucidated. The theory and practice of concentration, as far as it refers to gold-milling, is next considered, together with the most approved modern method of treating the concentrates and other products of milling. Chapters are appended on the economic considerations involved and on the assaying of gold ores and products. The book is fully illustrated.

TWO new boron compounds, diphenyl boric acid and the corresponding chloride, have been obtained in the Rostock Laboratory by Prof. Michaelis, and an account of them, together with several other more complex aromatic derivatives of boron, is contributed to the latest issue of the *Berichte*. In the year 1879 Prof. Michaelis, in conjunction with Dr. Becker, succeeded in preparing phenyl boron chloride, $C_6H_5BCl_2$, the first boron compound containing a benzene radicle. This interesting substance, a liquid which boils at 175°, was obtained by heating together to about 200° in a sealed tube the corresponding quantities of boron chloride, BCl_3, and mercury diphenyl, $Hg(C_6H_5)_2$. Upon bringing it in contact with water a beautifully crystalline and powerfully antiseptic substance, pheny boric acid $C_6H_5B(OH)_2$, was produced, which upon heating evolved water vapour, and yielded the anhydride C_6H_5BO. It is now shown that diphenyl boron chloride, $(C_6H_5)_2BCl$, is formed when the mono-phenyl compound is heated along with a further quantity of mercury diphenyl to 300–320° in a sealed tube. The product is a mixture of diphenyl boron chloride with mercury chloro-phenyl $Hg(C_6H_5)Cl$, from which latter compound the former may be separated by extraction with an organic solvent. Upon distillation of the extract a liquid is eventually isolated which boils at 270°, and which proves to be pure diphenyl boron chloride. It is a thick colourless liquid which fumes slightly in moist air. Upon heating with water it is decomposed with formation of a substance endowed with an exceedingly powerful and penetrating odour. This substance rapidly collects as an oil upon the surface of the water. After purification by solution in ether and evaporation of the latter it takes the form of a colourless viscous substance, which soon solidifies to a mass of crystals, colourless at first but subsequently faintly yellow. The crystals melt at 264°, evolving the characteristic odour in a still more pungent form. Even the merest trace of the compound is at once rendered evident in a room by its unmistakable effect upon the olfactory nerves. A small quantity introduced into a non-luminous flame imparts a brilliant green colour to the latter. It appears to act as a truly acid substance, dissolving readily in alkalies; the salts produced, however, are not endowed with any great stability, for the acid can be extracted from the solutions by means of organic solvents.

IN an appendix to Prof. Victor Meyer's memoir, referred to last week (p. 349), a recent extension of the subject of stereochemistry to purely inorganic elements is alluded to. Dr. Werner, in a treatise upon the nature of the isomerism of the numerous ammoniacal compounds of cobalt, platinum, and other metals, shows that the complex relations of these substances are capable of a surprisingly simple explanation upon the assumption of different arrangements of the various atoms and groups in space. The foundations of a stereochemistry of platinum are laid by assuming the atom of the metal to occupy the centre of a regular octahedron, to the six corners of which the various groups are attached. In this manner the existence of the two isomeric series of complex compounds of the composition $Pt(NH_3)_2X_4$ is accounted for, the difference between them being brought about by a difference in the relative positions of the two NH_3 groups. It would thus appear that the great concentration of research upon the organic compounds, which has been the salient feature of the chemical progress of the last twenty years, has had the fortunate effect of so enlightening us as to the internal structure of chemical molecules as typified in carbon compounds, that the remaining complex problems of inorganic chemistry may now be attacked with much greater likelihood of success.

NOTES from the Marine Biological Station, Plymouth.—During the past fortnight the floating fauna has assumed a considerably richer character, chiefly owing to the marked increase in the numbers of Decapod larvæ (esp. *Zoœa*), and to the reappearance of Cœlenterates, which have been very scarce for the past two months. *Ephyræ* of *Aurelia* have appeared, and are already fairly numerous; a few specimens of the Anthomedusa *Rathkea octopunctata* have been observed, and a Leptomedusa, apparently *Phialidium variabile*, has been taken in fair quantity. Some Ctenophore larvæ have also been observed. Prosobranch and Opisthobranch veligers are plentiful, and a single specimen has been obtained of the pelagic postlarval stage of *Arenicola*, discovered at Plymouth last year. Other captures on the shore and with the dredge include *Æolis papillosa*, *Platydoris planata*, and large numbers of *Myzostomum* from *Antedon rosacea*. *Littorina littorea* is breeding.

THE additions to the Zoological Society's Gardens during the past week include two Bonnet Monkeys (*Macacus sinicus*, ♀ ♀) from India, presented respectively by Col. J. North, and Mrs. Hewit; a Macaque Monkey (*Macacus cynomolgus*, ♀) from India, presented by Mr. F. Reynolds; a Pinche Monkey (*Midas œdipus*) from New Granada, presented by Miss Farmer; a Banded Ichneumon (*Herpestes fasciatus*), two Vulturine Guinea Fowls (*Numida vulturina*), four Red-bellied Waxbills (*Estrelda rubriventris*), two Madagascar Weaver Birds (*Fondia madagascariensis*), two Alario Sparrows (*Passer alario*) from East Africa, presented by Mr. Besant; a Red-eared Bulbul (*Pycnonotus jocosus*), a yellow-bellied Liothrix (*Liothrix luteus*), three Indian Silver-bills (*Munia malabarica*) from India, a Chestnut-breasted Finch (*Donacola castaneothorax*) from Queensland, two Java Sparrows (*Padda oryzivora*) from Java, two Russ Weaver Birds (*Quelea russi*), a Crimson-crowned Weaver Bird (*Euplectes flammiceps*) from West Africa, two Saffron Finches (*Sycalis flaveolus*) from Brazil, presented by Mr. C. S. Simpson; a Chaffinch (*Fringilla cœlebs*), a Brambling (*Fringilla montifringilla*), a Greenfinch (*Ligurinus chloris*), a Linnet (*Linota cannabina*), three Lesser Redpolls (*Linota rufescens*) British, presented by Mr. L. V. Dance; a Moustache Monkey (*Cercopithecus cephus*, ♀) from West Africa, a Green-winged Trumpeter (*Psophia viridis*) from the Amazons, deposited.

OUR ASTRONOMICAL COLUMN.

A TEMPERED STEEL METEORITE.—Among the many objects collected by the Peary Expedition to Greenland in 1891 was a meteorite weighing about 267 pounds. It was found by Prof. A. Heilprin, near Godhaven, Disco Island, and sent to the Academy of Natural Sciences of Philadelphia, in the Proceedings of which (1893, p. 373) it is described by Mr. E. Goldsmith. When received at the Academy, the meteorite appeared to be solid and devoid of cracks or any signs of disintegration, but this condition soon changed, and the mass slowly cracked and began to fall to pieces. It is thought that this crumbling was due to oxidation resulting from the existence of a higher temperature and a greater quantity of ozone in the latitude of Philadelphia than in that of Greenland. Mr. Goldsmith has examined some of the pieces separated from the mass. The substance could easily be separated into hard, metallic and tough granules, and a powder capable of reduction to any degree of fineness. A determination of the separated quantities gave 73·8 per cent. as the proportion of the granules, and 26·2 per cent. as that of the powder. The specific gravity of the former proved to be 6·14, and of the latter 4·73. One of the pieces from the meteorite was reserved for grinding and etching, but it was found that the process involved considerable difficulty owing to the extreme hardness of the specimen. Indeed, the mass was so hard that it would scratch soft iron, making an impression visible to the eye and sensible to the touch. This and other tests seems to warrant Mr. Goldsmith calling the object a tempered steel meteorite. Possibly the meteorite fell into a pool of water or deposit of snow or ice, and was thus quickly cooled down from the heated condition obtained by rushing through the atmosphere.

Analyses show that there is a distinct difference between the granules and the separated dark powder. The former contains a sulphuret, probably troilite; the latter contains no sulphuret, but, instead, a sulphate. Iron, nickel, sulphur, traces of carbon, chlorine, phosphorus, and chromium were found; also a silicate in which lime and magnesia were recognised. Copper and cobalt were searched for, but in vain. According to Prof. A. E. Nordenskiold and J. L. Smith, the Disco Island terrestrial iron contains copper, cobalt, phosphorus, and comparatively large quantities of carbon. As Mr. Goldsmith remarks, these differences are too great to be overlooked in comparing analytical work; they indicate that the mass found by Prof. Heilprin is not of terrestrial, but of celestial, origin.

ASTRONOMY IN POETRY.—Some litterateurs and ultra-sentimental poets affect to believe with Macaulay that the advance of science means the death of poetry. It was left to Lord Tennyson to show that scientific facts admit of the highest poetical expression. Another instance of the exactness of his references to astronomical matters is given in the February number of the *Observatory*. In "Maud" the beautiful lines occur—

> "a time of year
> When the face of night is fair on the dewy downs,
> And the shining daffodil dies, and the Charioteer
> And starry Gemini hang like glorious crowns
> Over Orion's grave low down in the west."

A little further reference is made to the planet Mars, "As he glow'd like a ruddy shield on the Lion's breast." The whole passage refers to the Crimean War, which was from 1854 to 1856, and, from the first quotation, it is evident that Tennyson had in mind the months of April and May. It was interesting, therefore, to see whether Mars occupied in the fifties the position named by the poet. Upon looking up the matter it appears that the planet was in Leo in June 1852, November 1853, April and May 1854, October 1855, and not at all in 1856. In 1852 Mars passed rapidly through the constellation, but in 1854 he was nearly a month in exactly the position—"on the Lion's breast"—described by Tennyson. From internal evidence alone, therefore, the time referred to in the poem can be fixed as the spring of 1854.

NOVA AURIGÆ.—In a brief note to *Astronomische Nachrichten*, No. 3209, Mr. Martin Brendel says that he has found Nova Aurigæ upon an auroral photograph taken by him at Greifswald, Norway, on January 5, 1892. It will be remembered that Dr. Anderson announced his discovery at the end of January 1892, and that Prof. Pickering afterwards found the object upon photographs taken in December of the previous year.

AGRICULTURAL EXPERIMENT STATIONS.

THE general British public regards with suspicion the granting of State aid for scientific experiments. But though the reluctance to give such assistance to pure science may be partly understood, it might reasonably be expected that the shop-keeping instinct would have led to the adequate endowment of an applied science like agriculture. An article by Mr. James Long, however, in the January number of the *Record of Technical and Secondary Education*, shows how unfavourably England compares with other countries as regards institutions in which the scientific principles of agriculture are taught. We have two or three excellent agricultural colleges carried on by private enterprise, but it is a question whether they supply the requirements of the practical farming class. Compare this with what has been done abroad. "Some thirty years ago," says Mr. Long, "the Government of the United States made grants of land to each State for the purpose of establishing colleges. At the time, the proportion handed over was 30,000 acres for each senator or representative in Congress to which the State was entitled according to the census of 1860. In addition to this grant, large and frequent money grants in connection with the agricultural sides of these colleges and to the experiment stations, which have also been established, have been made. Figures, which have been furnished to me by one of the officials of the U.S. Government, show that in some instances the value of the permanent endowment of each college exceeds £100,000, while the interest brings in amounts reaching, in some instances, to nearly £10,000 per annum. To this may be added the value of the buildings which have been erected from funds supplied by the Central and State Governments, which vary from £20,000 to £200,000, and these values are constantly increasing. The first systematic attempt to teach agricultural science in America was conducted at Yale, which, from time to time, was followed by Michigan, New York State, Kansas, and Massachusetts. There are now some fifty State agricultural colleges, conducted upon a recognised system by men of capacity, and generally equipped in a manner which leaves little or nothing to be desired."

The work of these colleges is not restricted to the instruction of students in the science and practice of agriculture, for to each college a State experiment station is generally attached. In England experimental work in agriculture has been left entirely to private enterprise. As Mr. Long remarks, were it not for Rothamsted our scientific work in agriculture would have been sorry indeed as compared with that accomplished by the people of other countries. In the United States there are more than fifty experiment stations maintained by grants from each State and the Central Government.

One of the stations visited by Mr. Long, that of Geneva, in New York State, has an income of £4000 a year, from which it pays in salaries £1650, and in wages £1200. There are six chemists on the establishment, in addition to the director, an assistant director, a horticulturist, a pomologist, a clerk, and a staff of workmen. No wonder that a large amount of valuable work has been performed at the station during the last eight years.

Canada possesses five experimental farms of considerable size. Roughly these farms cost £15,000 a year, or £3000 a year each, omitting salaries. Coming to this side of the Atlantic we find that France has three important agricultural colleges. To the chief of these, that in Grignon, near Paris, a large farm is attached upon which experimental work is conducted. Italy possesses the experiment station at Lodi (Reale Stazione Sperimentale di Caseificio), where instruction is given in science and practice, and chemical investigations are conducted, the funds being provided by the Government and the Province and Commune jointly. Germany is full of agriculture experiment stations. The station at Kiel is supported by grants from the Central and Provincial Governments, and combines instruction with experimental work. In Denmark experimental work is carried on in the laboratory at Copenhagen, in experiment grounds, and at the Lyngby agricultural school and experiment farm, which is a good example of the Danish colleges. In Sweden and Norway Mr. Long visited the agricultural schools and stations at Ultuna and Alnarp. In addition to the usual farm, the former possesses an experiment station conducted somewhat on the Canadian lines. The best class of scientific investigations seems to be carried on at the chief station near Stockholm. Mr. Long also briefly refers to the systems of agricultural instruction adopted in Switzerland, Holland, and Belgium. His report shows clearly that Great Britain is behind other nations, both as regards State provision for instruction in agriculture and the establishment of experiment stations. It is quite time that the necessity for these stations was recognised by the Government.

THE SPENCER-WEISMANN CONTROVERSY.[1]

AS most readers of NATURE are aware, a very interesting controversy has arisen between Mr. Herbert Spencer and Prof. Weismann. The subject, although many minor issues appeared, is that apple of discord of modern biology, the existence of an inheritance of acquired characters, and in necessary association with that, the extent of the operation of natural selection. The two approach the questions in sharply-contrasted attitudes. Mr. Spencer looks at the problems of biology in their philosophical aspect as part of the large field of abstract thought which he himself has done so much to analyse, synthesise, and codify. Prof. Weismann, although best known by his theories, has been above all things a minute investigator of structural details. In the present controversy, Spencer maintains that the weight of evidence and argument in favour of the inheritance of acquired characters is so great that "unless there has been inheritance of acquired characters there has been no evolution." Weismann believes that there are insuperable difficulties in the way; that there is no evidence for such an inheritance; that natural selection is an all-sufficing cause.

Mr. Spencer's first argument is drawn from the gradations of tactual discriminativeness in the human skin. These gradations range from the ability of the tip of the tongue to recognise double contact in the points of a pair of compasses when their points are one-twenty-fourth of an inch apart, to the ability of the middle of the back which requires the points to be two and a half inches apart before double contact can be distinguished. It is a fair statement that these gradations are so distributed on the skin that those parts which are more used to the opportunity of discriminating are more capable of discrimination than parts with lesser opportunities. Spencer points out the difficulty or impossibility of believing that minute increases of tactile discrimination, as, for instance, distinguishing contact as double when the points are one-twenty-fourth inch apart instead of when they are one-twentieth inch apart, could not determine the existence of animals, and so could not have been selected. On the other hand, were the effects of use inherited, the gradations are explained. Against this, as against other individual cases, Weismann points out that there are not sufficient data; we know little or nothing of how variations occur, and what are the least variations that have value in selection. In the particular case of the tongue, one must remember that the tongue is one of the most highly specialised organs of the highest exist-

[1] "The Inadequacy of Natural Selection," by Herbert Spencer. I. *Contemporary Zeview*, February, 1893. II. id. March, 1893.
"Prof. Weismann's Theories," by Herbert Spencer. *Contemporary Review*, May, 1893.
"A Rejoinder to Prof. Weismann," by Herbert Spencer. *Contemporary Review*, December, 1893.
"Die Allmacht der Naturzüchtung. Eine Erwiderung an Herbert Spencer." Van August Weismann. Jena: Gustav Fischer, September, 1893. (Of this an English rendering appeared in the *Contemporary Review* for September and October, 1893.)

ing type of mammalia, and we know nothing of the myriad changes that have taken place during its evolution. Spencer urges that Weismann has made no reply to the difficulty of the distribution of tactile discriminativeness over the skin. But even were it an established fact that the effects of use are inherited, Mr. Spencer's suggestion would bring us no nearer an explanation, as it cannot be supposed that increased use would multiply the number of tactile end organs. If the origin of the end organs be left unaccounted for, and it be said that these changes in the brain that are the result of practice in discrimination are accumulated by inheritance, still the argument is not cogent. For a variation in the brain leading to the slightest increase of discrimination in interpreting the messages from the peripheral sense organs certainly have a value in selection.

In the matter of Panmixia, Mr. Herbert Spencer has misunderstood Weismann completely. Panmixia does *not* imply selection of smaller varieties, but the cessation of the elimination of smaller or more imperfect varieties. The discussion of the variation of cooperative parts leaves the issues open. In the case of the giraffe, Mr. Spencer thinks that the main points of its extraordinary structure must be due to natural selection. Nägeli some time ago selected the case of the giraffe as a special instance of the inadequacy of selection. But in the giraffe, and in many other cases, as in the horns of a stag, increase of an organ to be of any use must be accompanied by modifications of a multitude of cooperating parts. For such cases of coadaptation, natural selection without the inherited results of increased use, Mr. Spencer believes inadequate. Weismann's chief reply is drawn from a study of neuter ants. In them there are many structures different from the corresponding structures in males and females, and of these some imply the harmonious modification of cooperating parts. Following those who have investigated ants most fully, Weismann believes that most of these modifications arose subsequently to the loss of reproductive power by workers and soldiers, and that, consequently, we have here an instance of modifications involving coadaptation where there is no possibility of the inheritance of acquired characters. Against this, Spencer has set forth "certain views concerning the origin and economy of social insects, which differ from those that are current." According to these views reproductive power was lost by neuters subsequently to the appearance in them of the new characters, and consequently upon his theory the inheritance of acquired characters is not excluded. Thus, on his view the issues are still open.

When Mr. Spencer brought forward a set of instances supporting the popular belief that offspring to a second sire occasionally show traces of the first sire, he was apparently unaware that Weismann had already discussed a number of such cases, grouping them under the name "telegony." In the famous case of Lord Morton's mare it appears that the only resemblance to the first sire was zebra-like stripes, and it has been known for very long that such stripes not infrequently appear. Settegast and Nathusius, two very great authorities on questions relating to the breeding of animals, deny that there is proof of the existence of telegony, and for the present at least it cannot be said that it forms an argument against Weismann's theories. Moreover, the suggestion made by Prof. Romanes, and accepted by Weismann, provides an intelligible explanation of the hypothetical facts. To anyone who has seen under the microscope the intricate method in which nuclear matter prepares for division, Spencer's suggestion that it passes from cell to cell, leaving the embryo and reaching the tissues of the mother, must seem absurd, and his comparison of the wanderings of microbes will not render his supposition more intelligible.

The discussions of the "immortality" of the Protozoa, and of the exact meaning of division of labour, are largely academic, and do not admit readily of being summarised. But it is clear that unless *generatio æquivoca* be admitted, many existing Protozoa have been reproducing by simple division since at least tertiary times, and that is a length of life certainly amounting to the concept of "immortality" as used by Weismann. And if there be a material basis of heredity at all (a view which is by no means peculiar to Weismann), the material basis whether it be called germ-plasm or not, and whether it be modified in each ontogeny or not, stretches from animal to animal since the beginning of things, and has a dower of life immensely greater than the dower of life of somatic protoplasm.

P. CHALMERS MITCHELL.

ANCIENT EGYPTIAN PIGMENTS.[1]

THE red pigment used by the Egyptians from the earliest times is a native oxide of iron, a hæmatite. Most of the large pieces found by Mr. Petrie are an oolitic hæmatite. One specimen, on analysis, gave 79·11 per cent. and another 81·34 per cent. of ferric oxide. The pieces to be used as pigments were no doubt carefully selected, and the samples that I have examined, mostly from Gurob and Kahun, are very good in colour. All the large pieces were of a singular shape, having one side smooth and curved; and in all cases this side was strongly grooved with striæ, giving somewhat the appearance to the mass of its having been melted, and allowed to cool in a circular vessel. No doubt the explanation of this smooth-curved surface is, that these pieces had actually been in part used to furnish pigments, and having been rubbed with a little water in a large circular vessel, had been ground to this shape. By experiment it was found that these pieces of the native hæmatite yielded, without any further addition by way of medium, a paint which could readily be applied with a brush, as it possesses remarkable adhesive properties, and it resembles exactly, in every particular, the red used in the different kinds of Egyptian paintings. In addition to these samples of the pigments, all of which are native minerals and in their natural conditions, there are other reds, finer in colour and smoother in texture, evidently a superior pigment; these apparently have been made from carefully selected pieces of hæmatite, which have been ground and washed, and dried by exposure to the air. Some of these pieces are very fine in colour, and it would be difficult to match them with any native oxide of iron that is used as a pigment at the present day. There is every reason to believe that this is the earliest red pigment which was used, and it remains to this day the commonest and most important one; it is a body unattacked by acids, unchangeable by heat, and even moisture and sunlight are unable to alter its colour. At the present time many artificial products are used to take the place of this natural pigment.

Yellow Pigments.—These, again, are natural products, and by far the most common yellow used by the Egyptians is a native ochre. These ochres consist of about one-quarter of their weight of oxide of iron, from 7 to 10 per cent. of water, and the rest of their substance is clay. When moist they have a greasy feel, and work smoothly and well with the brush. There is no evidence of these bodies having changed colour, but undoubtedly they are chemically not nearly so stable as the red form of oxide of iron. Many of the pieces of this pigment, found at Gurob and at Tel-el-Armarna, are very fine in colour.

Some of the specimens of the very earliest colours of which the exact history is known, appear to be an artificial mixture of these two colours, the red and yellow, thus producing an orange colour. These samples were found on a tomb at Medum, which, according to Prof. Flinders Petrie, was built by Nefermat, a high official and remarkable man at the Court of Senefru. Senefru is known to have lived in the fourth dynasty, about 4000 B.C. and to have preceded Khufu, the Cheops of the Greeks, who was the great Pyramid builder. Now, on Nefermat's tomb the characters and figures are incised and filled in with coloured pastes, which I have been able to examine, and it is of interest to know that this use of colour was a special device of Nefermat, for on his tomb is stated that: "He made this to his gods *in his unspoilable* writing." In this unspoilable writing the figures are all carefully undercut, so that the coloured pastes, so long as they held together, should not be able to drop out. All the pastes used are dull in colour, consisting entirely of natural minerals. Hæmatite, ochre, malachite, carbon, and plaster of Paris appear to be the materials used. Chessylite, as a blue, probably was known even at that date, but the artificial blues seem hardly at this period to have come into use; certainly they are not found in the specimens of the Nefermat colours which I have examined. Another yellow pigment, far brighter in colour, was also often used. It is a sulphide of arsenic, orpiment; it is a bright and powerful yellow, again a body found in nature, but a much rarer body than ochre, and consequently, probably was only used for special purposes, when a brilliant yellow was required. As far as it is known at present, this pigment did not come into use until the eighteenth dynasty. Gold might even be placed among the yellow pigments, for it was largely used, and with wonder-

[1] A lecture delivered at the Royal Institution of Great Britain, on March 17, 1893, by Dr. William J. Russell, F.R.S

fully good effect. Its great tenacity seems to have been fully recognised, for gold is found in very thin sheets, and laid on a yellow ground, exactly as is done at the present day.

These pigments are then simply natural minerals, no doubt carefully selected, and sometimes ground and washed previous to being used; but the blue colour which is so largely used by the Egyptians is an artificial pigment, and consequently has far more interest attached to it than those already mentioned. It is a body requiring considerable care and experience to make, and thus its manufacture enables us to some extent to judge of the knowledge and ability which its producers had of carrying on a chemical manufacture. No doubt the splendid blue of the mineral chessylite was first used, but certainly in the twelfth dynasty—that is, about 2500 B.C.—these artificial blues were used. They are all an imperfect glass, a frit, made by heating together silica, lime, alkali, and copper ore.[1] The number of failures which may have occurred, and how much material may have been spoilt, cannot be known, but all the blue frit which I have examined—and it is a considerable amount, some being raw material, lumps as they came from the furnace, and the rest ground pigment—all has been, though differing in grain and quality, well and perfectly made. Now this implies that the materials have been carefully selected, prepared, and mixed, and that definite quantities of each were taken, this necessitating the carefully measuring or weighing of each constituent. An early application of the fundamental law of chemistry, combination in definite proportion. The amount of copper ore added determined the colour; with 2 to 5 per cent. they obtained a light and delicate blue; with 25 to 30 per cent. a dark and rather purple blue; with still more the product would be black; if the alkali was too little in amount, a non-coherent sand resulted; if too much, a hard, stony mass is formed, quite unsuitable for a pigment. The difficulties, however, did not by any means end with the mixture of the materials. For the next process, the heating, is a delicate operation. Unfortunately up to the present time the exact form of furnace in which this operation was carried on is not known. The furnaces were probably, especially after use, very fragile structures, and have passed away. Considerable experience in imitating these frits even when using modern furnaces has taught me that the operation is really a very delicate one; the heat has to be carefully regulated and continued for a considerable length of time, a time varying with the nature of the frit being prepared; and, further, in the rough furnaces used it must have been specially difficult to have prevented unburnt gases from coming in contact with the material; but if they did, a blackening of the frit must have taken place. However, all these difficulties were avoided, and a frit was made which exactly answered all the necessary requirements. It had, for instance, the right degree of cohesion, for many of the large pieces which have been found have, like the hæmatite, a smooth, curved striated surface, and on rubbing in a curved vessel with water, easily grind to powder. The powder is naturally much less adhesive than the hæmatite powder, but on adding a little medium, it could at once be used, without other preparation, as a paint. Some of the pieces vary in colour in different parts. This may have arisen from imperfect mixing, or from some parts of the furnace being hotter than others. It hardly appears to be intentional, possibly some of the dark, purplish-coloured frits were produced by accident; large pieces of it have as yet, I believe, not been found. By means of comparatively small alterations these frits could be obtained of a green colour. One way was by introducing iron. If, for instance, the silica used was a reddish coloured sand, it gave a greenish tinge to the frit; and frit made with some of the ordinary yellowish desert sand was found to give a frit undistinguishable from the most common of the old Egyptian frits. Again, a rather strong green colour is obtained by stopping the heating process at an early stage, this green frit simply on heating for a longer time becoming blue. Another way in which even the strong-coloured blue frits have been converted into apparently green pigments is by their being coated over with a transparent but yellowish coloured varnish which has to a remarkable extent retained its transparency, but no doubt become with age more yellow, and although strongly green now, may very likely originally have been nearly colourless, and consequently the frit was then seen in its original blue colour. Even as early as the twelfth dynasty the green frits used were dull in colour, and if by chance a brighter green was required, then they used the mineral malachite. No doubt by far the most brilliant blue used at any time was selected and powdered chessylite, and even down to the twenty-first dynasty they seem to have made use generally of somewhat brilliant coloured frits; but after that time more subdued colours appear to have been used, and even the scarabs were made of a much duller colour than formerly. All these blue frits form a perfectly unfadeable and unchangeable pigment. Neither the sun nor acids are able to destroy or alter their colour.

The only other pigment to which I can refer this evening is the pink colour, which, in different shades, was much used. This is again an artificial pigment, and belongs to an entirely different class from any of the foregoing ones, for it is one of vegetable origin. On simply heating it, fumes are given off and the colour is destroyed, but a large white residue remains; this is sulphate of lime. It may here be stated that the white pigments used sometimes were carbonate of lime, but more generally sulphate of lime in form of gypsum, alabaster, &c. This substance is often very white in colour, is very slightly soluble in water, and has a singular smoothness of texture, which makes it work well under the brush; and in addition to these qualities, it is a neutral and very stable compound, so is well fitted for the purpose to which it was applied. It was easily obtained, being found native in many parts of Egypt. It is also interesting to note that there is an efflorescence consisting of this substance which frequently occurs in Egypt, and is of a remarkably pure white colour; probably this was used as a superior white pigment. It was easy to prove then that the pink colour was gypsum stained with organic colouring matter, and to try and imitate the colour appeared to be the most likely way of identifying it. Naturally, madder, which it is known has from the earliest times been used as a dye, was the vegetable colouring substance first tried, and it answered perfectly, giving under very simple treatment the exact shade of colour to the sulphate of lime which the Egyptian pigment had. Essentially the same colouring matter may have been obtained from another source, viz. Munjeet. In the case of madder it is interesting to note that the colour is not manifest in the plant—the *Rubia tinctorum*—for it is obtained from the root, and is even not ready formed there. In the root it exists as a glucoside, and this has to be decomposed before the colour becomes manifest. In this root there exist several colouring matters, which are known as madder-red, madder-purple, madder-orange and madder yellow. On breaking up the roots and steeping them in water for some length of time, the colours come out, some sooner than others, so that the tints vary. Again, changes of colour are easily obtained by the addition of very small quantities of iron, lime, alumina, &c., so that in these different ways a considerable range of colours could be obtained, but a delicate pink colour was the one probably generally made. This colour is easily obtained by simply stirring up sulphate of lime in a tolerably strong solution of madder, and adding a little lime, taking care to keep the colouring matter in excess; the colouring matter adheres firmly to the lime salt, and this settles on to the bottom of the vessel; the liquid is then poured off and the solid matter, if necessary, dried, or mixed—probably with a little gum, and used at once without other preparation. That the colouring matter was really madder could also be tested by another method, viz. by means of spectrum analysis. Both the madder-red (alazarin) and the madder-purple (purpurin) give, when the light which they transmit is analysed by the prism, very characteristic absorption bands; the purpurin bands are the ones most easily seen, consequently it became a point of considerable interest to ascertain whether from a specimen of this pigment, some thousands of years old, these absorption bands could be obtained. A small sample of this pink pigment was taken from a cartonage which was exhibited, and by treating it with a solution of alum, the colour was thus transferred to the liquid, and by throwing the absorption spectrum which it gave on the screen, and comparing it with the spectrum from a madder solution, it was clearly seen to be identical.

Many specimens in imitation of different coloured frits, and a large copy of a cartonage coloured with pigments prepared by the lecturer, were exhibited.

[1] A sample of the pale-blue frit gave, on analysis, the following results:—

Silica	88·65
Soda	0·81
Copper oxide	2·09
Lime	7·88
Iron oxide, alumina, &c.	0·57
	100·00

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Oxford.—At a meeting of the Ashmolean Society, held on Monday last, Mr. V. H. Veley read a most interesting paper, entitled "A Criticism of the Electrolytic Theory of Chemical Change," which excited a warm discussion. At the same meeting Mr. J. E. Marsh read a paper on "Some New Derivatives of Camphene," which embodied some of the results of recent investigations made by him and Mr. J. A. Gardner.

At a meeting of the Junior Scientific Club on Wednesday, 7th inst., Mr. H. Balfour exhibited primitive tobacco pipes and vessels of skin and sinew from India and South Africa. Papers were read on "Hertz's Researches on Electromagnetic Radiation" by Mr. E. F. Morris, of Balliol, and on "The Distribution of Extra-marine Mollusca," by Mr. E. W. W. Bowell, of Wadham.

In the list of newly-elected members of the Board of the Faculty of Natural Science given last week, the name of Mr. W. Esson was inadvertently given instead of that of Mr. H. T. Gerrans.

As a result of the memorial presented by the Demonstrators to the Hebdomadal Council last year, the following statute has been passed by Council, and will be promulgated in Convocation on March 20. If all that the Demonstrators demanded has not been conceded, the new statute has at least the merit of recognising their position and given them a definite university status.

"Whereas it is expedient to make regulations respecting (1) the appointment of Demonstrators and other Assistants in certain laboratories, and (2) their tenure of office, the University enacts as follows:—

After Statt. Tit. iv. Sect. 1, § 3 (page 32, ed. 1893) the following subsection shall be added:—

§ 4. Concerning Demonstrators and other Assistants in laboratories.

1. Every Demonstrator or other Assistant appointed by any of the Professors enumerated in the Schedule annexed to this Statute shall receive at the time of his appointment a written statement of the emolument and duration of his office.

2. In all cases in which a Demonstrator or other Assistant is so appointed for a longer period than two terms, Easter and Trinity terms being for this purpose computed as one term, the name of the person appointed and the terms of the appointment shall be submitted for approval to the Vice-Chancellor, who, if he gives his approval, shall notify the appointment in Convocation, and cause it to be published in the usual manner.

3. Any Demonstrator or other Assistant who has been dismissed from office by the Professor shall have the right of appealing against the dismissal to the Vice-Chancellor.

Schedule.

The Savilian Professor of Astronomy.
The Professor of Experimental Philosophy.
The Waynflete Professor of Chemistry.
The Professor of Geology.
The Linacre Professor of Comparative Anatomy.
The Waynflete Professor of Physiology.
The Sherardian Professor of Botany."

Cambridge.—Mr. T. H. Riches has been appointed to the occupation of the University's table at the Naples Zoological Station for the next five months.

The General Board of Studies recommend that Dr. Ruhemann's Lectureship in Organic Chemistry should be continued for five years from Michaelmas next. Dr. Ruhemann's teaching appears to have been very popular; during last term he had 123 students under instruction. His work, though it is under University auspices, is conducted for the present in the laboratory of Gonville and Caius College.

The Agricultural Examinations Syndicate have issued, through their Secretary, Mr. Francis Darwin, Deputy-professor of Botany, a scheme of the Examination in Agriculture to be held next summer. The examination will extend from July 2 to July 8, and will include papers and practical work in Chemistry, Botany, Physiology, Entomology, Geology, Engineering, and Book-keeping (constituting Part I.), and Practical Agriculture and Surveying (constituting Part II.). The fee for admission will be one guinea for Part I., and two guineas for Part II. The names of candidates are to be sent to the Registrary by June 13, 1894. Schedules of the subjects over which the examination will extend are published in the *University Reporter* for February 13. Candidates who pass both parts will receive a diploma testifying to their competent knowledge of the science and practice of agriculture.

SCIENTIFIC SERIALS.

Wiedemann's Annalen der Physik und Chemie, No. 1.—Radiation of gases, by F. Paschen. The experiments were conducted upon gaseous carbonic acid and steam. By using mirrors instead of lenses, and a prism of fluor spar, purer spectra and more decided maxima were obtained than those found by Angström. The absorption spectra of CO_2 at ordinary temperatures, and of steam at 100°, correspond in general to the emission spectra at higher temperatures, except that at higher temperatures the maxima are displaced towards the less refrangible end. This displacement was found, however, to be reversed for at least one of the steam maxima. The principal maximum of CO_2 was at λ 4630. The other, at 2710, nearly coincided with that of steam, at 2660. The other maxima due to steam were found at 8060 and 7160. All these maxima were very decided. A layer of CO_2 7 c.m. thick showed almost complete absorption at the darkest bands. These bands did not, as sometimes supposed, broaden with increasing thicknesses of layers. A layer of air 83 c.m. thick showed them clearly. One principal band due to steam was found represented in the absorption spectrum of water, but those of water were as a rule displaced towards the red end. No absorption by oxygen and nitrogen could be discovered under similar conditions.—On the artificial colouring of crystals and amorphous bodies, by O. Lehmann. The recently discovered phenomenon of "liquid crystals," *i.e.* dissolved crystals retaining their doubly-refracting properties in the state of solution, has confirmed the author's belief that the properties of crystals depend more upon those of their molecules than upon the aggregation of the latter. Hence it is probable that substances which are not isomorphous may, after all, be capable of crystallising together. This has been actually observed in the case of sal-ammoniac and copper chloride, and subsequently in a large number of substances, such as meconic, hippuric, and succinic acids when brought into contact with bodies like Hofmann's violet, phenyl blue, or methyl orange.—On galvanic deposits arranged in streaks, by U. Behn. The streaky deposit found in silver voltameetrs and similar apparatus owes its arrangement to currents within the liquid due to variations of density during electrolysis, as was proved by varying the position of the voltameter. In the case of silver nitrate, the streaks are most highly developed when the solution is dense and the current feeble. The amount of E.M.F. is without influence.—The polarisation of solid deposits between electrolytes, by P. Springmann. The counter E.M.F. generated by a current flowing through two electrolytes was determined, in cases where the two liquids gave a solid deposit upon the membrane (parchment or gypsum) separating them. With a current of 21·4 milliampères, solutions of lead nitrate and copper sulphate gave a polarisation of 1·964 volts after five, and 2·02 volts after ten minutes.

Bulletin de l'Académie Royale de Belgique, No. 12.—Essay on the variations of latitude, by F. Folie. This is an attempt to explain the observed variations of latitude by a superposition of initial nutation and an annual displacement of the earth's pole of inertia due to inequalities in the distribution of snow in the various north circumpolar regions. Supposing that the snow falling in America between the meridians of 235° and 285° E. of Gr. is counterbalanced by that falling in Europe and Siberia from 55° to 105°, the chief unbalanced tracts would be those between 105° and 135° in Siberia, and 15° and 55° in Europe. These masses would have their centres of gravity at about 120° and 35° respectively, giving a resultant centre of gravity at 77°. Assuming that the thickness of snow accumulated from autumn till midwinter is equivalent to 0·3 m. of water, and that the solid crust extends down to the extent of one-tenth of the earth's radius, a rough calculation gives 0·06″ as the angle by which the pole of inertia would be displaced towards North America during the period considered, afterwards returning by the same amount between midwinter and midsummer. The combination of this annual period with that of initial nutation, of 427 days, would give an apparent period of 396 days, agreeing closely with that of 398 days found by Chandler.—

Remarkable meteors in the night from November 6 to 7, 1893, by the same author. Several striking meteors were observed in various quarters during that night, in the constellations of Pegasus, Ursa Major, and Ursa Minor. The report of the explosion of the last was plainly audible.—On some new processes for the detection of vegetable and mineral oils, by W. de la Royère. An alkaline solution of rosaniline may be used for determining minute quantities of fatty oils mixed with mineral oils. Half a gramme of fuchsine is dissolved in half a litre of boiled distilled water. A 30 per cent. solution of caustic soda is added drop by drop until complete discolouration is just obtained. The mixture is then made up to one litre with distilled water, and kept in a well-stoppered bottle. A few drops of this are added to a small quantity of the oil in a porcelain dish, and stirred. The animal and vegetable oils quickly assume a pink colour, and mixtures of these with mineral oils are coloured red with an intensity proportional to the quantity of animal or vegetable oil present. Other coal-tar products, such as picric acid, purpurine, rosolic acid and eosine, show a similar behaviour.

Internationales Archiv für Ethnographie, Bd. vi., Heft vi.—This is the last number of the first series of this valuable journal, which has been so excellently published by Heer Trap. The first article, by Schmeltz, on a Dyak and two Japanese swords, is lavishly illustrated by three coloured plates. Baron van Hoëvell describes and figures the flattening of the skull and chest in Buool (north coast of Celebes). The chest flattening-board is always employed on the boys, but not always the head-board; both are always inflicted on the girls, the object being solely for beauty, and to improve the marriage value of the latter. It is not for the purpose of making them clever and active, for the people themselves say "Reason is the gift of God." Schmeltz adds an appendix, in which he gives the geographical distribution of the custom of skull deformation.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 1.—"An Instrument for Grinding Section-plates and Prisms of Crystals of Artificial Preparations accurately in the desired directions." By A. E. Tutton.

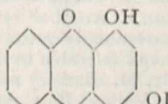
By means of this instrument a truly plane surface may be ground and polished in any desired direction in a crystal accurately to within ten minutes of arc, in a fraction of the time required for the hand grinding of an approximately true surface, and without danger of fracturing the crystal. It consists essentially of four parts. (1) A rotating horizontal divided circle, within the vertical axis of which two other axes are capable of vertical motion; the innermost carries at its lower extremity the crystal and its means of adjustment, and the other is connected with a counterpoising apparatus by which the pressure with which the crystal bears upon the grinding disc can be modified according to its relative softness and friability. (2) A series of graduated circular adjusting movements by which the desired direction (plane) in the crystal can be brought exactly parallel to the grinding surface. (3) A horizontal collimator and telescope for goniometrically observing the crystal. (4) A rotating table carrying a detachable grinding disc of ground glass, and underneath it a polishing disc of much more finely ground glass. A special crystal holder is also provided, which enables a second surface to be ground truly parallel to the first. Prisms may be ground with the same facility as section-plates.

"An Instrument of Precision for producing Monochromatic Light of any desired Wave-length, and its Use in the Investigation of the Optical Properties of Crystals." By A. E. Tutton.

This instrument enables the whole field of an optical instrument to be evenly and brightly illuminated with spectrum monochromatic light of any desired wave length. It has been devised especially for use in connection with the axial angle polariscopical goniometers, spectrometers, stauroscopes, microscopes, and other instruments employed in the investigation of the optical properties of crystals, but is capable of much more extensive application. It was suggested by the apparatus described by Abney (*Phil. Mag.* 1885, vol. xx. p. 172), but differs from that arrangement in most of its details, and particularly in the employment of a fixed instead of a movable exit slit; of a rotatory instead of a fixed dispersing apparatus, which is capable of accurate graduation for the passage of rays of definite wave-lengths through the exit slit; and in the manner of utilising the issuing line of monochromatic light, which, instead of being directed upon an opaque white screen, is diffused so as to be evenly distributed over the field of an observing instrument when that instrument is placed directly in its path.

The instrument resembles a compact spectroscope in appearance. The two optical tubes are exactly similar. Each carries a slit, the jaws of which are made to move equally on each side of the line of contact, and a lens combination of two inches aperture, in order to pass a large amount of light. A single prism of heavy flint glass is employed, of large size and of the highest dispersion compatible with freedom from colour; it is carried upon a rotating divided circle. Either optical tube may be used as collimator. The other may be converted into a telescope for the purpose of graduating the instrument by attaching an eyepiece in front of the slit; the knife edges of the latter, which are clearly focussed by the eyepiece, serve as parallel cross wires between which solar or metallic lines may be adjusted by rotation of the prism. The readings of the circle for such positions are recorded in a table supplemented by a curve. Upon removal of the eyepiece and illumination of the receiving slit by any sufficiently powerful source of light, monochromatic light of any desired wave-length may at once be produced by setting the circle to the reading recorded for that wave-length. The issuing line of coloured light is widened just sufficiently to fill the whole field of the observing instrument by attaching a screen of very finely ground glass, carried in a short tube sliding along a bar, about one inch in front of the exit slit. Upon bringing the optic axial angle goniometer, carrying an adjusted section plate, close up so that the end of the polarising tube almost touches the ground glass, the interference figure is observed sharply defined upon a homogeneously coloured and illuminated background. The arrangement is particularly valuable for the study of cases of crossed axial plane dispersion. It is equally adapted for use in the determination of indices of refraction by the methods of refraction or total-reflection, and also in the determination of extinction angles by means of the stauroscope.

Chemical Society, January 18.—Dr. Armstrong, President, in the chair.—The following papers were read:—The molecular formulæ of some liquids as determined by their molecular surface energy, by Miss E. Aston and W. Ramsay. The molecular weights of phenol and bromine in the liquid state are somewhat greater than in the gaseous state; liquid nitric acid has approximately the molecular formula $H_2N_2O_6$. The molecule of liquid sulphuric acid below 132° has the composition $32H_2SO_4$; liquid phosphorus has the normal molecular composition P_4. Chloropicrin has the composition $CCl_2(NO_2)_2$.—Contributions to our knowledge of the aconite alkaloids. VIII. On picraconitine, by W. R. Dunstan and E. F. Harrison. The "picraconitine," obtained by Groves from the roots of *Aconitum Napellus* is merely impure isaconitine.—Contributions to our knowledge of the aconite alkaloids. IX. The action of heat on aconitine, by W. R. Dunstan and F. H. Carr. On heating aconitine it breaks up into acetic acid and pyraconitine, $C_{31}H_{41}NO_{10}$; the latter base on hydrolysis yields benzoic acid and pyraconitine $C_{24}H_{37}NO_9$.—Contributions to our knowledge of the aconite alkaloids. X. Further observations on the conversion of aconitine into isaconitine, by W. R. Dunstan and F. H. Carr.—Interaction of benzylamine and ethylic chloracetate, by A. T. Mason and G. R. Winder. The first product of the action of benzylamine on ethylic chloracetate is benzylamidoacetic acid; the latter readily condenses, yielding dibenzyl-α-γ-diacipiperazine. — Condensation products from benzylamine and several benzenoid aldehydes, by A. T. Mason and G. R. Winder.—Constitution of rubiadin, by E. Schunck and L. Marchlewski. The authors assign the following constitution formula to rubiadin:—



—The monalkyl ethers of alizarin, by E. Schunck and L. Marchlewski.—Ruberythric acid, by E. Schunck and L. Marchlewski.—The colouring matter of the Indian dye-stuff "Tesu," by J. J. Hummel and W. Cavallo. The dye-stuff "Tesu" consists of the dried flowers of *Butea frondosa*; the latter contain a glucoside which on hydrolysis yields a compound of the formula $C_{15}H_{14}O_5$.

Linnean Society, February 1.—Prof. Stewart, President, in the chair.—The President exhibited a remarkable specimen of a South African butterfly, *Teracolus halyattes*, from Natal, in which the wings on one side were those of a male, and on the other those of a female, and made some remarks on hermaphroditism in the Lepidoptera.—On behalf of Mr. William Borrer, of Cowfold, Sussex, there was exhibited a skull of the pine marten, *Martes sylvatica*, Nilsson, from a specimen killed near Crawley (*Zool.* 1891, p. 458), an examination of which confirmed the view of the late E. R. Alston (*P.Z.S.* 1879, p. 469), that so far as could be ascertained this is the only species of marten found in the British Islands.—On behalf of Mr. W. B. Tegetmeier, there was exhibited a drawing of a snow leopard taken for the first time from life, namely, from the animal now living in the Zoological Society's Gardens, Regent's Park. The long, thick, and soft fur, suggestive of a cold habitat, and the unusual size of the wide spreading feet, well suited for travelling over an expanse of yielding snow, were noteworthy features.—Mr. Malcolm Laurie read a paper on the morphology of the *Pedipalpi*. He considered the first two ventral sclerites of the abdomen to be appendages, and not sternites. The first of these—the genital operculum—covers the ventral surface of two segments, the genital aperture and the first pair of lung books lying beneath it. The first pair of lung books, he thought, probably represent the remains of the appendage of the second segment. The arrangement of this region resembles that in *Eurypteridæ* and in the spiders (*e.g. Liphistius*), while differing markedly from that in scorpions. The posterior end of the intestine is diluted into a large stercoral pouch which is part of the mid-gut, the malpighian tubes arising from its posterior end. The cephalothoracic portion of the mid-gut differs in structure from the abdominal portion, and in addition to lateral diverticula has two median ventral diverticula. The conal gland opens at the base of the third pair of appendages, and a sensory organ of unknown function occurs on each side of the last segment. A discussion followed, in which Mr. R. I. Pocock, Mr. H. M. Bernard, and the President took part, and Mr. Laurie replied.—A paper was then communicated, by Mr. W. West, on the fresh water algæ of the West Indies, in which several new species were described and illustrated. Mr. G. Murray, in commenting on this paper, testified to the extreme care and accuracy with which the species had been worked out.

Zoological Society, February 6.—Sir W. H. Flower, K.C.B., 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 month of January, 1894.—Mr. Sclater exhibited a fine mounted specimen of the Riverhog of Madagascar from the Tring Museum, lent for exhibition by the Hon. W. Rothschild, and pointed out that three distinct species of this well-marked genus of *Suidæ* were now known to occur in the Ethiopian region. A communication from Mr. Last gave an account of the habits of this animal, as observed in Madagascar.—Mr. Sclater also exhibited a stuffed specimen of the Whitebilled Great Northern Diver (*Colymbus adamsi*) from Norway, which had been lent to him by Prof. R. Collett, and made remarks on the distribution of the species, and on its interest as occasionally occurring on the British coast.—Prof. Howes read a paper on synostosis and curvature of the spine in fishes, with especial reference to the Common Sole.—Mr. F. E. Beddard, F.R.S., gave an account of the development of the Tadpole of an African Frog (*Xenopus lævis*), as observed in specimens of this Batrachian hatched and reared in the Society's Gardens.—Mr. Chas. W. Andrews gave an account of some remains of the extinct gigantic bird (*Æpyornis*) which had been recently received at the British Museum from several localities in Madagascar. These were referred to three species—*Æ. muelleri*, *Æ. medius*, and *Æ. titan*, the last being of larger size than even *Æ. maximus*. Another set of remains showed differences which might eventually prove to be of generic importance, and were perhaps referable to the newly established genus *Muellerornis*.—Mr. M. Barkley read some notes on the Antelopes of the Pungue Valley, East Africa, as observed by him during a recent hunting expedition in that district.—The Marquis of Hamilton made some observations on the Antelopes met with by him during a recent excursion from the Pungue along the coast northwards towards the Zambesi.—Mr. O. Thomas read the description of a new species of Bat of the genus *Stenoderma* from Montserrat, West Indies, proposed to be called *S. montserratense*. This Bat was stated to be very injurious to the cacao plantations in that island.

Entomological Society, February 7.—Mr. Henry John Elwes, President, in the chair.—The President announced that he had nominated the Right Hon. Lord Walsingham, F.R.S., Prof. Edward B. Poulton, F.R.S., and Colonel Charles Swinhoe, vice-presidents of the society for the session 1894–95.—Mr. Jenner Weir exhibited, on behalf of Mr. J. M. Adye, a specimen of *Plusia moneta*, Fabr., which had been captured at Christchurch, Hants, and remarked that this species, which had been found in this country for the first time so recently as June, 1890, was apparently becoming a permanent resident here, as it had been since taken in several of the southern counties. He also remarked that *Aconitum napellus*, on which the larva fed, though rare in England as a wild plant, was very common in gardens. Mr. Jenner Weir also exhibited a nearly black specimen of *Venilia macularia*, L., the yellow markings being reduced to a few small dots.—Mr. Hamilton Druce exhibited a female specimen of *Hypochrysops scintillans*, lately received by him from Mioko, New Ireland. He said that only the male of this species had been as yet described.—Mr. F. Enock exhibited, and made remarks on, a nest of the British Trap-door Spider, *Atypus piceus*, recently found near Hastings by Mrs. Enock.—Mr. W. F. H. Blandford stated that he had recently obtained an additional species of *Scolyto-platypus* from Japan, which, though closely allied to the species he had formerly described, showed a very distinct modification of the male prosternum.—Mr. M. Jacoby exhibited and remarked on a specimen of *Leptispa pygmæa*, Baly, which was doing much injury to sugar-cane in the Bombay Presidency. Mr. G. C. Champion stated that he had found an allied species on bamboo.—Dr. F. A. Dixey read a paper (which was illustrated by the oxyhydrogen lantern) entitled "On the Phylogeny of the *Pierinæ* as illustrated by their wing-markings and geographical distribution." A long discussion ensued, in which the President, Mr. Osbert Salvin, F.R.S., Mr. Jacoby, Colonel Swinhoe, Mr. Jenner Weir, Mr. Hampson, and Mr. Kenrick took part.—Dr. T. A. Chapman read a paper entitled "Some notes on those species of Micro-Lepidoptera whose larvæ are external feeders, and chiefly on the early stages of *Eriocephala calthella*." Mr. Hampson and the President made some remarks on the subject of the paper.—Mr. Hamilton H. Druce read a paper entitled "Description of the female of *Hypochrysops scintillans*, Butl."—The Rev. Dr. Walker communicated a paper by Mr. R. H. F. Rippon, entitled "Description of a variety of *Ornithoptera* (*Priamoptera*) *urvilliana*."

CAMBRIDGE.

Philosophical Society, January 29—Prof. T. McKenny Hughes, President, in the chair. The following communications were made:—Electricity of drops, by Prof. J. J. Thomson. The experiments and observations of Lenard were first referred to. No electrification is detected in a free falling drop, but if drops after falling be arrested by coming in collision with a plate or wire, the droplets generated in the splash are found to be electrified. Prof. Thomson, has studied the conditions more closely. The electrification on a free falling drop is masked by the opposite electrification of the air surrounding it, till by some sudden blow the drop is broken up. Special observations show that the blow does not generate the electricity, but merely separates already existing opposite electrifications. The effects produced by various liquids have been studied, and it appears that there is an obvious connection between the nature (reducing or oxidizing) of the liquid used and the kind or amount of electrification detected. A very small amount of impurity in water is enough to produce a marked change in the electrification observed. The most remarkable case is that of phenol; this substance is only moderately soluble in water, but if only ·2 cc. of water saturated with phenol is added to 100 cc. of pure water, the increase in electrification is obvious; and when 2·5 cc. of solution are added to 100 cc. of water, the effect on the electrometer is nearly seven times that due to pure water. The sign and magnitude of the electrification depend on the nature of the gas through which the drops fall before breaking up, hydrogen producing effects opposite to those produced by air. No electrification can be detected when drops of water fall through pure water-vapour, but the smallest addition of air brings about electrification.—Mr. Griffiths described an easy method of making absolutely air-tight joints between glass and metal tubes, by means of an alloy which has a low melting-point The use of this alloy was suggested by Mr. F. Thomas. An illustration was given of the ease and certainty of the method.—A compensating open-scale barometer was then exhibited and described by Mr. Griffiths. The principle of this instrument is the same as that of Prof. Callendar's long distance air thermometer. An air bulb is placed within a second bulb, and the annular space between them is filled with sulphuric acid. The air and the H_2SO_4 have a common surface in a tube connecting the two bulbs, the H_2SO_4 also communicates with the air by means of a vertical tube partially filled with acid. The masses of air and sulphuric acid are so adjusted that when the temperature of the instrument is raised, the increase in pressure due to the increased length of the sulphuric acid column in the vertical tube exactly counterbalances the increase in pressure of the contained air, and thus the position of the common surface is unchanged by alterations in temperature, although at once affected by alterations in the external pressure. The resulting scale is about six times as open as the scale of a mercury barometer, and the readings give the pressure expressed in terms of the length of a column of mercury at 0° C. in latitude 45°, without any preliminary calculations.—On the condition of the interior of the earth, by Rev. O. Fisher. The author has lately calculated the tidal deformation of a liquid earth owing to the attraction of the moon, assuming Laplace's law of density; the moon's potential is substituted for that of the centrifugal force in the usual calculation of the earth's figure by means of Laplace's functions; and the result obtained is a deformation of 3·45 feet, or 6·90 feet from highest to lowest. This value is nearly four times as great as a value used in an earlier paper "On the hypothesis of a liquid condition of the earth's interior, &c." read in May, 1892. The calculation of the new value leads the author to consider that the first three pages of the earlier paper lose their force, though the remaining portions stand unaffected. The author points out that the existence of ocean tides is not a conclusive argument in favour of rigidity, inasmuch as on the hypothesis of liquidity mountains must have "roots," sinking deep into the heavier liquid, the result being a deflection of the tidal wave in the substratum, whence would arise irregularities analogous with "establishment of ports."—On a combination of prisms for a stellar spectroscope, by Mr. H. F. Newall. An isosceles and nearly equiangular prism is polished on three faces, and light from a collimator after falling on the base and emerging from one side falls normally on the hypotenusal face of a right-angled prism, and after two reflections within the prism is made to fall upon the third face of the first prism and to emerge from its base. The spectroscope has therefore a dispersion equal to that of two prisms, and is arranged so that the light reflected from the base at primary incidence passes into the same telescope as is used to view the spectrum, and gives rise to a simple image of the slit, which can be used as a luminous pointer. For astronomical purposes it is convenient; for, when the slit is widened, an image of the star can be seen, and the star may be identified amongst its neighbours. The brightness of the pointer is proportioned to the spectrum to be observed. No double adjustment is necessary in directing the telescope.

DUBLIN.

Royal Dublin Society, December 20, 1893.—Prof. D. J. Cunningham, F.R.S., in the chair.—Dr. G. Johnstone Stoney read a paper upon vision, with special reference to vision with compound eyes. The most interesting points brought out by this investigation are the two following:—(1) The amount of detail that is visible by human beings is limited by the spacing of the cones in the macula lutea of the human eye, by the limited size of the pupil, and by spherical and chromatic defects in the eye regarded as an optical instrument. In persons with the best vision, these three limiting causes concur in fixing about one minute of arc as the smallest angular interval to be subtended by two objects at the eye, in order that they may be visible as two. With an insect's compound eye a corresponding limit is placed by the spacing of the lenses over its cornea, and by the small aperture of each lens. Judging from these, we learn that predatory insects, such as dragonflies, which have the largest number of lenses, see so much less perfectly than we do that the angular interval at which two objects must stand to be seen as two, is nearly a degree; while in moths, butterflies, bees, ordinary flies, &c. which have not this great number of facets, the angular interval that is requisite rises to be two degrees or more: so that such insects do not see details upon their own antennæ, close to them as they are, so distinctly as we can see them from the great distance from which we are obliged to view them. Moreover, when the number of facets has to be increased, as it is in predatory insects, in order to improve their vision, it is necessary at the same time that the aperture of each lens should not be unduly diminished. This accounts for why the compound eyes of such insects are of excessive size when compared with their other features. (2) Again, our eyes see distinctly only a small central patch of the field of vision, but can be directed towards various objects in succession by rotating the eye in its orbit, and can be accommodated to the distance of each. There is no such motion of rotation possible to insects, but in compensation they seem to be able to see distinctly throughout the whole of the field of vision, and to have the remarkable power of being able simultaneously to adjust the different parts of their compound eye to see distinctly at different distances, so that, for instance, a wasp hovering over a breakfast-table can accommodate his eyes to see with as much distinctness as the insect can see, the several objects on the table, though they may be at very different distances from him.—Dr. J. Joly, F.R.S., read a paper on the effect of temperature upon the sensitivness of the photographic dry plate, of which the following is a brief abstract: The visible spectrum photographed upon plates one-half of which were maintained at a low temperature (about − 30° C.) and the other half kept warm, showed that the loss of sensitiveness is in the case of isochromatic plates confined almost entirely to the yellow-green and green-blue. In fact the sensitiveness ordinarily conferred by the action of the dye is annulled save for some survival of the very strong band in the green, which is continued, much weakened, from the warm half across the cold half, and without shift. It appears from this that the use of orthochromatic plates in cold climates out of doors offers little or no advantage over ordinary gelatino-bromide plates. The spectrum taken upon a cold region on the ordinary gelatino-bromide plate shows a very slight weakening throughout, but most markedly in the rays of lowest refrangibility. The feeble action of the dye at low temperatures seems to confirm Abney's view that the action of the dye is mainly of a chemical nature.—At the meeting held January 17, Prof. J. Mallet Purser in the chair, the following communications were presented:—Dr. J. Joly, F.R.S., demonstrated some simple methods in teaching elementary physics. By the use of a floating piston (a contrivance enabling a wide column of mercury to be supported without friction or risk of falling out in a tube), the author uses as a "Boyle's tube" a uniform straight tube about 1 metre long, closed at one end. The tube is placed vertical with the closed end downwards, a certain volume of air v_1 (defined by linear measurement upon the tube) is enclosed by a short column of mercury; the length of this added to the height of the barometer affords P_1. The air is now further loaded with mercury; and v_2 and P_2 measured as before. The operations are evident at a glance, and very accurate results may be obtained. To show the rate of thermal expansion of air and to convey the meaning of absolute zero, by gas therometer, the end of the tube—all as above—is placed in melting ice, and mercury added till the air occupies 273 mm. of the tube. It is then dipped into a flask of boiling water having a long neck. The column of air now increases to 373 mm. when the usual inferences may be drawn.—Prof. D. J. Cunningham then gave a magic-lantern demonstration of the development of the convolutions and fissures of the human brain

PARIS.

Academy of Sciences, February 5.—M. Lœwy in the chair.—On the propagation of sound against various resistances in a fluid, by M. J. Boussinesq. An analytical determination of the problem discussed in several recent communications.—On the propagation of electromagnetic waves, by M. Mascart. The mean speed of propagation is given as 302,850 km. rejecting the more doubtful results. No regular variation with the length of the waves is apparent.—On the theory of the satellites of Jupiter, by M. J. J Landerer.—On the temperature of the higher regions of the atmosphere, by M. Alfred Angot. A reply to a recent criticism by M. G. Hermite.—On the thermal value of the replacement of phenolic hydrogen in orcin, by M. de Forcrand. The heat of solution for 1 mol. of anhydrous orcin in 2 litres of water at 10° C. is − 2·64 Cal. The mean value for replacement of one atom of hydrogen by one atom of sodium is + 39·68 Cal., a number very near those given by other plenols.—On campholene, by M. Guerbet. The author obtains a 73 per cent. yield by distilling $C_{10}H_{17}ClO$ in presence of a trace of phosphoric anhydride. Campholene yields a a hydrocarbon

C_9H_{18} by reduction with HI at 280°. It boils at 132°–134° and has the sp. gr. 0·783 at 0°. It is saturated and very in ert; it yields trinitropseudocumene with difficulty when treated with fuming nitrosulphuric acid. It is identical with the hexahydropseudocumene obtained from Baku petroleum.—Attenuation of viper poison by heat and vaccination of the guinea-pig against this poison, by MM. C. Phisalix and G. Bertrand. The authors conclude that the toxic substances present in the poison of the viper include (1) a diastasic substance—echidnose; (2) a nerve poison—echidnotoxine. These are considerably modified if not destroyed by a temperature of 75°, and the product acquires vaccinating properties.—On the utilisation of ligneous products for the feeding of cattle, by M. Emile Mer.—Physiological observations on the kidney of the snail (*Helix pomatia*, L.), by M. Paul Girod. The snail possesses, in its urinary vesicule, a special alkaline gland which transforms the uric acid excreted by the kidney into sodium urate.—On the salivary glands of Hymenoptera, by M. Bordas.—On an aquatic stridulating Hemipteron, *Sigara minutissima*, L., by M. Ch. Bruyant.—On the relation between marine encroachments and the movements of the earth-crust, by M. A. de Grossouvre. The movements occurring in Europe during the secondary era are traced.—On the chances of obtaining artesian waters along the Wady Ighargar and the Wady Mya, by M. Georges Rolland.—On a possible relation between the frequency of storms and the position of the moon. A letter from M. A. Barrey pointing out the relation between the age of the moon and the frequency of storms in France, in which the possibility of a connection between the perturbations of the earth's path due to the moon and the frequency of storms is shown.

BERLIN.

Physiological Society, January 12.—Prof. du Bois Reymond, President, in the chair.—Dr. D. Hausemann, on the various forms of mitotic nuclear divisions, which he divided into two groups, pathological and physiological. The first kind he further divided into three classes, according to the behaviour of the chromosomata, viz. hyperchromatic, normochromatic, and hypochromatic, of which examples are found in carcinomata and sarcomata. He had also observed differences of the chromosomata in physiological cell division, according to the tissue from which they were taken.—Prof. Munk spoke on the tactile areas of the cerebral cortex, which he had found in the well-known motor areas, whereas other observers had located them either in the hippocampal convolution (Ferrier) or the gyrus fornicatus (Horsley and Schäfer), or in the parietal regions (many clinicians). The hippocampal convolution had been soon given up as the seat of the tactile areas for the skin. The speaker had shown that it is impossible to operate on the gyrus fornicatus, owing to its position, without injury to the motor regions, and since the localisation of the tactile areas for the skin in the motor regions of the brain can only be determined by extirpation of the latter, he regarded the experiments of Horsley and Schäfer as inconclusive. With regard to the parietal lobes, experiments on monkeys and dogs showed that its removal did not upset their tactile sensibility. It is important in these observations to discriminate sharply between touch, perception of contact, pressure, &c. and the general sense of pain. The perception of the cuticular sense is connected with the motor regions, and is permanently lost when these are destroyed, whereas, on the other hand, general sensibility can be done away with by many different injuries to the brain, but reappears after a short time. The temperature sense of the skin belongs to the sense organ, and is permanently destroyed by removal of the motor areas.

AMSTERDAM.

Royal Academy of Sciences, January 27.—Prof. van de Sande Bakhuyzen in the chair.—Messrs. Hoogewerff and van Dorp gave the results of their investigations on some derivatives of camphoric acid. They succeeded in isolating two camphoramic acids, which are formed according to the equations:

$$C_8H_{14}\left\langle\begin{array}{l}CO\\CO\end{array}\right\rangle O + 2NH_3 = C_8H_{14}\left\langle\begin{array}{l}CONH_2\\COONH_4\end{array}\right.$$

$$C_8H_{14}\left\langle\begin{array}{l}CO\\CO\end{array}\right\rangle NH + KHO = C_8H_{14}\left\langle\begin{array}{l}COOK\\CONH_2\end{array}\right. .$$

These substances are both derivatives of the same camphoric acid. The formation of these camphoramic acids was explained by the authors in the following way. Camphoric acid being dissymmetrical, the atom of oxygen, linking together the two groups of carbonyl in the camphoric anhydride, and also the group NH, linking together the two groups of carbonyl in the imide, will not be attracted with equal force by the two carbonyls. The carbonyl exerting the smallest attraction towards the O in the anhydride, will also exert the smallest attraction towards the NH in the imide. In the reactions, represented by the above equations, the rings in the anhydride and imide will therefore be opened in corresponding places, whereby two camphoramic acids must be formed.—Mr. Franchimont communicated a paper in his name and that of Mr. H. van Erp. The authors have compared the zinc and copper salts of the dinitromethylic acid of Frankland with the corresponding salts of the methylnitramine, because it seems that many chemists think the two bodies were identical. Treated with diluted sulphuric acid and ether, the methylnitramine salts yield the methylnitramine with the known properties; the salts of the dinitromethylic acid yield in the same manner an acid body, which melts ± 20° higher than the methylnitramine, and differs in form and solubility. The authors intend to investigate the chemical structure of the dinitromethylic acid.

BOOKS AND PAMPHLETS RECEIVED.

BOOKS.—The Mean Density of the Earth: Prof. J. H. Poynting (Griffin).—Economic Geology of the United States: R. S. Tarr (Macmillan).—Materials for the Study of Variation: W. Bateson (Macmillan).—The Theory of Heat: T. Preston (Macmillan).—Annuaire de' L'Observatoire Royale de Belgique, 1894: F. Folie (Bruxelles).—Faraday as a Discoverer: J. Tyndall, 5th edition (Longmans).—Statistique de la Production des Gites Metallifères: L. de Launay (Paris, Gauthier-Villars).—Construction du Navire: A. Croneau (Paris, Gauthier-Villars).—Tree Pruning: A. des Cars, translated by Prof. C. S. Sargent (Rider).—Practical Forestry: A. D. Webster (Rider).—Tobias Mayer's Sternverzeichniss (Leipzig, Engelmann).—Wood Working Positions, sheets 1 to 12 (large and small sizes): (Chapman and Hall).—Annuaire pour l'an 1894 publié par le Bureau des Longitudes (Paris, Gauthier-Villars).—Ostwald's Klassiker der Exakten Wissenschaften, Nrs. 43 and 45 (Leipzig, Engelmann).—Gestaltung und Vererbung: Dr. W. Haacke (Leipzig, Weigel).—Beni-Hasan: P. E. Newberry, part 2 (K. Paul).—Norwegian North Atlantic Expedition, 1876-8, xxii., Zoology, Ophiuroidea: J. A. Grieg (Low).

PAMPHLETS.—Scarlatina and Scarlatinal Sore Throat: Dr. A. K. Chalmers (Glasgow).—Researches on Matrices and Quaternions: Dr. Th. B. van Wettum (Leyden, Brill).—A Short History of Astronomy: G. Knight (Philip).

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