THURSDAY, OCTOBER 10, 1895.

LIEBIG.

Justus von Liebig: his Life and Work (1809-73). By W. A. Shenstone, F.I.C. (London: Cassell and Co., Limited, 1895.)

TO those who listened—it is now twenty years ago—to the Faraday Lecture given by the late Prof. Hofmann within the walls of the Royal Institution to the Fellows of the Chemical Society of London, or to those who have since read the report of this eloquent and enthusiastic discourse in the *Transactions* of the Chemical Society, the task of preparing a new account of the life and labours of Liebig would appear to be a very difficult one.

But to say merely that Mr. Shenstone has succeeded in this difficult task, would be scarcely to do justice to his admirable little volume, which has evidently been very carefully compiled, and which, while it possesses literary charm of its own, gives a clear and, at the same time, critical summary of the work and writings of the great chemist, which makes it, for popular reading at all events, preferable to Hofmann's brilliant lecture. Mr. Shenstone is evidently a master of exposition, and if in reading through the pages of his book the scientific man encounters one or two statements or expressions of opinion with which he cannot agree, he will be ready to condone these delinquencies in view of the generally excellent style of the whole. And notwithstanding the remark in the preface, that the object has been "not so much to dwell upon Liebig's private life as to tell what he was, what he did, and why all chemists and all those who are versed in the history of science admire and esteem him so greatly," the book, as a biographical sketch, is superior to the lecture. As pointed out by the author, it is quite true, and as remarkable as it is true, that few people nowadays, even among students of chemistry, know much about Liebig's scientific work and his services to the great departments of applied chemistry in physiology, medicine, and agriculture. Liebig's extract of meat, Liebig's potash bulbs, and Liebig's condenser are the only things which a present-day student can usually recall if asked to give an account of Liebig's work, and these he seems generally to regard as trivial inventions deserving of little remark. Liebig's life, cut short, as one would say in these days of general longevity, at the early age of threescore years and ten, was full of activity. The Royal Society Catalogue of Scientific Papers gives a list of upwards of three hundred papers published by him, of which some five-and-twenty were issued under joint authorship with Wöhler, his life-long friend and associate. And the *Annalen*, which to this day are familiarly referred to as "Liebig's," contain in the first 165 volumes issued during his lifetime all the long array of memoirs which embody the results of the researches of the master and his pupils.

Up to the age of sixteen, little promise of future greatness was given by the restless boy, at once "the plague of his teachers and the sorrow of his parents," as he was told by the Rector of the Gymnasium. This period of his life, marked chiefly by conflict with his schoolmasters, reminds one of Darwin's early days at Shrewsbury. And examples of this kind, of which many are now well known, fill one with wonder that the schoolmaster does not yet recognise the need for greater elasticity in the prevalent system of education.

The ideal schoolboy is an orderly machine, always obedient, receptive, submissive, ready in the cricket-field, and with real or simulated enthusiasm for football, despising all other games, and conservative to the backbone. He is the darling of the master, who sends him home with glowing reports and arms-full of prize-books. It seems never to occur to any one that there may be natures to which the classical languages and history make no appeal, who have not the gift of the mathematician, and who do not even care to play at cricket or football. If such appear in a public school they have a bad time of it, dragging out their miserable days at the bottom of the form, regarded as fools by the masters, and as muffs by the boys. And yet among these school failures there may be Liebigs or Darwins, or at any rate there may be, and commonly there is, the material out of which good and useful citizens are made, if only they had a chance to show what they can do.

It is not surprising that Germany should cherish the memory of Liebig, for to his example and influence she undoubtedly owes the development and activity of her chemical schools; and it is interesting to note the relative progress made by the chief European nations in this direction. In Liebig's youth the supremacy of the English and French chemists was unquestioned, Berzelius alone representing the science in Sweden. It was, as Liebig himself says, "a wretched time for chemistry in Germany."

Since that day things have greatly changed, the German laboratories have outnumbered those of England and France together, and their output of scientific results has so greatly exceeded the achievements of all other European countries as to have formed a subject of not undeserved reproach to the rest of them.

At the present time, however, things are not so bad, and there is great hope, from the renewed activity of the universities and technical schools in France and in England, as well as in other parts of Europe and in America during the last few years, that these other countries will in future contribute their full share to the work of experimental investigation and the encouragement of scientific education and thought.

It would be scarcely fair to the author of this "Life" to make any attempt to epitomise it, short and compact as it is. Those who are interested must read the book, and those who read it will certainly be interested. But the estimate formed by the author of the relative value and importance of the several kinds of service rendered by Liebig to the world, seems to be scarcely in agreement with that which is more generally current among chemists and physiologists. First in importance we should place Liebig's work in the domain of organic chemistry. Having shown how to analyse carbon compounds, he led the way in their investigation, and by the introduction of the theory of compound radicles laid the whole foundation of modern organic chemistry. Scarcely second in importance was the establishment of the system of practical teaching in the laboratory at Giessen, which certainly set an example soon followed by all the universities on the continent, and led to the erection of laboratories in England, not in the great universities, to their shame be it said, but at such places as University College, London, and the College of Chemistry.

Liebig's researches in connection with physiology and agriculture were of the utmost importance in their day, but chiefly by reason of the stimulus afforded to inquiry; for while the whole, or nearly the whole, of his chemical work remains as firmly established as ever, the greater part of his physiological theories in relation to plant nutrition, to fermentation, and to animal physiology, have been either superseded altogether, or so modified as to be no longer recognisable.

The author will probably see fit, on further reflection, to alter some of the views expressed in his own remarks; but enough has been said to show that Mr. Shenstone has made a contribution to the "Century Series" which will, we venture to think, be by no means the least attractive and interesting of these useful little volumes.

W. A. T.

THE SELECTION OF HEALTH RESORTS.

Climates and Baths of Great Britain. Vol. i. (London: Macmillan and Co., 1895.)

THIS work is the outcome of the report of a committee appointed by the Royal Medical and Chirurgical Society of London for the purpose of investigating questions of importance with reference to the climatology and balneology of Great Britain and Ireland.

The information contained in the volume—which deals with the climate of the south of England and with the chief medicinal springs of Great Britain—may be summarised as follows:—

(1) Information received from medical practitioners in the districts dealt with.

(2) The results of personal investigations by members of the committee.

(3) The analysis of published vital statistics of the localities in question.

That the treatment of the climatology of very small areas of these islands is a difficult and complex matter, is a fact patent to every one; it is every one's experience, for instance, that one side of a bay or headland, owing to its exposure, may be tonic and bracing, whereas the other side, owing to a different aspect, or to protection by high cliffs and woodland, may be warm and relaxing. But since meteorological data are of undoubted value in determining the suitability of an area for the residence of those suffering from various diseases, it is certain that some measure of the utility of the present work should be gauged from the detail and precision of these data; and the book will be found lacking in this respect. Little blame is attachable, however, to the contributors, who have in the majority of cases made the most of their available information; the fact is, we have not yet at hand sufficient data to enable a scientific work upon the climatic conditions of all the many small areas here dealt with to be penned; the records are so few, that it is very frequently found necessary to supplement instrumental observations by personal impressions. Thus we are constantly told that one place is *probably* colder than another, that it is thought to have more mist and moisture in the atmosphere, and so on; and one so frequently encounters such remarks as "there are no climatic records, but the impression is," &c., that the conviction is more and more borne home that it would have been well if the committee had first taken some steps, through medical men and others, to secure more scientific data before publishing the present volume. With rare exceptions, precise meteorological data are confined to towns and their immediate neighbourhood; and to show the difficulty with which the committee had to contend in the case of one important county (*i.e.* Somerset), it is sufficient to state that this county possesses at the present time only one station of the Royal Meteorological Society.

Then, again, atmospheric conditions and health are so largely the outcome of geological factors, that in a few instances it is matter for regret that this subject is not treated with a little more fulness; and in such a work one would expect to find some observations upon the mean height, and the extent of variation from the mean, in the ground-water level, knowing as we do the important bearing which this has upon health and disease.

So far as the information relates to the healthiness of the various areas treated of, and their suitability for residence by patients suffering from various diseases, much will be found of real value; but here again the contributors have had to face great difficulties—difficulties which in many respects are practically insurmountable; and here again the work presents some shortcomings. In making deductions from vital statistics, it would have been better and safer to have done so from as many returns as possible, and not to have rested satisfied, as in so many instances, with the actual records of just one brief year; and it would, moreover, have been more serviceable to those who would like to make their own deductions as to the relative advantages of different areas, if instead of the actual number of deaths being given, the rates of the more important diseases had been worked out for each locality. As it is, it would be a matter of no small labour to decide which of the many areas dealt with stands best with regard to *relative* immunity from any particular disease.

In the reports of local practitioners there is occasionally some evidence of the touch of a loving hand, the attractions and healthiness of the part being enthusiastically attested to; and for this reason, again, it will be no easy matter to conclude, from a perusal of the work, as to which is the most desirable spot to select; but at least one is not likely to fix upon Dartmoor, which an informant asserts has on an average 319 wet days in the year. Most of this local information, however, is very fair and impartial, and the conscientious and judicial manner in which conclusions are drawn by the different authors from the information at their hands is a striking feature of the work.

The committee points out that in a work comprising information of many sorts and from many sources, it is inevitable that a certain amount of error must have crept in; but as a matter of fact, the reader will discover scarcely any error of commission; what blemishes the work possesses are undoubtedly on the score of omission. There is one glaring instance of contradiction which we have noticed, and which will serve to present a good example, to the lay mind, of how doctors disagree. On

p. 38 we read, "The influence of sea air in causing anæmia is apparent on many parts of the coast," and on p. 47, "It may be stated that the infrequency of anæmia in the local inhabitants is no doubt due to their proximity to the Atlantic."

To instance the difficulty, which frequently presents itself, of arriving at just conclusions from the statistical information acquired by the committee, let us ask ourselves what inference may justly be drawn when the phthisis rate is high in certain health resorts. It is very properly pointed out that much of this excess is doubtless due to phthisical immigrants to a spot which is known to be congenial to phthisical patients. Quite true! But if we cannot ascertain *to what extent* the rate is influenced by phthisical immigration, how is one to know whether the local conditions, *per se*, are favourable or not to the disease in question? It is conceivable, in this relation, that certain limited areas of England with comparatively mild and equitable climates have now a native population strongly predisposed to phthisis, from the fact that their ancestors were originally phthisical immigrants attracted to the spot; so that even if it were practicable that the vital statistics of visitors could be separately compiled, the local and climatic advantages or disadvantages of the area in respect of this disease could never be put upon a scientific basis from vital returns alone. It is well known, moreover, that deductions drawn from meteorological data on the score of the suitability of the various areas for the residence of those suffering from different diseases, must be made with many reservations, that the subject does not admit of generalisations; for, *inter alia*, the suitability of the climates of certain health resorts for different patients is governed to such an extent by that wonderful personal factor that makes the same spot bracing to one and relaxing to another, benevolent to a certain disease in one and malignant to that disease in another, that frequently the individual can only arrive at the conclusion as to which area suits him best by an actual personal experiment. And thus it comes about that perhaps, after all, the surest lines upon which a physician can act, are in the main empirical as to his patient. We have lived long enough in these islands to know by experience which are the warmest, driest, and most sheltered spots, which are the dampest, and which are the most bracing and relaxing, and it is quite a question whether meteorological data will help the physician much farther. He will generally select for his patient what has been proved by the experience of many generations to be a congenial site, and nothing short of a cautious experiment with the patient himself will suffice to tell him which of several alternative sites suits his patient best; but to this end the experiences and views of other practicising physicians would be of immense value, and one is tempted to ask whether a work embodying and summarising as many as possible of these experiences would not serve even a more useful purpose than the first 500 pages of this book.

The chapters dealing with the medicinal waters of Great Britain are well written, useful, concise and impartial.

The committee hopes to deal in a further report with the climatology of the remaining districts, and with those mineral springs which are not included in the present volume.

OUR BOOK SHELF.

Abrégé de la Théorie des Fonctions Elliptiques. Par Charles Henry. 124 pp. (Paris: Nony, 1895.)

AN introductory course of elliptic functions, intended for those who have a fair acquaintance with integral calculus, should consist of three stages. In the first stage the subject would be approached as a development of integral calculus, the addition theorem and periodicity obtained, and a large number of applications made to problems whose solutions can be expressed in the notation of elliptic functions. Difficulties of the multiple interpretation of the square roots of variable functions would be pointed out, and left. In the second stage an elementary introduction to the modern descriptive theory of functions of a complex variable would be furnished, containing a fairly full account of the theory of doubly periodic functions, illustrated at every stage by examples from the functions whose existence has been foreshadowed in the first stage. The third stage would be a systematic development of the elliptic functions, with the help of the elementary theory of functions, finishing, not beginning, with the differential equation and the applications to integral calculus. Such a course would require at least twenty-five hour-lectures, and the unfamiliar character of the second and third stages would make a careful revision necessary.

The present little volume is concerned with the third stage; on the whole, there can be no doubt that it is the most suitable handbook which has yet appeared for the use of teachers engaged in such a course as sketched above. The elliptic functions are obtained by the infinite double series for $\wp(u)$; and certainly the idea is the right one, though it is easier to begin with the series for $\wp'(u)$. The differential equation is hence obtained, and the following chapter attempts to establish the functions on that basis. It seems preferable that this should be postponed, and treated only by Riemann's methods. Chapters iii. and iv. introduce the functions ζu and σu, as is quite proper; but it would seem much better that the addition equation, obtained in chapter v., should be obtained independently of the σ functions, and by Abel's method, with the help of a plane cubic curve. The functions $\sigma_1(u)$, $\sigma_2(u)$, $\sigma_3(u)$, are then obtained, and hence it is proved that the functions $\sqrt{\wp u - e_1}, \ldots$ are single-valued functions of u. It is a distinct step in the right direction to make the statement that these functions $\sqrt{\wp u - e_1}, \ldots$ are single-valued; but the fact ought to be obtained before, and independently of, the investigation of their actual values. The same remark holds in regard to the functions $cn\,u$, $dn\,u$; if $x = sn\,u$, it ought to be shown that $\sqrt{1-x^2}$ is single-valued before its actual value is obtained, and the remark emphasised by proving that such a function as $\sqrt{(1-sn\,u)(1-k\,sn\,u)}$ is equally a single-valued function of u. The fact, which is obtained, that all doubly periodic functions are rationally expressible by $\wp u$ and $\wp' u$, ought to be compared with the fact that all doubly periodic functions are rationally expressible by $sn\,u$ and $cn\,u\,dn\,u$; and it ought to be clearly seen that when we are dealing with Jacobi's functions, $cn\,u$ is no more a function of the same kind as $sn\,u$ than is $\sqrt{\wp u - e_1}$ of the same kind as $\wp u$ when we are dealing with Weierstrass's functions. In these two cases respectively, $cn\,u$ and $\sqrt{\wp u - e_1}$ are *factorial* functions, which ought to be carefully distinguished from the two fundamental functions whereby the algebraical irrationality under consideration is resolved.

With these criticisms, and the remark that the accounts of the transformation and of Jacobi's θ functions are not so full as one desires, we may conclude, strongly recommending all who desire a useful class book, to which, however, many explanations and illustrative examples must be supplied, to adopt the book. H. F. BAKER.

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.*]

Clausius' Virial Theorem.

THE question raised by Colonel Basevi, in NATURE for August 29, illustrates the importance of keeping in view a clear statement of what a general theorem such as that of Clausius with respect to the *virial* asserts, and the essential relativity of the forces which are regarded as acting on the particles, and of the kinetic energy of the system. The theorem asserts, I think, that if the motion of the system of particles be continued over any interval of time, t_1, the excess of the mean value of the kinetic energy of the system for that interval of time over the virial for the same interval is equal to the excess of the value of $\frac{1}{4t_1}\Sigma m\frac{d(\rho^2)}{dt}$ at the end of the interval over its value at the beginning, ρ being the distance of a specimen particle from the origin and m its mass, and the summation being extended over all the particles of the system.

It may be noticed here that the mean value of the kinetic energy of a system for an interval of time t_1 is equal to the *action* of the system for that interval taken per unit of the time in the interval.

There can be no doubt that the theorem is true, and will be verified by any test case to which it can be applied. The proof given by Clausius himself is perhaps the simplest, but the following mode of arriving at the theorem is instructive in some ways. Refer the particles to a system of rectangular axes in the ordinary way, and adopt the fluxional notation for velocities and accelerations. Thus taking a specimen particle, which is at the point x, y, z, at time t, regarding, as we are at liberty to do, the velocities $\dot{x}, \dot{y}, \dot{z}$, as functions of the position of the particle in the motion, we have

$$m\left(\dot{x}\frac{\partial\dot{x}}{\partial x} + \dot{y}\frac{\partial\dot{x}}{\partial y} + \dot{z}\frac{\partial\dot{x}}{\partial z}\right) = m\ddot{x} = \mathrm{X}$$

and two other equations for Y, Z, which can be written down from this by symmetry. Multiplying these equations by x, y, z respectively, adding, and rearranging, we easily find

$$\frac{m}{2}\left(\dot{x}^2 + \dot{y}^2 + \dot{z}^2\right)dt = -\tfrac{1}{2}\left(\mathrm{X}x + \mathrm{Y}y + \mathrm{Z}z\right)dt + \frac{m}{2}d\left(x\dot{x} + y\dot{y} + z\dot{z}\right).$$

Integrated from $t = 0$ to $t = t_1$, and extended to all the particles, this gives

$$\tfrac{1}{2}\Sigma m\int_0^{t_1}(\dot{x}^2 + \dot{y}^2 + \dot{z}^2)dt = -\tfrac{1}{2}\Sigma\int_0^{t_1}(\mathrm{X}x + \mathrm{Y}y + \mathrm{Z}z)dt + \tfrac{1}{2}\Big[\Sigma m(x\dot{x} + y\dot{y} + z\dot{z})\Big]_0^{t_1}.$$

The expression on the left [which may be written

$$\Sigma m\int(\dot{x}dx + \dot{y}dy + \dot{z}dz)]$$

is nowhere asserted, so far as I know, to be kinetic energy, but is the time-integral of the kinetic energy (that is the *action* of the system) for the time-interval t_1. Dividing both sides by t_1 we get the theorem as stated above, namely

$$\frac{1}{t_1}\int_0^{t_1}\mathrm{T}dt = -\frac{1}{2t_1}\Sigma\int_0^{t_1}(\mathrm{X}x + \mathrm{Y}y + \mathrm{Z}z)dt + \frac{1}{4t_1}\Big[\Sigma m\frac{d}{dt}(x^2 + y^2 + z^2)\Big]_0^{t_1},$$

where T denotes the kinetic energy of the system at the instant t.

It is clear that if t_1 be taken very great, and the velocity and the distance of each particle from the origin be always finite, the term on the left is neither infinite nor zero, while the last term on the right becomes vanishingly small. This is Clausius' case of "stationary motion," in which it is justifiable to write

$$\frac{1}{t_1}\int_0^{t_1}\mathrm{T}dt = -\frac{1}{2t_1}\Sigma\int_0^{t_1}(\mathrm{X}x + \mathrm{Y}y + \mathrm{Z}z)dt.$$

The expression on the right is the *virial*, and is in the circumstances stated undoubtedly equal to the time average or mean value of the kinetic energy, as the equation asserts.

If R be the force acting on a particle in the direction *towards* the origin along the line joining the origin with the particle, and ρ the distance of the particle from the origin, we have

$$\mathrm{X}x + \mathrm{Y}y + \mathrm{Z}z = -\mathrm{R}\rho,$$

and the theorem for stationary motion may be stated thus,

$$\text{Mean value of T} = \text{mean value of } \tfrac{1}{2}\Sigma\mathrm{R}\rho,$$

where the summation takes in each particle once, and once only.

Let us apply this to the case taken by Lord Rayleigh, and alleged by Colonel Basevi to contradict the theory, of two particles each of mass m, at a distance apart $r (= 2\rho)$, revolving round their common centre of gravity. Here, taking the origin at the common centre of gravity, we have constant values of the virial and of T, namely $\frac{1}{2}\Sigma\mathrm{R}\rho = \mathrm{R}\rho$ and $\mathrm{T} = m\mathrm{V}^2$. Thus, $m\mathrm{V}^2/\rho = \mathrm{R}$, which, as Lord Rayleigh remarks, agrees with the law of centrifugal force.

If we take the motion relatively to one of the two particles regarded as at rest, we get the same result. The relative velocity of the other particle becomes 2V, and the corresponding kinetic energy $2m\mathrm{V}^2$, the distance of the origin from the other particle 2ρ, and from itself zero. Since the acceleration of the moving particle relatively to the particle now supposed reduced to rest, is double its acceleration relatively to the common centre of gravity, the force now considered as acting on the moving particle must be taken as 2R. Thus we have $2m\mathrm{V}^2 = \frac{1}{2}2\mathrm{R} \times 2\rho$, or as before, $m\mathrm{V}^2/\rho = \mathrm{R}$.

If we do not suppose the origin to coincide with one of the particles reduced to rest in this manner, but to coincide for the moment with the *position* of one of the particles, the velocity of each particle is V, the force towards the origin on that distant from it r is R, and we have $\mathrm{T} = m\mathrm{V}^2$, $\frac{1}{2}\Sigma\mathrm{R}\rho = \frac{1}{2}\mathrm{R}r$, since now $\rho = r$. Hence once more $m\mathrm{V}^2/\rho = \mathrm{R}$.

Similarly, any other origin and axes of reference would give the same result. Colonel Basevi has, it seems to me, overlooked the fact that in the theorem it is the forces acting on each particle relatively to the assumed axes, and the corresponding motions that must be taken into account, and that in the case of a system of particles between which exist forces of mutual attraction, the stress between a given pair can only enter once into the value of $\frac{1}{2}\Sigma\mathrm{R}r$. A. GRAY.

Bangor, September 1.

I THINK the fort will not surrender at Colonel Basevi's summons. We have

$$m\frac{d}{dt}\left(x\frac{dx}{dt}\right) = mx\frac{d^2x}{dt^2} + m\left(\frac{dx}{dt}\right)^2;$$

and if we put $x = u$ and $\frac{dx}{dt} = v$, this may be written

$$m\frac{d}{dt}(uv) = mu\frac{dv}{dt} + mv\frac{du}{dt}$$

and

$$(uv)_t - (uv)_0 = \int_0^t u\frac{dv}{dt}dt + \int_0^t v\frac{du}{dt}dt = \int_0^t udv + \int_0^t vdu,$$

if you please so to write it. This corresponds to Colonel Basevi's equation, except that I have written v for his $\dot{x}$.

But now $m\int vdu$, or $m\int v\frac{du}{dt}dt$, *does* represent kinetic energy. And $-m\int_0^t udv$ or $-m\int_0^t x\frac{d^2x}{dt^2}dt$ is the virial. The equation shows that if for a certain time t, the right-hand member, vanishes, then on the average of that time t, the two terms on the right are equal and opposite.

The form $\Sigma\mathrm{R}r$ is a rather slippery one. If in the example which Colonel Basevi quotes from Lord Rayleigh, you put $\mathrm{X}x + \mathrm{Y}y$ for $\mathrm{R}r$, it comes out easily. For we may take for origin the centre of the circle of radius ρ. Then

$$\mathrm{X} = \frac{x}{\rho}f \quad \mathrm{Y} = \frac{y}{\rho}f \text{ and } \mathrm{X}x + \mathrm{Y}y = f\rho.$$

And therefore

$$\Sigma\tfrac{1}{2}mv^2 = \Sigma\tfrac{1}{2}mf\rho,$$

or

$$f = \frac{v^2}{\rho}.$$

S. H. BURBURY.

COLONEL BASEVI's criticisms of Clausius' virial theorem are not justifiable.

In the first place, the left-hand side of his equation at the foot of p. 413 should be $ux - [ux]_{t=0}$, since the latter term is not necessarily zero even for periodic motion; *e.g.* it equals 1 if $x = \exp. (\sin t)$.

In the next place, though this difference obviously vanishes for periodic motion when the "suitable value given to t" is a multiple of the period, yet for this *same* value of t the areas $\int udx$ and $\int xdu$ will *not* vanish; indeed for *no* value of t can the former vanish, as it represents $\int (dx/dt)^2 dt$, which is the sum of essentially positive quantities. Hence we can have but $\int udx = -\int xdu$ when $xu = [xu]_{t=0}$.

Thirdly, though in the case of stationary motion the areas $\int udx$ and $-\int xdu$ may not be exactly equal for any value of t, yet their difference can only fluctuate within certain narrow limits, so that when multiplied by $m/2t$ it becomes vanishingly small if t is large enough, which is all that Clausius asserts.

Fourthly, Clausius does *not* take $m\int udx$ to represent kinetic energy, but this expression divided by $2t$.

Fifthly, the fact is overlooked that R refers, not to single particles, but to *pairs* of particles; so that in Lord Rayleigh's case, $\frac{1}{2}\Sigma Rr = \frac{1}{2}Rr$, and not Rr, as asserted, there being only *one* pair of particles in question, and the virial equation *does* therefore give $R = mv^2/\rho$, the ordinary law of force for uniform circular motion.

Lastly, there is no ground whatever for taking $\frac{3}{2}Vr$ and $\frac{1}{2}\Sigma Rr$ as equal terms, there being absolutely no connection between them except that both represent energy; indeed, by this assumption Colonel Basevi obtains a formula which gives for the pressure in an ideal gas only half its proper value.

Christ Church, Oxford. ROBERT E. BAYNES.

Hutton's "Theory of the Earth."

IT is to be doubted whether any work, with the exception of Lyell's "Principles," has had a more important influence on the science of geology than Hutton's "Theory of the Earth," in which for the first time the true mode of studying the science was set forth and its fundamental facts outlined.

The theory was first propounded in a paper of some ninety-five pages, written in 1785, which appeared in 1788 in the first volume of the *Transactions* of the Royal Society of Edinburgh, and was at once attacked by a number of hostile critics.

Ten years later, in 1795, it was republished in Edinburgh, greatly extended, and including the results of much additional work, in two good-sized octavo volumes. These included the substance of a number of papers published by Hutton after the appearance of the first outline, as well as answers to his various critics, and is the work which has become a classic in the science.

The work, however, in its published form is evidently incomplete, for on the title-page it is stated to consist of four parts, and, in the table of contents, volume i. is called part i. and volume ii. part ii. Volume ii., furthermore, concludes abruptly with the following words: "Therefore in pursuing this object, I am next to examine facts, with regard to the mineral part of the theory . . . and endeavour to answer objections or solve difficulties which may naturally occur from the consideration of particular appearances."

Parts iii. and iv., so far as I can ascertain, if written, were never published. In the library of the Geological Society of London, however, there is a manuscript of Hutton's which is apparently a portion of one or other of these parts. It is bound in book form, and was presented to the library by Leonhard Horner, Esq., and in a note by that gentleman, presenting it to the Society, it is stated to be one of a series, and to have been given by Dr. Playfair, the populariser of Hutton's work, to Lord Webb Seymour, and on the death of this nobleman to have passed to the Duke of Somerset, who gave it to Mr. Horner. It bears no title, and consists of six chapters numbered from iv. to ix., and was evidently continued in another manuscript, as the last page, forming the conclusion of chapter ix., bears the words "chapter x." at the lower corner.

The manuscript treats chiefly of a subject the investigation of which has been so prolific of results in recent years, namely granite contacts, and especially the contact of granite masses with "schistus." He shows that the granite was not a "primitive" rock on which the schist was deposited, but that it was intruded through the latter in a molten condition, and holds that it was the agent by which mountain-chains were upheaved, supporting his proposition by a description of the relations of these rocks in various parts of Scotland and elsewhere, among them the Island of Arran. To the description of this last-mentioned locality a whole chapter is devoted, in which the true nature of the pitch-stones is also set forth, and the derivation of the felsites from them by a process of dentrification is recognised.

It is merely desired in the present letter to draw attention to the fact that at least some other volumes of this manuscript are extant, and to urge upon those who may know where they might be sought, or who may by chance come upon them, the importance of preserving them, and of placing them, if not in the Geological Society's library with the fragment above referred to, at least in some library where they may be at once secure and available for use.

The book is one of the most remarkable which has appeared in the history of geological science, and all who are interested in the science must desire to see it secured and preserved in its completed form. FRANK D. ADAMS.

McGill University, Montreal.

Abnormal Atlantic Waves.

IT happens that I have only quite lately seen a letter on this subject in NATURE of March 7, from Mr. E. C. Stromeyer of Glasgow. It may perhaps be of interest to some of your readers to learn that on January 6, 1891, and about 4 p.m., the people of Funchal, the chief town of Madeira, and situate on the south coast (lat. 32° 37′ 45″ N., long. 16° 55′ 20″ W.) were astonished by the arrival of a great wave which burst with violence on the shore, coming seemingly from the S.E. or E.S.E. The sea had been calm previously, and the wind was light. At Machico, a village some fifteen miles to the east of Funchal, a similar phenomenon took place contemporaneously, and also at Camara de Lobos, a village about six miles to the west. At the latter place, where there is a small bay amongst the rocks, there were three risings of the sea, one much higher than the others. The bottom of the bay was laid bare, and fishes were seen struggling in the mud. The boats lying on the beach were more or less damaged, but I did not hear that other property was injured.

Two electric cables belonging to the Brazilian Submarine Telegraph Company connect Funchal with Lisbon. Now, it is worth noting that early on the morning after the occurrence of the great wave, when the Company's officials stationed at Funchal went as usual to test the cables, one of them was found to be broken in deep water at a distance of seventeen or eighteen miles to the south of Madeira, whilst the other cable was in good working order. It is an unsolved question whether the same cause that produced the great wave had also broken the cable, or whether the two events were simply coincident but due to independent causes.

Slight shocks of earthquake are felt at distant intervals at Madeira, but no seismic disturbance was noticed near the date of the great wave.

As the wave came from the southwards, I asked a friend to make inquiry at Tenerife whether anything of the sort had been experienced there. The reply was that nothing extraordinary had occurred on January 6 at Santa Cruz on the south coast of that island. At Puerto Orotava, on the north coast, there was bright weather at the time, with light winds, and no wave had occurred, nor had any earthquake been felt.

JAMES YATE JOHNSON.

Funchal, Madeira, September 17.

Leaf-absorption.

A FEW weeks ago I threw some cuttings of the common Privet (*Ligustrum vulgare*) on the borders in the garden. Of these cuttings some perished, while the remainder were drawn into the soil by the worms, some with the cut end downwards, some only by a single leaf, leaving all the rest of the cutting *en* *plein air.* These latter are, at the end of this time, all as fresh and healthily green as they were at the moment of cutting off the parent plant, notwithstanding the very hot weather we have recently experienced. It seems to me that this is a clear proof that the *rôle* of leaves is to *absorb* as well as *evaporate*, a point on which much doubt has often been expressed. G. PAUL.

Harrogate, September 29.

IT has been proved over and over again, and it is easy to prove, that the leaves of some plants, though probably not of all, are capable, under certain conditions—usually abnormal conditions—of absorbing aqueous vapour or fluid water; but this action can hardly be regarded as a function, though I am not prepared to say that absorption of moisture by leaves is in no case a part of the every-day life of a plant. The return to turgidity of the leaves of a plant during the night is, however, in a general way, due, doubtless, to reduced transpiration, rather than absorption from the atmosphere. Yet in the absence of a counteracting current of water from the roots, the leaves of some plants, especially of those inhabiting almost rainless regions, but where the air sometimes reaches almost complete saturation, absorb moisture. At least, so it is asserted. With regard to absorption by detached leaves, or by leaves of detached branches, the development of the action depends, apart from other circumstances, on the amount of vital energy left; and this is determined, to a great extent, by age. The common Privet is a shrub of extraordinary vitality, rare in our native vegetation. I hardly need add that proof of leaves being able to absorb water may be had by inserting withered leaves in water by their upper halves, leaving the stalk out. If not too old, or too much dried, the whole leaves will regain turgidity, though the process may be a slow one.

W. BOTTING HEMSLEY.

Tertiary Fossil Ants in the Isle of Wight.

IN a paper published in NATURE for August 22, p. 399, by Prof. C. Emery, on "The Origin of European and North American Ants," the author states that "the Sicilian amber of Miocene age contains genera which belong to the actual Indian and Australian fauna, while the Baltic amber contains the genera Formica, Lasius, and Myrmica." In the Bembridge limestone in the Isle of Wight, of Eocene age, the same as the Baltic amber, the following genera occur: Formica, Myrmica, and Camponotus, and some others not yet described. In my collection there are a large number of these Hymenoptera, generally well preserved, and seem to be more numerous than any of the other insects from the same beds. It is only of late years that any number of insects have been met with in the British tertiaries, and it is well to record the two genera referred to Formica and Myrmica, being found both in the Baltic amber and Bembridge limestone. Among the numerous fossil insects in my possession from the Lias, no trace of any ants has been observed, and it seems that they did not come into existence until the later Tertiary epoch. P. B. BRODIE.

THE NORMAL SCHOOL AT PARIS.

IN connection with the celebrations of the centenary of the foundation of the École Normale in Paris, referred to at the time in these columns (vol. li. p. 613), a ponderous tome has been published[1] containing the complete history of the school, and details concerning the most renowned of its alumni. Opportunity is thus afforded of giving a sketch of the development of a school which has played an important part in the history of education for nearly a century, and which has been the training college of many of the most distinguished Professors in France.

The most elaborate article in the volume is a detailed history, by M. Paul Dupuy, on "L'École Normale de l'an III." That article has furnished the particulars with reference to the early history of the school given in this contribution.

When the Convention of the 9th Brumaire, An. III. (October 30, 1794), passed the decree to which the Normal School owes its foundation, it realised an idea which had occupied the attention of the University and Parliament for many years. So far back as 1645 the University of Paris considered a proposal by the rector, Dumonstier, to provide the means for the education of teachers and principals. After the expulsion of the Jesuits in 1761, the Parliament of Paris began to carry out the idea by instituting fellowships and uniting at Louis-le-Grand the scholars of the small colleges of the University. At the time when Parliament was taking these steps, Barletti de Saint-Paul was forming a training school for teachers, in which his principles of personal pedagogy were taught; and Bernardin de Saint-Pierre pleaded for a college of instruction. "J'admire avec étonnement," he wrote in 1789, "que tous les arts ont parmi nous leur apprentissage, excepté le plus difficile de tous, celui de former les hommes." To the influence which these educational reformers had in bringing the matter before the Government of the Revolution must be added the impulse derived from Germany, through Alsace. Alsace was then the only province of France able to furnish ideas and models for popular instruction. It had been touched by the great pedagogic movement in Germany, and its great influence upon the three Revolutionary Assemblies makes it prominent in the history of the Normal School.

Practically every part of the educational system of France owes its development to the Republic. The Committee of Public Welfare early concerned itself with the question of national education, and Commissions were appointed to report upon the best means for developing an educational system. In 1793 a plan was put forward to establish normal schools for the training of teachers. Nothing definite was formulated, however, with reference to the Normal School until September 1794, when the Committee of Public Instruction adopted a series of articles, the first of which was to the effect that "there should be established, at Paris, a Normal School, where instruction in the art of teaching science should be given to persons already possessing scientific knowledge." At the end of the following month, the National Convention, after a discussion of the scheme and the subjects to be taught, passed a law for the establishment of Écoles normales. The idea was to establish these schools in various parts of France, but it was not then realised, and the Normal School at Paris is the only one that owes its existence directly to the law of the Convention. Referring to the designation of the schools, an official note reads: "The word *normal*, which has been applied to the schools newly decreed, is taken from geometry. It expresses really the perpendicular or level. In the sense employed in this case it announces that all knowledge belonging to science, to the arts, to belles-lettres, &c., will there be taught, and taught to all equally." Science was thus placed upon the same footing as the humanities. The methods and results of investigation were not to be known to a few, but were to be taught by the most eminent men it was possible to obtain. The first programme of the courses and professors shows the scope of the instruction given.

Subjects.	Professors.
Mathematics	Lagrange and Laplace.
Physics	Haüy.
Descriptive Geometry	Monge.
Natural History	Daubenton.
Chemistry	Berthollet.
Agriculture	Thouin.
Geography	Buache and Mentelle.
History	Volney.
Morals	Bernardin de St. Pierre.
Grammar	Sicard.
Analysis of the Understanding ...	Garat.
Literature	La Harpe.

A glance at this list will show that the professors were selected on account of their eminence in different

[1] "Le Centenaire de l'École Normale." (Paris: Hachette et Cie.)

branches of knowledge rather than for purely pedagogic ability, though the object for which the school was founded was to instruct teachers in the principles of their profession. Berthollet was the only one of the professors of science who paid any serious attention to that subject in the official programme issued to the students; his colleagues confined themselves to purely scientific matters. Methods of research appear to have formed the subjects of the lectures rather than methods of exposition and education; Lagrange and Laplace made this plain in the following announcement of their courses: "To present the most important discoveries that have been made in the domain of science, to develop the principles underlying them; to notice the acute and valuable ideas which gave birth to them; to indicate the most direct road to discovery, and the best sources where details can be obtained; to show what is still to be done, and the steps it is necessary to take; these are the objects of the Normal School, and it is from this point of view that mathematics will be taught."

On January 21, 1795, the lectures commenced at the Museum d'histoire naturelle, the amphitheatre of which had just been completed, and which was given up provisionally to the Normal School. In the presence of a large assembly, Lakanal read the decree establishing the school, and was followed by Laplace, Haüy, and Monge, each of whom read their programmes, and indicated the lines they intended to follow. But the excited state of France during this period was such that the students could not be properly disciplined. Political petitions and manifestos frequently emanated from the school, and there appears to have been an almost entire want of organisation. The excessive petulance of the students showed itself during the lectures, and especially in debates after the lectures, the subjects of which were freely discussed and criticised, to the frequent embarrassment of the professors. Eventually the debates were suppressed in the case of the science lectures. Haüy substituted the debates by laboratory work, and the professors of mathematics instituted debating societies to be managed entirely by the students, who were to mutually assist one another. These conferences were only organised for mathematics, and they appear to have been installed at the College de France, where they were held every day. The "conference" system of education is a legacy from the Normal School of the year III. of the National Convention; to that school is also largely due the place which science now occupies in the French system of education; letters and science were taught by men of equal high rank and authority, and the students selected either branch of knowledge, according to their inclinations and natural gifts. The students at the school were drawn from all parts of France, and maintained by the Republic. But the national exchequer at the time could not stand any extra drain upon its impoverished resources. It is, therefore, no matter of surprise that when the courses ended in May 1795, the school was closed.

In spite of its imperfections, the School of the Convention exerted great and beneficial influence upon the French nation. Biot, in his history of science during the French Revolution, compares the school to a "vast luminous column which rose so high from the middle of a desolate land that its great brilliancy covered France and enlightened the future." And, speaking at the Paris Academy of Sciences in 1833, Arago said, with reference to the school, "It was always necessary to go back to the École normale to find the first public instruction in descriptive geometry. From that school the instruction passed, almost without modifications, to the École polytechnique. From the École normale also dates a veritable revolution in the study of pure mathematics. The demonstrations, methods, and important theories hidden in academic collections, were for the first time presented to students, and encouraged them to rebuild, on new bases, the works intended for education." Arago thus showed that, through the Normal School, science gained the right of an important place in public education. He insisted upon another point none the less important, viz. that at the Normal School, for the first time, at least officially, public education was given by the first men of intellect in the country. "With some rare exceptions, scientific investigators at one time formed in France a class totally distinct from that of the professors. By bringing the first geometers, the first physicists, the first naturalists into the professoriate, the Convention endowed the educational functions with unusual advantages, the fortunate results of which are still felt. In the eyes of the public, the school that bore the names of Lagrange, Laplace, Monge, and Berthollet could claim equality with the highest places of instruction." The first Normal School, in fact, in spite of its brief existence, founded a tradition which was preserved during the Restoration, and under the second Empire, and which has had a decisive influence upon the history of education in France. For this reason, M. Dupuy is justified in concluding his detailed history of the School of the Convention with the words: "The centenary that the École normale has celebrated this year is therefore more than the centenary of its name; it is that of the institution itself under its first form."

The second stage in the history of the Normal School began in 1808 (that is, four years after Napoleon had changed France into an Empire), with an Imperial decree establishing "un pensionnat normal, destiné à recevoir jusqu'á trois cents jeunes gens qui y seront formés à l'art d'enseigner les lettres et les sciences." This decree extending the organisation of the French University, created two years before, founded definitely the present school. Before students were permitted to enter the school, they had to agree to remain in the teaching profession at least ten years. They attended classes at the Collège de France, the École polytechnique, and the Museum d'histoire naturelle, according to whether they intended to instruct in letters, or in different branches of science. An annual grant of three hundred thousand francs (£12,000) was voted for the expenses of the school. The regulations were based upon those of the colleges of the old university, so the students were prevented from taking part in the affairs of the political world. This organisation, however, did not last long; for in 1814 there came the entrance of France by the Allies, the abdication of Napoleon, and the tragic hundred days, all of which, with later events, had their effects upon the school. Louis XVIII. proposed to change the organisations of the school and university, and a decree with this end in view was passed in February 1815. But when Napoleon returned from Elbe, a few days later, he entirely suppressed the new regulations, and re-established the Imperial University in accordance with the decree of 1808. And when the Empire finally fell, the ministers of Louis XVIII. abandoned the idea of changing the organisation, and themselves supported the Imperial system. The school existed up to 1822 under these rules, when it was decided that its place should be taken by Écoles normales partielles. Four years later the school was re-established, but in order not to excite memories of the Revolution and the Empire, it was named the "École préparatoire." Only in the name did this school differ from the old Normal School, and even that was restored by Louis Phillippe, Duke of Orleans, who, in August 1830, shortly after he became King of the French, issued an order that "the school devoted to the education of professors, and for some years carried on under the name of École préparatoire, is to reassume the title of École normale." A little later, the school was organised on the lines upon which the studies are carried there to-day. The duration of the course of study, which in the École préparatoire had been two years, was definitely fixed at three years, and the sections of science and letters were more clearly separated than they had ever been before. After studying together during the first year, the science students, during the second and the third years, were arranged into two divisions, one of the physical and mathematical sciences, the other of natural sciences, the chemists being classified with the naturalists. In the second year the mathematicians and physicists had a few courses in common with the chemists and naturalists, but during the third year were kept altogether distinct.

The Government of Louis Philippe, which, in a way, established the fundamental system of primary instruction in France, gave the Normal School a firm standing by instituting competition and new classes; it also took steps to provide proper accommodation for the students. The buildings of the Plessis, where the studies were conducted, were falling to pieces, and it was recognised that new ones would have to be provided. In 1838 the site in the rue d'Ulm, now occupied by the school, was chosen; the plans were prepared, and money required to execute them was voted in the spring of 1841.

But six years passed before the work was done, and it was not until 1847 that the school was transferred to its new domicile, and the title of "École normal supérieure" was inscribed over the door. M. de Salvandy presided over the opening ceremony, and the director of studies, Dubois, who succeeded Cousin in 1840, read a summary of the history of the school. From that time until 1848, when Louis Napoleon became President of the French Republic, no change of importance occurred. The first event which, of the whole of the religious reactions favoured by the future Emperor of the French, foreshadowed rigorous changes in the school's regulations, was the substitution of M. Dubois by M. Michelle, rector of the Besançon Academy, in July 1850. The new director took the rank of inspector-general, and the school ceased to be represented upon the Council of the University. A year later, M. Vacherot, the director of studies, followed Dubois, and then M. Jules Simon, whose lectures were suspended at the end of 1851, resigned his connection with the school. The idea of suppressing the school altogether was afterwards seriously considered, but fortunately it was not carried into execution. Attempts were made to limit the freedom with which subjects were dealt, and, for a time, Protestants and Jews were refused admission. A better period commenced in 1857, when Nisard succeeded Michelle as the director of the school, and Pasteur became the director of scientific studies. Five science Fellowships were created in the following year, and the holders of them carried on researches under Henri Saint-Clair Deville and Pasteur, whose investigations increased the school's reputation.

After the affairs of 1870, which deposed Louis Napoleon and established the third Republic, Bersot was nominated director of the school by Jules Simon, and occupied that position until 1880. Under him, the constitution of the school was sustained, and brought back to what it was under the direction of Cousin and of Dubois. Bersot died in 1880, and the fifteen years that have elapsed since his death form the last period in the eventful history of the Normal School. M. Fustel de Coulanges was the director from 1880 to 1883, and since then the present director, M. Georges Perrot, has occupied that position. In 1880 a section of natural sciences was re-established, and this, with other improvements in the internal organisation, has assisted the school to the high place it now occupies.

The second part of the volume, from which many of the foregoing details were obtained, is taken up with biographies of the directors (each accompanied by a fine photogravure of the subject) and of papers referring to the men who have helped to develop the different departments of the school. Passing over the former section, we arrive at an account of the mathematical work at the school, by M. Jules Tannery. The high standing of this department may be judged by the fact that, of the six members of the Section of Geometry of the Paris Academy of Sciences, three belong to the Normal School. The Section of Astronomy contains two old students—one the present Director of the Paris Observatory. The school has contributed to this Academy the names of Pouillet, Delafosse, Pasteur, Jamin, V. Puiseux, P. Desains, Bouquet, Van Tieghem, Debray, Hébert, Tisserand, Fouqué, Wolf, Darboux, Troost, Mascart, Lippmann, Duclaux, Picard, Appel, and Perrier. M. Bertrand, the eminent Perpetual Secretary of the Academy, was one of the first among the illustrious men who have made the school what it is, and encouraged its students to scientific investigation. After him, Cauchy dominated mathematical education at the school. Hermite, Puiseux, Briot, and Bouquet were the close friends and disciples of this profound geometrician, who, during the early part of this century, gave mathematical science so great an impetus. Of these, only Hermite survives, and he celebrated his jubilee a few months ago. Among those who benefited by Hermite's instruction and counsel stand out the names of Baillaud, Charve, Floquet, and Pellet. Appel, Picard, and Goursat are among other students who have brought credit to their *alma mater*.

Verdet, whose electrical and optical researches are known to every physicist, became maître de conférences, that is, professor, of physics in 1848, and held that position until 1866. Mascart succeeded him for a few months, and was followed by Bertin-Mourot, who remained at the head of the physical department until 1884, since which year MM. Violle, Bouty, and Brillonin have filled the post.

Of all the teachers that the school has had, none have exercised greater influence upon it than Saint-Claire Deville. For thirty years he devoted his activities to the advancement of science at the school and to the welfare of his students. He succeeded Balard in 1851 as maître de conférences in the section of chemistry, and at once commenced to reorganise the work and develop research. His advice to students who looked to books to supply them with subjects of investigation, was: "Fermez bien vite tous les liveres, venez au laboratoire, passez-y toute la journée, faites-y n'importe quoi, reprenez par exemple minutilusement un travail classique; vous êtes intelligent, vous ne tarderez pas à trouvez quelque résultat interressant." His numerous pupils profited by his invitation to work whenever possible in the laboratory, and many of them became his collaborators. Among these occur the names of Debray, Troost, Fouqué, Fernet, Lamy, Lechartier, Mascart, Isambert, Ditte, Joly, André, Angot, Dufet, Margottet, Chappuis, Parmentier, all of whom have advanced scientific instruction and research in France. Henri Deville never refused an investigator access to his laboratory, no matter what line of work was taken up, and the result was that not only chemists, but students of natural history, astronomy, and even an alchemist, availed themselves of the opportunity. After devoting the activities of a lifetime to science, Henri Deville died in July 1881, and by his death France lost one of its brightest lights.

Debray held a Fellowship at the Normal School when Henri Deville became the maître de conférences, and the two great investigators worked side by side for thirty years. He entered the school in 1847, and succeeded his master as professor at the Sorbonne and as maître de conférences at the school in 1875. He died in June 1888. Chemistry is at present under the charge of MM. Gernez and Joly.

The department of natural science in the school was established in 1880. The school had not existed until then, however, without paying any attention to the study of that division of scientific knowledge. M. Delafosse was maître de conférences of zoology, botany, geology, and mineralogy so far back as 1827, and among the naturalists who taught one or other of the subjects before the new section was created were Hébert, Lory, Fouqué, Van Tieghém, Dastre, Perriér, Cornu, Giard, Le Monnier, and Bonnier. The feature of the instruction now given is the large attention paid to field work. Frequent geological, botanical and zoological excursions are made under the charge of the professors, both during the school year and the holidays. At the marine biological stations, holiday courses are always offered. Owing to the labours of Prof. de Lacaze-Duthiers, biological laboratories have been established at various points on the French coast. Since 1881, many students of the Normal School have worked at the stations at Roscoff, Banyuls, Concarneau, Wimereux, and Saint-Waast, and the knowledge they have thus gained from nature herself is far in advance of that received through lectures or from books.

Pasteur's connection with the school has a melancholy interest at the present time. Before he left the Faculty of Sciences at Lille, to become administrator and director of studies, he had made his important researches on the tartrates of soda and ammonia, and had commenced the study of fermentation. He therefore wanted a laboratory in which to continue his researches, but the school could not at the time offer him one. After a little difficulty, one small room, about ten feet square, was obtained, and in that restricted space he made some of his most valuable discoveries. This accommodation however, was gradually increased. In 1862 a large room was expressly constructed for Pasteur's work, and was added to from time to time as the value of the researches carried on came to be recognised. Finally, it was impossible for him to carry on his extensive researches under the hospitable roof in the rue d'Ulm, and he had to remove to a larger building. A few years later his work for science and humanity was recognised by the construction, at a cost of more than £100,000, raised by international subscription, of the Pasteur Institute in Paris, where the results of his researches are daily applied, and where the remains of the great investigator will finally rest.

The valuable *Annales d'École Normale* owe their commencement to M. Pasteur. The journal was first issued in 1864, and many important memoirs by members of the teaching staff, and by students, have appeared in it. Pasteur was editor from 1864 to 1870, and was succeeded by Henri Deville, who held the position until 1881, though the publication must have entailed pecuniary loss. Finally, the *Annales* were placed upon a firm footing by M. Zevort, Director of Secondary Education, who twelve years ago increased the subscription list by providing for the introduction of the journal into a number of *lycées*, and since then the assistance thus rendered has been continued by succeeding Directors of Higher and Secondary Education. M. Debray held the editorship of the *Annales* from 1882 to 1888, and M. Hermite now edits it, with an editorial committee comprising many of the most eminent men of science in France.

Many other names, in addition to those already mentioned, have contributed to the glory of the school. The work of Galois, for instance, whose short life ended in 1832, while still a student at the school, has had great influence upon the development of mathematics.

In the early part of this century, little attention was paid to astronomy at the Normal School. The mathematicians there produced a number of important memoirs on celestial mechanics, and made astronomical tables, but practical astronomy was entirely neglected. When Le Verrier became director of the Paris Observatory, he obtained permission for a limited number of students to work at the Observatory while still retaining their position in the school. Victor Puiseux and Paul Desains were the two first students selected, and they were succeeded by Paul Serret and Marié-Davy. Le Verrier thus opened a new career for students at the school, and the way they availed themselves of it is shown by the fact, that, in 1866, there were as many as fifteen of them upon the Observatory staff. Among the names of astronomers who were students at the school, are MM. Tisserand, Rayet, André, Angot, Stéphan, Simon, and Voigt; and at one time or another the school has provided directors for all the State observatories in France.

What more need be said? The names and works of the school's alumni are known and honoured throughout the scientific world, and that is sufficient testimony to the character of the instruction. The French Government is generous in its treatment of the school, but the expenditure is returned increased a hundredfold through the works of the students. And not only do these works benefit the Republic; they have an international value. Therefore the centenary which the school celebrated this year, interests all who are concerned with the advancement of natural knowledge.

R. A. GREGORY.

THE "GEMMI" DISASTER.

A MONTH ago, the Swiss newspapers were full of various accounts of a destructive avalanche which took place at the Gemmi on September 11, at 4 a.m. The first report read as follows: "A large part of the Altels glacier got loose and slipped down, covering three kilometres of ground on the Spital Alp, two hours' walk above Kandersteg. Men (6) and cattle (300) have been killed by the slipped mass. The break across the glacier may be seen from the valley with the naked eye. Help has been sent up from the villages of Leuk, Kandersteg, and Frutigen." (*Allg. Schw. Ztg.*, September 12.) More correct details afterwards decreased the loss of cattle by about one half, and the whole damage is estimated at from 60,000 to 80,000 francs.

The part concerned will be perfectly familiar to many English travellers. Few foot-tourists in Switzerland miss the Pass of the Gemmi, which bridges the beautiful limestone mountains between Canton Bern and Canton Wallis at their western end. The tourist coming from the North leaves the broad Aare Valley of Canton Bern and its lakes at Thun, and ascends gradually through the lateral Kander Valley towards the glaciated chain of the Diablerets, Oldenhorn, Wildstrübel and Altels on the southern horizon. The characteristic group of snowy summits known as the Blümlis Alp closes in the south-eastern. The valley itself is bestrewn with gigantic remnants of old mountain-slips, now clad with fir-tree and a rich flora. At Kandersteg it narrows, long moraines fringe the mountains, and the driving-road is left for a a steep winding footpath which climbs the mountain-sides beneath the shade of densely-grown larch and fir. The main stream hurls over rocky escarp and raves in deep ravine. A sudden opening in the wood discloses the tributary stream of the Gastern, its grey cliffs, and tumbling waterfalls; surely one of the most picturesque glens in the Alps!

Immediately beyond this point of view, the path descends slightly for a short distance and bends round the base of a wooded hill, known as the *Stierenbergli*, before it once more rises to the mountain pasturage and châlets of the *Spital*. Here, the sound of cow-bells rings over a grassy river-flat, hemmed in east and west by mountain ridges, northward by a thick tongue of moraine. Only one steep, narrow passage defiles the northern rocks and marks the contact of the Altels range with the moraine tongue. A dammed-up lake basin, often dry in summer, lies on the other side of the moraine where the road leads to the cosily-sheltered Schwarenbach Inn. Three-quarters of an hour's farther walk on rocky shelving ground takes the tourist past the Daubensee to the height of the Gemmi Pass and the Hotel.

Such was the walk to the Gemmi before the avalanche occurred. Now the broad pasturage flat, the narrow defile above it to the Schwarenbach Inn, as well as several passages of the road below, especially the "Stierenbergli," lie beneath masses of ruin and disorder. Fir-slopes have been felled at one blow. Dismembered parts of cattle have been floated hither, thither, in the ice-stream. What makes it the sadder is that all had been in readiness on the Spital Alp for the departure of the herd-boys and cattle on the following day to their villages in Wallis.

Although the cause of the disaster was the fall of the ice-mass, it must not be forgotten that the actual destructive force is the wind-pressure ("Windschlag") in advance of the falling mass. Living things and timber are flailed to the ground, or borne to considerable distances. The mass of ice then buries all beneath tons of weight, and transports still farther, tearing and breaking whatever it carries.

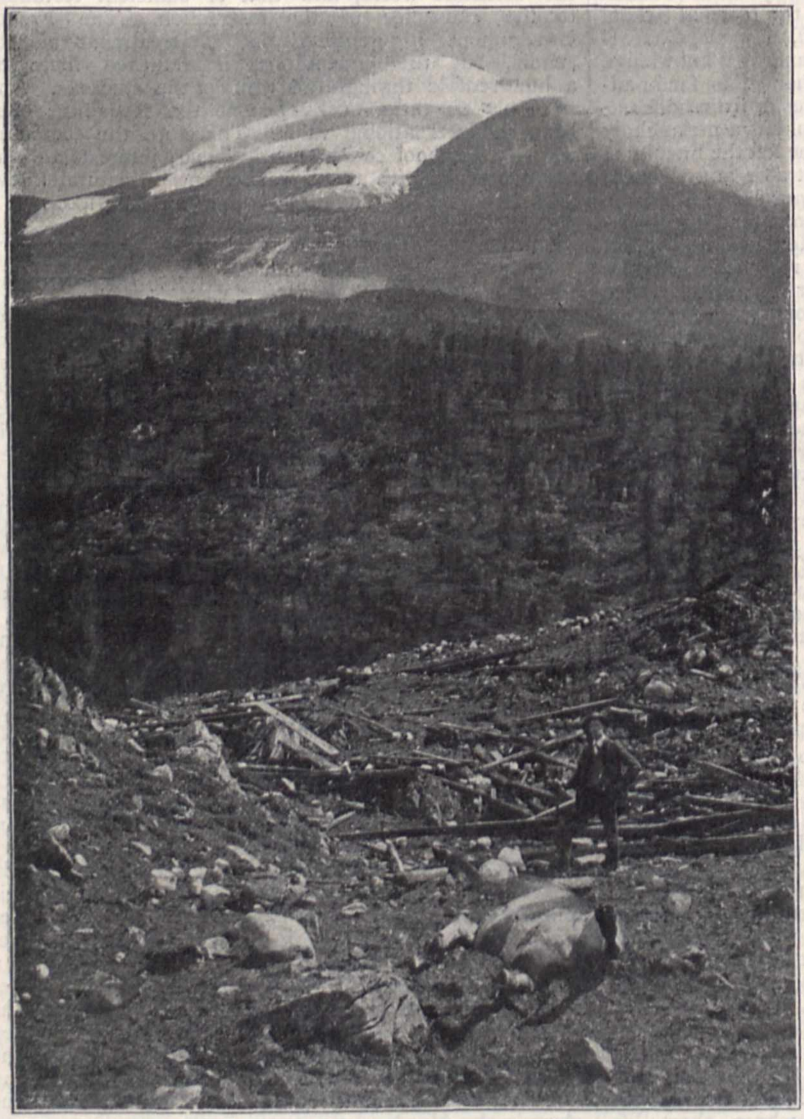

Fig. 1.—Ice-break on Altels Mountain.—Dead cow and fragments of châlet in the foreground.

The enormous rush of wind, together with the terrifying sounds of the avalanche, gave the people of the neighbourhood a rough awakening from their night's rest. They thought an earthquake was convulsing them. Only one witnessed the coming of the avalanche, that was the waitress at the Schwarenbach Inn, who had just risen to prepare an early cup of coffee for some of the guests. She rushed out, in time to see the ice skimming the road's corner on its way to destroy the Spital Alp. Had the fall taken place half a day sooner or later, tourists must inevitably have suffered on the much-frequented path.

Dr. Albert Heim, Professor of Geology at Zürich, was at once telegraphed for to make a thorough investigation of the disaster. The result of his examination will not be fully published until the end of the year. Meantime some of the more exact details may be stated here. The accompanying photographs are a few of those taken at Prof. Heim's wish immediately after the disaster.

The first shows the break in the ice on the Altels Mountain. It occurred near the foot of the nevé or "Firn-snow" region of the Altels glacier, at a height of 3300 metres (11,000 feet). The mass of ice which broke away measured about 300 metres in length, 200 metres in breath, and 30 metres in thickness. It streamed down the steep-dipping, smooth slabs of limestone rock on Altels, and spread itself out fan-like on the Spital Alp, 1900 metres high (6270 feet). The vertical height of the fall was therefore some 4700 feet. The immense impetus thus gained caused the ice to pursue its course up the steep incline of the "Oeschinen Grat." The main part in the centre of the avalanche "fan" dashed itself with its spray of ice-dust and débris against the ridge, surmounted it in parts as high as 2360 metres, over 7700 feet, and pitched many fragments upon different levels on the other, or Oeschinen Valley, side of the ridge. The outer wings of the fan, on the other hand, curved backwards; that on the north side can be traced as a return stream from Winteregg to the Stierenbergli corner of the Gemmi road referred to above (Fig. 2).

This return stream did especial damage to the trees; and nothing can be more striking than the sight of the long larch and fir trunks felled in one and the same direction, and clean-cut along a definite line. One hillock has been stripped of its timber on one side, while no harm has been done on the other. The course of the avalanche has left its trail of stems; up-torn roots, ravaged châlet, dead cattle, even cheeses may be distinguished jammed in the general heaps of ruin.

The result on the ice of its own motion and pressure during its fall deserves attention (Fig. 3). The photograph shows the typical form which the ice takes, viz. that of hard rounded pieces of ice of all sizes mixed in loose ice powder. Friction produces various markings on the rolled ice.

There is altogether a remarkably small proportion of carried *rock*-débris mixed with the ice. The whole field of ice on the Spital Alp simply portrays a "Staub Lawine," or dust avalanche on a large scale. In the course of a few years nature itself will have removed the last signs of a wreckage which at present hundreds of willing hands are doing their best to clear away in part from road and Alp.

MARIA M. OGILVIE.

FIG. 2.—Return stream covering the Gemmi road at the Stierenbergli corner.

FIG. 3.—Ice structure in the avalanche.

THE LATE PROFESSOR HOPPE-SEYLER.[1]

ERNEST FELIX IMMANUEL HOPPE[2] was born in Freiburg on the Umstrut (Saxony) on December 26, 1825. At the age of nine he lost his mother, and at eleven, being left an orphan by the death of his father, he was taken charge of and educated by the governing body of an endowed institution in Halle. After the completion of his school course he commenced in 1846 the study of the natural sciences as a student of the University of Halle. Migrating early in his student's career to Leipzig, he had the good fortune to lay the foundations of his knowledge of anatomy and physiology under the three distinguished brothers Weber (Ernst Heinrich, Wilhelm and Eduard), to study chemistry under Erdmann, and under the eminent physiological chemist Karl Gotthold Lehmann, medicine under Oppolzer, surgery under Günther, and pathological anatomy under Bock. Hoppe spent the last two semesters of his student's course in Berlin, following the courses of Romberg, Langenbeck and Casper. He took the degree of Doctor of Medicine in 1850, presenting a dissertation "De cartilaginum structura et chondrino nonnulla," which he dedicated to his former master E. H. Weber, and which indicated the impulse he had received towards anatomical as well as chemical investigation, on the one hand through the influence of the Webers, on the other through that of K. G. Lehmann.

Having settled in medical practice in Berlin, Hoppe was appointed medical officer to the workhouse, and whilst occupying this post, devoted himself to researches, partly chemico-physiological and partly clinical. To the former class belong investigations on cartilage bone and tooth, as well as chemical analyses of certain so-called transudations; to the latter, studies of which the object was to discover the physical principles which underlie many of the phenomena revealed by the percussion and auscultation of the chest in disease. In 1856, Hoppe was appointed Prosector in the University of Greisswald, where he qualified as Privat-docent; here, however, he only remained until 1858, when he was recalled to Berlin by Virchow, in order to act as his assistant. Virchow had just been appointed the first ordinary professor of pathological anatomy in the University, and Hoppe, as his only assistant, was at first called upon to take a part in all the work of the Pathological Institute, whether anatomical or chemical. Very soon, however, he was enabled to confine his attention to researches in physiological and pathological chemistry, and to the superintendence of the chemical laboratory of the Insti-

[1] Though some weeks have elapsed since the death of this eminent man of science, a brief account of his life and an attempt to convey some idea of the part which he played in the advancement of physiological chemistry may not prove uninteresting to the readers of NATURE. In the preparation of this paper I have been greatly assisted by the information contained in an article which appeared in the *Vossiche Zeitung* of August 12.—A. G.

[2] The subject of this notice changed his name from Hoppe to Hoppe-Seyler somewhere about the year 1862.

tute. In 1860, Hoppe was appointed an extraordinary professor in the philosophical faculty of the University of Berlin. In 1861 (he had now assumed the name of Hoppe-Seyler) he was appointed to the chair of Applied Chemistry in the University of Tübingen, where he had as colleagues the botanist von Mohl, the physiologist Vierordt, the anatomist Leydig, the chemist Strecker, and the great physician Niemeyer.

It was whilst in Tübingen that Hoppe-Seyler published (1866–1870), under the title of "Medicinisch-Chemische Untersuchungen," a series of valuable papers by his pupils and himself, some of which will be always referred to by thorough students of physiological chemistry; such are the researches of Diakonow on lecithin, of Miescher on nuclein, and Hoppe-Seyler's own papers on hæmoglobin, its compounds and certain of its derivatives.

When, in 1872, after the conclusion of the Franco-German war, the German Government gave to Strasburg the new and splendidly-endowed Kaiser Wilhelm's Universität, Hoppe-Seyler was one of the distinguished men chosen to fill its chairs, being appointed to the only ordinary professorship of Physiological Chemistry in the German empire. Among those who were called with him, and who were destined to shed a brilliant lustre on the new academy, which had arisen Phœnix-like out of the ashes of the old Strasburg, were such men as Waldeyer, Recklinghausen, Leyden, Gusserow, Schmiedeberg and Flückiger. No wonder that Strasburg has already become one of the chief centres of research in Europe!

Amongst the laboratories—the so-called institutes—which are clustered around the Hospital of Strasburg, is the so-called Physiologisch-Chemische Institut, in which since his appointment Hoppe-Seyler has continued the work which he had begun in Berlin and in Tübingen, surrounded by pupils, many of whom—I shall merely name Baumann, Brieger, Kossel, and Thierfelder—have won for themselves honourable positions in contemporary science, and for their master the reputation of a great teacher, in the best sense of the term. Here Hoppe-Seyler worked until the very eve of his death. Leaving Strasburg apparently in the fulness of health and vigour to enjoy a few weeks of rest on his property by the shores of the Lake of Constance, Hoppe-Seyler was to be spared the misery of prolonged illness. Some sudden and unsuspected cardiac mischief brought to a standstill the life of a man of singularly great activity, intellectual as well as physical. He died on the forenoon of August 10, 1895.

ARTHUR GAMGEE.

THE FUNERAL OF PASTEUR.

AMID signs of national sorrow, the funeral of Pasteur took place on Saturday last. France, more than any other nation, knows how to do honour to the memory of those who have contributed to her greatness, and by giving a national funeral, as well as taking the cost of it upon herself, she has once more shown the esteem in which she holds those who have devoted their lives to the increase of the world's knowledge and happiness. How very full was this expression may be gathered from the report of the *Times* correspondent at Paris. We read: "Quite a small army of infantry, marines, cavalry, artillery, and municipal guards, mounted and on foot; deputations from all the schools and learned societies; most of those who speak and of those who govern and command in the name of France, came to render homage to the stainless glory of this Frenchman, whose genius devoted its efforts to the whole of mankind, and who deserves the gratitude of the world, not merely for the labours which he accomplished but for the new paths which he opened to science by the fresh discoveries which he made for the benefit of mankind." Shortly after ten o'clock on Saturday morning, the troops and innumerable deputations, which had assembled in and near the Pasteur Institute, marched past before the coffin containing the body of the illustrious investigator. The funeral procession was then organised. General Saussier, surrounded by his staff, and followed by the first division of infantry, preceded the hearse, and behind him came a long line of deputations, many of which had wreaths in their centre. A number of wreaths were borne on litters, and others were carried on six cars, each drawn by a pair of horses.

"Along the route from the Rue Dutot to Notre Dame," says the *Times* correspondent, "the compact and silent crowd respectfully uncovered their heads as the hearse passed, and the two thousand soldiers and policemen, drawn up in line to keep the way clear, had absolutely nothing to do. The pall-bearers were M. Poincaré, M. Joseph Bertrand, M. Georges Perrot, Dr. Brouardel, M. Gaston Boissier, and M. Bergeron. After marching for an hour and a half along the left bank of the Seine, the procession reached the square of Notre Dame. The aspect of the Cathedral was most impressive. The presence of President Faure, the Grand Duke Constantine, Prince Nicholas of Greece, Cardinal Richard, the whole of the Diplomatic Corps, the Ministers, the Institute of France, the office-bearers of the Senate and the Chamber of Deputies, the red-robed Judges, the members of the University faculties, in orange, red, and crimson robes, and the other distinguished persons invited—all this display of official mourning was coupled with and yet eclipsed by the profound silence, the manifest grief. The immense crowd was a rare and impressive, if not a unique spectacle."

The Royal Society was represented by Mr. W. T. Thiselton-Dyer, C.M.G., Director of the Royal Gardens, Kew. At the final funeral, which will be held in connection with the Centenary of the Institute, on the 25th inst., several of the Officers and Fellows of the Society will be present, together with many delegates from other of our learned societies.

After the service in Notre Dame, the coffin containing Pasteur's remains was removed to a catafalque outside the Cathedral, and M. Poincaré delivered an oration before it, on behalf of the Government.

Thus does France venerate the memory of her noblest son. But France is not alone in her grief. The human race joins with her in mourning the loss of one who has done so much for humanity and science. The name of him to whom the world owes so much good is imperishable.

NOTES.

IN July of this year, a special Parliamentary Committee, of which Mr. Rhodes, the Premier, was a member, sat in Cape Town to consider the advisability of beginning a systematic geological survey of the Colony. The Committee, after hearing evidence, recommended the House of Assembly to appoint a standing Commission which should take charge of the work, and become in the first instance responsible for its being efficiently carried out. Parliament having accepted this recommendation, the warrant appointing the Commission has been duly drawn up and signed by the Governor of the Colony. The following gentlemen compose the Commission: the Hon. I. X. Merriman, M.L.A.; Dr. Gill, Astronomer Royal; Dr. Muir, Superintendent General of Education; Mr. Charles Currey, Under-Secretary for Agriculture; and Mr. Thomas Stewart. The three first-mentioned are Trustees of the South African Museum, Cape Town, and it is intended that the geological staff shall have its headquarters in the new museum building, which is just approaching completion. In past years a great amount of detached work, chiefly of the nature of prospecting and reporting upon mineral occurrences, has been done in Cape Colony, while many European geologists have written papers dealing with the rocks, fossils, and in some cases the structural characters of different portions of the Colony which at various times they happened to have visited. The Commission intends, as one of its first duties, to have a bibliography of all such papers and reports published, but will at the same time have an organised systematic scheme of field work entered upon. A topographical map on a scale of two miles to an inch has already been published for about one-twelfth of the entire area of the Colony, and it is intended to utilise this for the geological details.

DR. W. S. CHURCH will deliver the Harveian oration before the Royal College of Physicians, on Friday, October 18.

PROF. RAOULT, of Grenoble University, has been awarded the prize of twenty thousand francs given biennially by one of the bodies constituting the Institute of France, and awarded this year by the Academy of Sciences.

WE regret to notice the death of Prof. A. von Bardeleben, the eminent surgeon, and for many years one of the Presidents of the Berlin Medical Society. The death is also announced of Baron Felix Larrey, member of the Paris Academy of Medicine, and author of a number of works on military surgery.

THE *Bulletin* of the Royal Gardens, Kew, announces that Sir Joseph Hooker has presented the Gardens with a replica of a portrait of the late Dr. T. Thomson, F.R.S. Dr. Thomson was the first botanist to enter the Karakoram mountains, and was for some time Director of the Calcutta Botanic Gardens.

DURING the Leyden Zoology Congress a small volume, entitled "Guide Zoologique de la Hollande," was presented to the members. This little book, containing a number of photographs, was compiled by the General Secretary to the Congress, Dr. Hoek, and is full of information on the zoological laboratories, the museums, the zoological station and the zoological gardens, as well as concerning the study and the teaching of zoology in Holland. Several chapters are, moreover, devoted to the fauna of the country.

AT last week's meeting of the Pharmaceutical Society of Great Britain, the Hanbury Medal was presented to Dr. A. E. Vogl, Professor of Pharmacology in the University of Vienna, through Count Clary, Prof. Vogl being unable to attend in person. The medal is awarded biennially in accordance with the condition of the Hanbury Memorial Fund, and the award rests with the Presidents of the Pharmaceutical Society, Linnean Society, Chemical Society, and the British Pharmaceutical Conference. The first presentation was made in 1881, the recipient being Prof. Flückiger.

AT the Royal Microscopical Society, on Wednesday, October 16, the following papers will be read:—"On the Division of the Chromosomes in the Pollen Mother-Cell of Lilium," by Prof. J. B. Farmer; "New and Critical Fungi," by G. Massee; "A Fluorescent Bacillus," by F. J. Reid.

THE inaugural lecture of the newly-instituted "Course of Scientific Instruction in Hygiene and Public Health" at Bedford College for Women, was delivered by Dr. Louis Parkes on Saturday afternoon, October 5. The course aims at promoting systematic instruction in hygiene and all those allied branches of science necessary to a thorough knowledge of sanitation and laws of health, and so qualifying women to become teachers and lecturers, and inspectors of workshops and factories where female labour is employed.

A MEETING of the Institution of Mechanical Engineers will be held on Wednesday, October 23, and Thursday, October 24, at the Royal United Service Institution, Whitehall. The chair will be taken by the President, Prof. Alexander B. W. Kennedy, F.R.S., and the following papers will be read and discussed, as far as time permits:—"The Electric Lighting of Edinburgh," by Mr. Henry R. J. Burstall; "Report on the Lille Experiments upon the Efficiency of Ropes and Belts for the Transmission of Power," translated by Prof. David S. Capper; "Observations on the Lille Experiments upon the Efficiency of Ropes and Belts for the Transmission of Power," also by Prof. Capper.

THE death of Moritz Wilkomm, the eminent botanist and geographical explorer, is announced in the *Geographical Journal*. Of his life we read:—"Born in 1821, at Herwigsdorf, in the kingdom of Saxony, after 1841 he studied medicine and natural science at Leipzig. In 1844 he for the first time visited the Pyrenean peninsula, which he subsequently traversed so often, sometimes by the year together, making thorough investigations into the botanical, geognostical, and geographical relations of the country. After having, in 1852, gained some experience as teacher of botany at Leipzig, and having been called thence first to Tharandt, and afterwards, in 1868, to Dorpat, he occupied the chair of Botany at the German University at Prague from 1873 until the receipt of his pension in 1892, being at the same time Director of the Botanical Garden in that city. He did much good work by his rich botanical collections, principally from Spain and the Balearic Isles, as well as by his special botanical works dealing especially with the descriptive side of the science; whilst as a geographer he did lasting service, not only in connection with the geography of plants—in particular in South-West and Central Europe—but also by his comprehensive geographical description of Spain and Portugal; and, above all, he threw light on the geography of Austria by his excellent work on the Böhmerwald (1878), which region he was the first to throw open to science in its most inaccessible parts, still at the time clothed with primeval forest."

WITH reference to the letter by Mr. Pillsbury on "Colour Standards" (NATURE, August 22, p. 390), Mr. J. W. Lovibond writes from Salisbury:—"In justice to myself, may I be allowed to point out that the difficulties named no longer exist, since it remains as an experimental fact that the solution of every position which Mr. Pillsbury describes as desirable and lacking is now a matter of everyday routine in many laboratories and manufactories. . . . Every sensation, whether of light or colour, which can be differentiated by the vision can be matched by means of the Tintometer Standard Glasses, and defined by means of a system of colour terms; the colour sensation itself can be reproduced at any future time by simply using the matching glasses. The operation of matching a colour is so easy that in those factories where frequent changes of colour require noting, or where it is necessary to work up to a given colour, an intelligent workman is found competent to effect them."

THE current number of *Himmel und Erde* contains the concluding part of two interesting articles on scientific balloon ascents, by Dr. R. Süring, of Potsdam. The author briefly reviews all ascents since that by Jeffries and Blanchard on November 30, 1784, and shows that relatively little use has been made of the observations, probably because they have not always been free from objection, or from the fact that most ascents have been of an isolated character. The principal exceptions, among the older ascents, are the celebrated voyages of Welsh and Glaisher, and more recently those made by the Bavarians and

Russians; the latter dealing more especially with wind conditions in high and low barometric pressures. The German Society for the promotion of scientific balloon ascents, under the patronage of the Emperor, will probably obtain important results, and solve several open questions relating to cloud formation, and atmospheric electricity under various hygrometric conditions of the atmosphere.

A SUSPENSION for physical instruments free from the vibrations of the laboratory would be an inestimable boon to physicists, especially in crowded cities. At Leyden University, Prof. Einthoven mounted his delicate capillary electrometer on an iron plate floating on mercury. This device was exceedingly successful, although somewhat cumbersome and bulky, and he was thus enabled to take a photographic record of the instrument magnified 800 times. Sir G. B. Airy was in the habit of placing his artificial horizon upon a table suspended by caoutchouc bands attached to another table similarly suspended, the arrangement being repeated three times. This, however, was even more cumbersome. Now Herr W. H. Julius, in *Wiedemann's Annalen*, describes a contrivance which is both simple and effective. It consists of a small circular table suspended by three vertical wires about 6 or 8 feet long, the ends of which form the points of an equilateral triangle. A movable weight is attached to a rod projecting downwards from the centre of the table. It can be clamped in any position, so as to bring the centre of gravity of the table and the instrument into the plane of the table itself. Any lateral displacement of the upper ends of the wire will start waves down the wires, which will arrive at the table simultaneously, but will only affect it perceptibly when the period of the disturbance coincides with the period of oscillation of the table about the point of suspension. Even then the axis of the table is always strictly vertical. To clamp the oscillations peculiar to the suspension the author attached little vanes, dipping into oil or water, to the table. With a rough preliminary apparatus constructed in this manner, the author succeeded in reducing the vibrations to one-tenth of their original amplitude.

THAT sedimentation plays an important part in the purification of water, was shown as long ago as the year 1886 by Dr. Percy Frankland in the case of his laboratory experiments on the removal of micro-organisms from water. That it is a factor of great importance in the storage of water in reservoirs, was also shown by him in his investigations at the London water-works; but quite recently Dr. H. J. van 't Hoff has indicated how this now recognised process of sedimentation may be taken advantage of in the abstraction of tidal water for purposes of water-supply. It appears that the city of Rotterdam derives its water-supply from the river Maas, and that the Company's intake is situated within the tidal area of the river; the water is, however, only abstracted at particular times, *i.e.* two hours after high-water has been reached. During this period the river is at rest, and sedimentation can proceed unhindered, and Dr. van 't Hoff estimates that at least 50 per cent. of the bacteria present are eliminated during this time of comparative stagnation. Unlike the city of Hamburg, which before and during the great cholera epidemic abstracted tidal water from the river Elbe, and distributed it in its raw condition in Rotterdam, the Maas water is submitted to filtration before delivery. In consequence, however, of a very large demand on the resources of the water-works, the rate of filtration is considerably higher than it should be; and this fact, combined with the unpleasant circumstance that the city disposes of its refuse by conducting it into the river, would naturally lead us to anticipate a bad bacterial filtrate. Dr. van 't Hoff does not, unfortunately, cite any figures for the filtrate, but states that "the very satisfactory bacteriological results which obtain at the Rotterdam water-works" are doubtless in great part a consequence of the improvement which takes place in this tidal water through sedimentation, rendering the raw water comparatively easy to deal with, whilst its microbial contents after the stagnation period average only from 4,000 to 10,000 per cubic centimetre, a remarkably small number for a polluted water.

MESSRS. OLIPHANT, ANDERSON, AND FERRIER are about to issue a new popular science series for children, under the title of "Science Talks to Young Thinkers." The first volume is "Nature's Story," by Mr. H. Farquhar.

THE last part of "The Natural History of Plants," by Kerner and Oliver, which Messrs. Blackie have for some months been issuing, has just appeared, and the whole of that excellent work can therefore now be obtained in volumes.

MESSRS. CASSELL AND CO. have issued the first part of a "new and revised edition" of Sir Robert Ball's "Story of the Heavens." We hope that succeeding parts have been brought up to the present state of knowledge, so that the edition will really be a revised one.

SEVERAL years ago it was intimated by a circular that Dr. Buchanan White was engaged in the preparation of a Flora of Perthshire, which he hoped to issue after a brief period of time. Dr. White's death, last December, prevented its issue by himself, but he left it in a state that permits of its immediate publication; and we are glad to notice the announcement that the book is to be issued on behalf of the Perthshire Society of Natural Science. Prof. Trail, F.R.S., has undertaken to edit it, and to preface it with a sketch of the author's life and scientific work.

A SERIES of five simply-worded books on wild flowers, by Dr. M. C. Cooke, has been published by Messrs. T. Nelson and Sons. The volumes are entitled "Down the Lane and Back," "Through the Copse," "A Stroll in a Marsh," "Around a Cornfield," and "Across a Common." Written in an attractive conversational style, and with scanty use of the "hard words" which children, and even those of older growth, always associate with the study of nature, the books are well suited to the juvenile public for whom they are intended.

WE are glad to note that the Harveian oration delivered by Dr. Lauder Brunton before the Royal College of Physicians last October, and printed in full in these columns at the time, has been published in the form of a handy volume by Messrs. Macmillan and Co. It will be remembered that the subject of the oration was "Modern Developments of Harvey's Work"; and those who know how well and fully Dr. Brunton treated his subject, will be gratified at the publication of the oration in a convenient form. The volume is dedicated to Sir J. Russell Reynolds, the President of the Royal College of Physicians.

WE have received the second part of Mr. J. W. Taylor's "Monograph of the Land and Freshwater Mollusca of the British Isles," from Messrs. Taylor Brothers, Leeds, and are pleased to see that the high standard of excellence to which we called attention in our notice of the first part is well sustained. The descriptive text is clear, and generally accurate, while the paper, print, and illustrations (coloured and otherwise) are all praiseworthy. The present part practically completes the consideration of the shell, and the next issue will be devoted to the animal and its organisation.

THE "Zoologisches Adressbuch," which R. Friedländer and Sohn, Berlin, have edited and published in connection with the Deutsche Zoologische Gesellschaft, will prove of very great assistance to workers in all parts of the world. The volume contains the names and address of zoologists, anatomists, physiologists, and zoo-palæontologists of all countries. The classification is according to countries, the towns of which are arranged (with a few exceptions) in alphabetical order, while the names follow the same order. Each name is followed by a full address, and by an indication of the special branch or branches of study in which the person it designates is interested. To give an example of the scope of the contents, it may be said that under London we find the names of the professors and assistants in the zoological and kindred departments in the various colleges and medical schools; the staffs of the departments of zoology and geology in the Natural History Museum; some of the members of the Geological Survey of England and Wales; a list of the members of the Zoological Society; the names and places of meeting of a number of London and suburban scientific societies interested more or less in zoology; and lists of draughtsmen, opticians, publishers, and of taxidermists and dealers in animals. In some cases the lists are much fuller than in others, owing probably to the fact that some colleges and institutions furnished the publishers with more detailed lists than others. But though a few names are omitted from the places where one first looks for them, they can in most cases be found somewhere in the volume. Very valuable is an index of the names arranged in groups according to the subjects especially studied, and a geographical index. And, finally, the personal index at the end of the volume renders it possible to find the name, address, and special work of any zoologist entered in the work in a few moments. It is well known that the Germans excel in producing directories of the kind before us, and, so far as we can make out, the present work will sustain their reputation. Being international, the directory will help to bring together observers accumulated in widely separated regions of our globe, and so will lead to a better knowledge of the world's fauna. We congratulate Messrs. Friedländer upon the enterprise they have shown in preparing and producing such a useful work; and we hope the time is not far distant when the designations of students and investigators in the domain of physical science will be brought together in a similar directory.

THE additions to the Zoological Society's Gardens during the past week include a Black Ape (*Cynopithecus niger*) from Celebes, presented by Mr. Frank Greswolde Williams; a Rhesus Monkey (*Macacus rhesus*, ♂) from India, presented by Mr. H. Small; a Bonnet Monkey (*Macacus sinicus*, ♀), a Macaque Monkey (*Macacus cynomolgus*, ♀) from India, presented by Mrs. Lionel Smith; a White-tailed Ichneumon (*Herpestes albicauda*), two Blotched Genets (*Genetta tigrina*) from Natal, presented by Mr. W. Champion; a Cape Hyrax (*Hyrax capensis*), two Suricates (*Suricata tetradactyla*) from South Africa, presented by Mr. J. E. Matcham; two Norwegian Lemmings (*Myodes lemmus*) from Norway, presented by Mrs. Haig Thomas; a Passerine Parrakeet (*Psittacula passerina*) from Brazil, a Silky Cow-Bird (*Molothrus bonariensis*), a Red-crested Cardinal (*Paroaria cucullata*) from South America, presented by Mr. R. Norton; two Common Kingfishers (*Alcedo ispida*), British, presented by Mr. J. A. Clark; a Passerine Parrakeet (*Psittacula passerina*) from Brazil, a Tuberculated Iguana (*Iguana tuberculata*) from the West Indies, two Common Teguexins (*Tupinambis teguexin*) from South America, deposited.

OUR ASTRONOMICAL COLUMN.

MEASUREMENT OF PLANETARY DIAMETERS.—In a paper giving particulars of measurements of the polar diameter of Mars (*Astronomical Journal*, No. 354), Prof. Campbell gives an interesting summary of the conditions of planetary measures in general. He points out that measurements of diameter are affected by a variety of errors, among them being spherical and chromatic aberration, imperfect atmospheric conditions, irradiation, diffraction, and imperfect focus, all of which tend to increase the apparent diameter of the object; while, in addition, personal equation and accidental errors may also affect the results. The effects of spherical and chromatic aberration, as well as of diffraction, may be regarded as constant throughout a series of measures of any given object. Differential refraction can be satisfactorily corrected for, but the irregular refraction caused by the unsteadiness of the atmosphere, and resulting in "poor seeing," may produce very large errors indeed. The apparent increase of diameter due to irradiation may be regarded as sensibly constant with any given telescope, eyepiece, planet, and background. Imperfect focus may produce considerable and variable errors; in the 36-inch Lick telescope, an error of a thousandth of an inch in focussing increases the diameter of a planet by 0″·02. Experiments as to the best method of procedure were made by Prof. Campbell in June and July, 1894, with the result that the following programme was adopted in the case of Mars: (*a*) All the observations were made with the sun above the horizon, and the advantages of a bright sky background were very marked; it was believed to reduce all the errors, except possibly that of personal equation. (*b*) Observations were only made in a tranquil atmosphere. (*c*) The same eyepiece was used throughout. (*d*) An eyepiece cap with a very small aperture was employed. (*e*) The observer's eyes were always similarly situated with respect to the threads of the micrometer. (*f*) The micrometer threads were always placed parallel to the great circle passing through Mars and the sun. (*g*) The micrometer threads were placed directly upon the opposite limbs of the planet.

Following this programme, and adopting Young's value of 1/219 for the polar compression, the most probable polar diameter of Mars, at distance unity, was found to be 9″·25 + 0″·012, while the equatorial diameter resulting from the measures was 9″·30.

THE CRATERS ON THE MOON.—Much has been learnt about the configurations of the lunar surface since the idea of examining very greatly enlarged photographs came into practice. It was only natural, however, that many interested in the subject should have looked upon the interesting results of Dr. Weinek with scepticism, for it was hard to believe that such detail structure could be so perfectly secured on the photographic plates. Such doubts as to their existence were somewhat increased by the fact that many details were invisible to eye observations, or at any rate were thought to be, but the fact was not sufficiently grasped that the photographic plates showed only the detail as it appeared at the moment of the exposure, which might have differed considerably from that which preceded it or, followed it by a few seconds.

Every confidence is now placed in the photographic records, and under suitable and similar observing conditions the eye should be ably to verify them directly. M. C. M. Gaudibert, in *Astr. Nach.* No. 3310, tells us of his discovery, with an instrument of 260 m.m. aperture, by eye observations alone, of a small crater only 800 metres in diameter. It lies on the top of the central mountain of Albategnius. This crater has been subsequently found by Dr. Weinek on a negative taken by MM. Loewy and Puiseux 1894, February 13, 4h. 6m. Mean Time Paris.

A diligent search by M. Gaudibert has also enabled him to secure the necessary observational conditions to see the two small craters discovered by Weinek near the crater and to the east of the Rephées mountains.

SUGGESTION FOR ASTRONOMICAL RESEARCH.—Dr. Isaac Roberts draws attention to a piece of useful astronomical work which may be performed by those who take a practical interest in the subject, namely, to determine what changes, if any, have taken place among the stars in the regions photographed by him at intervals during the past eight years. In the first instance it will only be necessary to compare the earlier photographs published in his well-known "Photographs of Stars, Star Clusters, and Nebulæ" with the new series now appearing in *Knowledge*; but arrangements are being made which will enable investigators to refer to glass positives, or the negatives themselves, to settle any doubtful points. The photographs being enlarged to the same scale, comparative measurements may readily be made by means of a *réseau* ruled on glass, and a transparent protractor will enable position angles to be determined. The scale of the photographs is such that any change of position exceeding three seconds of arc may be detected by careful measurements. "Thus, a system of astronomical research would be inaugurated, that must eventually add largely to existing knowledge."

ANTHROPOLOGY AT THE BRITISH ASSOCIATION.

ON Thursday, September 12, the President's address was delivered. The address was followed by craniological papers.

Sir W. H. Flower exhibited four skulls of the aboriginal inhabitants of Jamaica, who had disappeared before the English occupation in the seventeenth century. They resemble the Carib type, and have been more or less markedly deformed during life.

The President, in the absence of Dr. J. G. Garson, gave an account of the physical characteristics of the "New Race" lately discovered in Egypt. Some 200 skulls were secured, and parts of 400–500 skeletons. The average index of length lies between 73 and 75; the alveolar index shows three predominant types, about 94, 96, and 99·5, which are confirmed by the male and female indices taken separately, and indicate a mixture of races. The nasal index is 54; wider than the European (47), and Egyptian and Guanche types (49), which are thus excluded. The great excess, especially from one of the sites explored, of female skulls of very small capacity is explained by supposing a segregation of a part of the race, and subsequent marriage of the smaller-headed women into the normal branch. The well-known decrease of cranial capacity in tropical, as compared with arctic and temperate races, suggests that the new race originated in tropical Africa. But the type of skull appears to be distinct from that of the negro; and the hair which has been found is either straight or wavy.

Each afternoon of the meeting was devoted to a lantern lecture of a somewhat more popular kind than the morning's work. On Thursday the President described the remains and civilisation of the "New Race" in Egypt, whose physical features had been already examined.

Several rites were discovered this winter between Ballas and Nagada, near Thebes, of an entirely un-Egyptian character. All the pottery was hand-made, though the potter's wheel had long been known in Egypt; and though metal was not entirely unknown, the great majority of the implements were of very delicately worked flint. The long knife-blades, and the forked spear-heads with peculiar hafting, for bringing down running deer, are particularly notable. Very beautifully formed jars of hard stone, with perforated ears for suspension, are also a characteristic manufacture, and are imitated in clay with painted marbling, and also later by the native Egyptians. Extensive cemeteries have been explored, and the manner of interment has been determined: the bodies were buried on one side in a contracted posture, with many vessels and other funeral furniture, and with "a great burning" as part of the ceremony. This, and the peculiar physical type of the people seem to connect them with the ancient Amorites of Southern Palestine; while, on the other hand, they seem to have invaded Egypt from the Libyan Desert, and to belong closely to the early inhabitants of the north coast of Africa. The date of their occupation of Egypt is fixed by the interposition of their tombs between those of sixth and twelfth dynasty Egyptians; so that their presence explains the fall of the Pyramid-Building dynasty, and the gap which has been observed at this point in the sequence of Egyptian history.

On Friday, Mr. H. W. Seton-Karr exhibited a large series of flint implements from Somali-land, and of illustrative photographs. The flint is of local origin, and a number of factories has been identified.

Mr. W. J. Knowles sent a "striated flint implement" from the North of Ireland, which gave rise to some discussion as to its origin.

Mr. B. Harrison contributed a report on the plateau flints of North Kent.

Mr. H. Stopes exhibited graving tools from the terrace-gravels of the Thames Valley and Palæolithic projectiles. In discussion, however, the human workmanship of some of the specimens was called in question.

The President gave a demonstration, with numerous illustrations, of flint and metal working in ancient Egypt. The earliest implements in Egypt are of Palæolithic types, found undisturbed and deeply stained by exposure, on the surface of the desert, 800–1200 feet above the Nile Valley. More advanced workmanship, with long parallel flaking, appears in the gravels of the Nile, 30 feet above the river. No intermediate stages are known between these and the rectangular-faced flakes of the fourth dynasty. The "New Race" which overthrew the Pyramid-builders surpassed all known flint-workers in the length, flatness, and regularity of their knives, javelin-heads, and sickle-flints. Bangles and other ornaments of great delicacy were made of the same flint. Under the XII. dynasty straight-backed and curved knives, adzes, axes with lugs, scrapers and sickles of native workmanship occur; but under the XVIII. dynasty, after another period of eclipse, bronze is found to have superseded flint. Flint implements, however, of a coarser kind, continued to be used as late as the fourth century A.D.

Metal-working is first found under the III. dynasty, and copper tools are habitually used under the IV. for mason's work; copper needles were also in use. Only one sample of bronze is known of this age; the rest are of pure copper. The "New Race," though devoted to stonework, produced occasional fine copper implements; one notable dagger is of an "Ægean" type. Under XII. dynasty, copper is still predominant, and much commoner; tempered with copper oxide and with arsenic. Bronze begins with XVIII. dynasty. Silver and gold are well worked from an early period; almost absent from "New Race" graves, which, however, seem to have been rifled. Iron has not been found earlier than foreign, mostly Greek deposits of XXVI. dynasty (650–550 B.C.). Earlier supposed allusions to "iron" in inscriptions really refer to "bronze."

Mr. H. Swainson Cowper gave a lantern lecture on the Senams, or megalithic monuments of Tripoli, of which he has visited nearly sixty. Rectangular enclosures of good masonry are associated with trilithons like those of Stonehenge, but with very narrow apertures between the jambs; the height varies from 6 to 15 feet. They are erected on footing stones, and are apparently designed to hold additional superstructures of wood. The forms of the stones themselves also sometimes recall carpentry types, which in so treeless a country are remarkable. A massive stone altar, often grooved, and level with the ground, sometimes stands in front of a trilithon. The few sculptures associated with the Senams are of Roman style, with Phallic subjects; but are not necessarily contemporary with the monuments themselves. The Senams appear to have been objects of worship, and usually stand upon hill-tops. Mr. Swainson Cowper suggests that they are analogous to the "Asherah" of the Old Testament, and to similar structures represented on Babylonian cylinders.

Mr. W. J. Lewis Abbott sent a report on the Hastings kitchen midden. The fissures in the sandstone cliffs at Hastings have been used as dwellings in Neolithic times, and the refuse, containing numerous flakes, implements, and fragments of pottery, has accumulated in front of their openings.

Saturday.—Ethnology.—The tenth report of the Committee on the North-Western Tribes of Canada was presented. This Committee was appointed at the Montreal Meeting 1884, and has published, hitherto, the following important memoirs in its reports to the British Association:—

Introduction (Report VII.). Sir Daniel Wilson.
Circular of Inquiry (III.).
North American Ethnology (V.). Mr. Horatio Hale.
Linguistic Ethnology (VIII.). Mr. Horatio Hale.
Physical Characteristics (VII.). Dr. Franz Boas.
The Blackfoot Indians (I.). Mr. Horatio Hale.
The Blackfoot Indians (II.). Rev. E. F. Wilson.
The Sarcee Indians (IV.). Rev. E. F. Wilson.
The Kootenay Indians (VIII.). Dr. A. F. Chamberlain.
Ethnology of British Columbia (V.). Mr. Horatio Hale.
Notes on Indians of British Columbia (IV.). Dr. Franz Boas.
Reports on Indians of British Columbia (V.–X.). Dr. Franz Boas.

The report now presented contains a further account of the physical characteristics of the tribes of the North Pacific Coast; notes on the Tinneh Tribe of Nicola Valley, by Mr. James Teit; on the Tinneh Tribe of Portland Canal, and on the Nass River Indians, by Dr. Boas; and the grammar and vocabulary of the Nísk'á and Tsetsā'ût languages.

Much, however, remains to be done in order to give a satisfactory review of the anthropology, even of British Columbia: in particular, the influence of the tribes of Millbank Sound on their neighbours; the highly developed art of the Haida, and the complicated symbolic and conventional ornaments; and the peculiar distribution of physical types need further elucidation.

The Committee has accordingly been reappointed with a grant of £100, in order to enable Dr. Boas to continue his important investigations.

Captain S. L. Hinde read a paper on the cannibal tribes of the Congo. Cannibalism is in his experience in this region almost universal, on the increase, and peculiarly inveterate. An extensive traffic in human flesh prevails, and slaves as well as prisoners are kept and sold for food. Even corpses are disinterred in spite of charms on the graves; the flesh is always cooked or smoked, but is not here eaten from any religious or superstitious motive. The practice of filing the front teeth is not found to be coextensive with that of cannibalism.

Mr. Darnell Davis derived the name "cannibal" from the Caribs of the West Indies, who, however, are not man-eaters; Mr. Elworthy discussed the theory of cannibalism as a means to acquire the properties of the thing eaten; and Mr. Hartland the survivals, in Europe, of ceremonial and sepulchral cannibalism.

Captain Hinde also described the pigmies of Central Africa, nomadic hunters, of less than four feet stature.

Mr. A. Montefiore gave an account of the Samoyads of the Arctic Tundras.

Reports were presented by the Committees on physical deviations of children from the normal, and on anthropometric measurements in schools.

The anthropometric laboratory, which is usually organised during meetings of the Association, was not this year available.

On Monday, Mr. Elworthy read a paper on horns of honour, dishonour, and safety. The head is the object of honour, and is adorned with symbolic attributes. Horns are symbolic of the crescent-goddess; so of divine power, protection and favour in general. Conversely, to "scorn" (French *écorner*) is to deprive of such horns and prestige. The paper gave rise to some comment. Not all horns are crescent-symbols; most were originally worn attached to skins; ornaments are decorative first, symbolic afterwards.

Mrs. Grove discussed the religious origin of dances, as forms of magic or worship. Weapon-dances arise from worship of weapons, or of an armed deity; ritual dances from the love of dancing attributed to the deity, and as the expression of exalted enthusiasm; funeral dances propitiate either death, or the departed soul. As civilisation advances, the expressions of emotion are restrained, and dances lose their meaning and popularity.

The report of the Ethnographic Survey of the United Kingdom was read by Mr. Hartland, who was followed by Mr. J. Gray with observations specially relating to East Aberdeenshire, and by Dr. Garson with similar results from Suffolk. Work has also been begun in Hertfordshire and East Anglia (by the Cambridge Sub-Committee), and is projected in Galloway, and in Caithness, Elgin, and Nairn, by Dr. Walter Gregor.

Mr. C. G. de Betham read a fully illustrated paper on the peculiarities of the Suffolk dialect, which retains an unusual number of Anglo-Saxon idioms; and on the proverbs, traditions, and folk-medicine of the district. Mr. Lingwood exhibited two young ash-trees from Needham Market, which had been split in order to pass sick children through the stem.

Mr. Clodd read a paper on the objects and method of the study of folk-lore, which was followed by a lantern lecture by Prof. A. C. Haddon, on the same subject, exhibiting a series of persons, trees, wells, and other natural objects and prehistoric monuments to which traditions are attached, and illustrating a number of games and ceremonies, in which primitive beliefs and practices are perpetuated.

On Tuesday a formal discussion took place on the results of interference with the civilisation of native races. The subject was briefly introduced by the President, and papers were contributed by Lord Stanmore, Prof. A. C. Haddon (New Guinea), Dr. Cust (India), Dr. H. O. Forbes (Dutch East Indies), Messrs. E. Im Thurm and Darnell Davis (British Guiana), Ling Roth (Tasmania and Australia), and Raynbird (Central India). The course of the debate was summed up by the President as follows. The principle of government should be to protect the natives against their own weakness, the evil influences of debt, and the loss of their land. Rigorous impartiality may be the greatest injustice to the natives, and it is only by dealing with them from their own sense of justice that influence can be obtained. Native customs should not be unnecessarily interfered with, and then only with careful attention to the native point of view. Laws of morality differ in various countries, and what is "right" here is "wrong" there. Changes of detail should be left to the change of native opinion, rather than be enforced by law. It is, for instance, as cruel and disastrous to dress a native of a jungle in our tight, ill-ventilated clothes, as to expose an European naked in a tropical climate. With regard to education, opinions seem to differ; the completely savage brain cannot acquire our ways of thought suddenly without excessive strain and enfeeblement; but native races differ very widely in receptivity and imitativeness. What is above all things necessary is that sympathy of fellow-feeling which at once places one man on an easy and equal footing with another, and which savage races are very quick to perceive and reciprocate.

Rev. Hartwell Jones followed with a philological contribution to the history of primitive warfare in Greece and Italy.

Dr. Garson described a skull found in Thames Valley gravel, which contains palæolithic implements, and claimed it as palæolithic on morphological grounds; supported by Mr. Stopes. Sir John Evans, Prof. Boyd Dawkins, and Mr. Myres disputed the attribution.

A large collection was exhibited of photographs illustrative of the Andamanese and their civilisation, sent by Mr. Maurice Portman.

On Wednesday, Dr. Munro gave a fully illustrated lantern lecture on the newly discovered Neolithic settlement at Butmir in Bosnia. Flint and jasper weapons were manufactured in great variety on the spot, while polished hammers and axes were brought from a distance; and black pottery, with elaborate incised angular ornaments, was extensively made. A principal feature in the site is the occurrence of irregular depressions in the basal clay below the débris. Continental observers considered these to be the floors of huts; but Signor Pigorini and Dr. Munro found traces of piles, and argued that the houses were pile-dwellings, and that the hollows were made to obtain clay for wattle-work and pottery. Sir John Evans supported the pile-dwelling theory, and suggested that dredging might explain the irregularity of the hollows.

Mr. A. J. Evans described a series of primitive European idols, with diagrams and exhibits. Beginning with the marble images of the Greek archipelago, he sketched the area over which kindred figures occur, in Italy, Sicily, Spain, Liguria; and thence into Central Europe and the shores of the Baltic, and even as far as Orkney. The Oriental origin of these figures, formerly maintained, is now strongly contested; they probably testify to an indigenous practice of burying at first actual, and subsequently substituted attendants with deceased persons. Prof. Petrie compared the Maltese seated figures with those of the "New Race" in Egypt.

Dr. Munro presented a further report on the Lake Village of Glastonbury. Amongst the relics found were examples of pottery which were, undoubtedly, highly ornamented specimens of late Celtic art. Other articles unearthed must have been imported two or three centuries before the Roman occupation. Prof. Boyd Dawkins regarded the evidence as conclusive that the Lake Village of Glastonbury might be dated from 200 B.C. to the time of the Roman occupation.

Mr. Theodore Bent contributed a paper on the natives of Southern Arabia.

The Section was closed with a hearty vote of thanks to the President.

MECHANICS AT THE BRITISH ASSOCIATION.

SECTION G, which is devoted to mechanical science, had an unusually heavy programme at the late Ipswich meeting; indeed it was rather too heavy for the majority of members, for often the proceedings were carried on before a very scanty audience. It is a question whether, in this Section at any rate, a good deal of judicious weeding could not be done. Of course it is understood that "mechanical science" shall be translated as engineering in general—and that is a very good thing, as otherwise many good papers on what is generally known as "civil engineering" would be shut out from the Association altogether—but with a most benevolent desire to give all branches of applied science a hearing, one cannot help thinking it would be an advantage to every one concerned—especially the authors—if some proffered contributions were returned with thanks. The fact is, an exercise of the selective faculty, and perhaps a little more callousness to the demands made by the sensitiveness of authors, would do much towards rendering the proceedings in Section G more bearable than they have been for some time past.

There was, however, a good deal that was interesting and distinctly valuable in the proceedings of the Section at this year's meeting. The pity was that it should have been often wasted on an all but empty room. Another cause of complaint on the part of members of this Section was that the second Wednesday was a *dies non*. Doubtless very few object to a whole holiday at these meetings, but what people do find fault with is that they should be kept hard at work on Saturday, when there are pleasant excursions, to be turned adrift on Wednesday. Of course one can go home and cut the business short, and that is what many do, and the Thursday's excursions thus suffer. Indeed a conscientious member, determined to do his Section G thoroughly, was unable to go to any of Saturday's excursions, and would have to spend an idle day waiting for the Thursday's excursions. The excursions are the great feature of the Association meetings, as they bring members together and make them known to each other in a way that no other institution or society does. Possibly more has been done for the Advancement of Science by such means than by the meetings of Sections, for there are other associations which afford opportunities for the reading and discussion of papers, but none which offer the same social facilities as the British Association. When it is remembered that only two Sections met on the second Wednesday, it is a question whether it would not be of advantage to make it a rule to fix the whole day excursions for Wednesday instead of Thursday. We are aware that this would create difficulties in regard to meetings of general committees, but surely these could be overcome.

The President of Section G this year was Prof. L. F. Vernon-Harcourt, who opened the proceedings of the Section by reading his presidential address.

The first paper taken was a contribution by Major-General Webber, on light railways as an assistance to agriculture. It contained the main elements of a scheme which the author had thought out for introducing a system of light railways in Suffolk. A good deal of attention was given to the subject of gauge, which the author considered should be narrower than the standard gauge of the country, viz. 4 ft. 8½ in. There is much to be said in favour of a narrow gauge for auxiliary railways, but also much to be said against it. No doubt a narrow gauge is cheaper than a wider one, but perhaps not so much cheaper as many persons imagine. Sharper curves can also be taken with a narrow gauge, and it can be laid in position where often the broader gauge would necessitate the widening of the road. On the other hand, the standard gauge enables the waggons and trucks of the trunk lines to be run on the auxiliary railways. It may be said that a light railway demands—on the score of cheapness—that the road bed shall be of a less substantial character than that of the trunk lines; but here it is essential to bear one fact in mind. The massive permanent way of our trunk lines is required for the heavy locomotives running at high speed. With small engines and comparatively slow speed very light permanent way will carry the ordinary railway goods stock with safety. The first thing, however, which has to be done in order to facilitate the introduction of auxiliary railways in this country, is to give power to the Board of Trade to relax its own regulations.

A paper by M. A. Gobert, of Brussels, on a freezing process for shaft-sinking, was next read. In general principle the suggestion is not new. In cases where water-bearing strata is encountered in shaft-sinking, a freezing medium is caused to circulate in pipes. The vehicle used is ammonia, which, evaporating in the pipes, produces the freezing effect.

The next paper read was of considerable interest; it was a memoir by Mr. W. H. Wheeler, of Boston, on the effect of wind and atmospheric pressure on the tides. For many years past the author has been making observations on this subject. From an analysis of two years' tides at the Port of Boston, (excluding occasions when the element of wind would affect the case), he found that out of 152 observations, 61 gave results opposite to that which would have been expected by the readings of the barometer alone; for a high barometer was frequently accompanied by a high tide, and a low barometer by a low tide. On the other hand it was found, with few exceptions, that when the wind blows with any force along a coast in the same direction as the main stream of the flood tide, the tides at all the ports along the coast will be higher than the calculated height given in the tide-tables; and when the wind blows against the flood tide, high-water will be lower than calculated. According to figures quoted in the paper, the effect of wind is such as to affect the tide as much as 5 to 6 feet, and a difference of as much as 8 feet has been observed between two succeeding tides. An analysis of the register of tides at Boston Dock for two years showed that 24 per cent. of the whole tides recorded were sufficiently affected by the wind to vary 6 inches from the calculated height. Thirty varied by 2 feet, seven by 3 feet, six by 3½ feet, three by 4 feet, two by 4½ feet, one by over 5 feet, and one by 6 feet 3 inches. From the observations he has made, Mr. Wheeler has deduced the approximate rule that with a given force of wind of 3 on the Beaufort scale a tide will be raised or depressed by half an inch for every foot of range. With a force of from 4 to 6, the variation may be expected to be 1 inch for every foot, with a gale from 7 to 8 it will be 1½ inches, and if the gale increases to 10 it will be 2 inches. It will be seen that the subject is one which possesses not only scientific interest, but considerable practical importance to mariners; and so far as we are aware, Mr. Wheeler is the first who has obtained quantitative results of this nature. In the discussion which followed, it was pointed out that the time element would have to be given its due value.

At the second sitting of the Section, on Friday, the 13th ult., Mr G. J. Symons gave what was really a lecture on the autumn floods of 1894. This contribution was discussed together with a paper by Messrs. Rapier and Stoney, on weirs in rivers. Any contribution by Mr. Symons is sure to meet with a good reception at a meeting of the Association, and Mr. Stoney's work in connection with river engineering is also so well known, that it was not surprising that the attendance in the Section should be a full one when the sitting opened. The floods of November of last year, it will be remembered, were of an unusually severe character, a great part of the low-lying lands of the Thames Valley being submerged. The meteorological conditions which led to these floods were traced by Mr. Symons, and the effects stated. With regard to the latter, it would be but to repeat a long history of flooded homes, spoiled furniture, and general damage to property. The extent of course will never be known, but it was sufficient to be accounted a calamity of considerable magnitude. There were two periods of heavy rainfall quickly succeeding each other, but it was the second which was the immediate cause of damage; the first, if it had stood alone, would have been comparatively innocuous. The first period occurred at the end of October, and nearly all the additional land water caused by it had passed over Teddington Weir before the second period arrived. The November rains, however, found the earth well saturated, and the water that fell ran therefore almost wholly into the river bed, with the unfortunate results before referred to. The moral Mr. Symons chiefly strove to impress was the necessity of automatic records and communication between different divisions of a water-shed, so that prompt warning might be given of a probable flood. Such precautions are taken by continental nations, but in England they are sadly neglected. The necessity for obtaining accurate data, and treating it in a systematic and scientific manner by trained observers, was well illustrated by instances given; for example, the river Mole was at its highest four days before the Thames, and if the warning thus given by nature had been heeded, much of the damage which followed might have been prevented.

The second paper gave a good description of the movable weirs which have become identified with Mr. Stoney's name, and which were so prominently brought before public notice in connection with the Manchester Ship Canal. A more recent example, and one which is better known to Londoners, is that at Richmond, where there is a half-tide lock and a series of lifting weirs. It has been claimed that if many of the fixed weirs in the Thames were removed, and these lifting weirs substituted for them, that there would be less danger from flooding of the river. How far Messrs. Rapier and Stoney go in this direction we did not gather from the paper, but such we took to be the general drift of their argument. The position was disputed during the discussion which followed, it being maintained by some speakers that even if the flow of water were absolutely unimpeded as far as Teddington Weir, the tidal portion of the river-channel is not of sufficient section to carry off all water that comes down in time of heaviest rainfall. The question is complicated by the ebb and flow of the tide, but it ought not to be impossible to arrive at a fairly definite conclusion. The matter is one which wants investigation by a competent authority, for we did not notice that any more than general statements were made in support of the alleged insufficiency of the tidal channel; and the statements, therefore, did not appear to rest on a substantial basis of fact. The problem of the utilisation of the head of water at the weirs in the Thames was also brought forward. Without going into details, it may be said that the discussion tended to show that there is little probability of any useful work being done in this direction unless some entirely new departure in the construction of turbines be discovered, Mr. Stoney, however, in his reply to the discussion, gave a sketch of a very ingenious device by which he proposed to increase the available head in the case of its diminution by the rise of water in a river. We think, however, that something more than this will be needed before the Thames weirs become commercially successful as a source of power.

Dr. Anderson described a rotating fan he had devised, to be used in place of bellows for organ-blowing. The application was successful, as might be supposed in the case where a volume of air, large in comparison with its velocity, was required to be set in motion. A paper by Mr. Birt, on the growth of the port of Harwich, was interesting from a commercial and economic point of view, and may be taken in conjunction with a note by the President, on the Hook of Holland route.

A description of a railway up Snowdon, which is in course of construction, brought the proceedings of the day to a close.

On Saturday the proceedings commenced with the presentation of two reports by Committees of the Section; the first on standardising, and the second on coast erosion. The standardising report was of an interim character, and does not require extended notice, in prospect of being brought forward again. The coast erosion report was also presented in another Section. Mr. A. G. Lyster gave a long description of the dredging operations now going on at the mouth of the Mersey to reduce the bar which has too long been allowed to impede the navigation of our great Atlantic port.

A paper by Mr. E. Hesketh, describing a process of refrigerating by carbonic anhydride, was next taken. This was a very interesting contribution, and afforded a good example of the type of paper that should be presented to the Section. It does not, however, lend itself very easily to our present purpose, as it consisted mainly of details of construction of the machinery, which, though highly interesting, it would be impossible for us to make clear without the many illustrations by which the author explained his meaning. Another good and characteristic paper was contributed by Mr. J. Napier, who described an installation that has been carried out at Ipswich of the Hermite process of purifying sewage. Briefly stated, the process consists of passing an electric current through sea-water. A part of the chlorides is converted into hypochlorite, and a deodorising agent is thus obtained. The electrolysed water is passed into the drains or sewers. The system, if worked to the full extent, as proposed by the inventor, would consist of having a separate service of the electrolysed water laid on for use in closets, house drains, &c. The system has been in use but a short time in Ipswich, and is said to promise very favourably by those who have been connected with its working.

The Monday of the meeting is always devoted by Section G to electrical engineering, and at the recent meeting the proceedings on that day, the 16th ult., were opened by a long paper from the pen of Mr. Philip Dawson, on the modern application of electricity to traction purposes. Mr. Dawson has evidently travelled much in the United States, and has there collected a vast amount of data bearing on the subject of his paper. To attempt to follow him into the details he gave in his paper would be hopeless in this report. He is a strong advocate of the trolley system of transmission, holding that it will supersede all others; and indeed experience in America goes far to bear him out in this. It is needless here to point out how great has been the progress made in the United States in tramway propulsion by electricity; but one fact stated at the meeting may be repeated, as it puts the whole matter very forcibly. It was said that it is becoming a great problem what is to be done with the horses that are being pushed out of the field by electricity. In some places they are being killed for the sake of their hides and tallow; whilst in other districts good horses were to be bought at two dollars each. The latter figure we think may be open to question, for surely a dead horse is worth more than two dollars. However, there is no doubt that electric traction has made immense strides in America, and has in great cities practically supplanted not only the horse and mule, but is fast edging out its mechanical rivals the cable and steam engine.

The next item on the agenda was a paper by Messrs. Preece and Trotter, on an improved portable photometer. This paper was listened to with great interest; Mr. Trotter illustrating his remarks by examples of the different forms and apparatus he had devised for street work. The paper began by a definition of what is meant by illumination. When light falls upon a surface, that surface is said to be illuminated. The illumination depends simply upon the light falling on the surface, and has nothing to do with the reflecting power of the surface, just as rainfall is independent of the nature of the soil. It depends also on the cosine of the angle of incidence. The lighting of streets and of buildings may be specified by the maximum and minimum illumination. The primary purpose of an illumination photometer is to measure the resulting illumination produced by any arrangements of lamps irrespective of their number, their height, or their candle-power. The instrument under notice consisted of a box, on the upper surface of which is a diaphragm of white card painted with a whitewash of magnesia and isinglass. It has one or more star-shaped perforations. Immediately below it, within the box, is a white screen capable of adjustment at different angles and two small electric lamps of different candle-power, either or both of which can be used. A portable secondary battery is used to supply them with current. The illumination of the hinged screen inside the box varies approximately as the cosine of the angle of incidence of the light from the electric lamps upon it. A handle with a pointer moving over a graduated scale is connected to the screen with a system of levers, and the inclination is so adjusted that the illumination of the screen is equal to that of the perforated diaphragm, the perforations seeming to disappear when this balance is affected. The illumination can then be read off on the scale in units of the illumination due to one standard candle at one foot distance. The object of the levers is to give an open and convenient scale. The scale is graduated by experiment, and does not depend upon the the cosine law. The colour difficulty, where arc light or daylight is to be measured, is reduced by the use of a yellow-tinted diaphragm and a blue-tinted screen, the tints being selected so that the readings are the same as the mean of a large number of measurements made with white screens. By means of a graduated quadrant and a gnomon the angle and the cosine of the angle of incidence of the light from a lamp may be measured. Rules are given for deducing the height of the lamp and the slant height, and hence the candle-power of the lamp.

The discussion on this paper was of a very brief nature, and elicited no new facts of importance.

Mr. H. A. Earle read a paper on storage batteries, dealing chiefly with the chloride battery which has lately been introduced, and which, it is claimed, possesses the advantages of other and earlier types without many of the attendant disadvantages, chiefly from the fact that an oxide paste is not used. A mixture of chloride of lead and chloride of zinc is cast into small tablets, which have cast round them at high pressure a frame of antimonious lead. The subsequent elimination of the chloride and zinc leaves a porous structure of pure lead of a crystalline nature, good conductivity, and with a large surface exposed to the electrolyte. The result is a large capacity for a given weight and space occupied.

At the last sitting of the Section, held on Tuesday, the 17th ult., nine papers were read and discussed. We must deal with these very briefly. The first was by Mr. P. V. Luke, and was entitled "the field telegraph in the Chitral campaign." It was of a popular nature, and was illustrated by magic lantern. Mr. G. Johnstone Stoney explained, by the aid of the apparatus itself, a movement designed to attain astronomical accuracy in the motion of siderostats. Without the aid of diagrams it would not be possible to explain the mechanism, and we will leave it therefore for the present. A paper by Mr. F. W. Turner explained the modern process of preparing flour from the wheat berry by means of metal rollers in place of the old millstones. The paper was very interesting and treated the whole subject throughout, illustrations of the various machines used being hung on the walls. Mr. J. Southward gave an interesting description of the Linotype process of printing, describing in detail and by the aid of illustrations the really wonderful machine which has been devised for the purpose. Mr. R. E. Crompton, in a memorandum on the B. A. screw gauge for small screws, pointed out the advantage that would follow if complete uniformity were observed among manufacturers in this matter, and dwelt on the desirability of a standard plate being provided for the purpose by the Board of Trade. Mr. John Key contributed a paper describing the differences in the practice of English and foreign Government departments and registration societies in their requirements for the provision for safety in marine boilers and enginees. The want of uniformity here again is undoubted.

Lieut. B. Baden-Powell described a means he suggested for navigating the air by means of kites. He pointed out that as greater height above the surface of the earth is reached, the wind nearly always increases in force. At 1000 yards it often blows at three times the velocity that it does near the surface. He proposes to take advantage of this difference by sending one kite to the upper atmosphere, and keeping another nearer the ground. The two kites would be connected by a long line, and the weight to be carried would be attached to the line at a point nearer to the lower kite than to the higher. The lower kite would thus supply a retarding medium to the upper, so that the effect would be the same in principle, though not in degree, as if the upper kite were held to the earth by a string, and the lower kite were towed through the air by a boy running with the string in his hand. By the forces thus brought to bear both kites would be kept flying although not held to the earth by a string in the usual way, and it is thought that possibly they might be navigated in directions other than that in which the wind might be blowing. It will be seen that the author depends on the difference in velocity of currents of air at two heights; and were this difference to fail, or to become insufficient, the experimenter would come to the ground. This might prove awkward unless a clear field were provided for the descent. The suggestion however is ingenious, and no doubt many persons interested in the problem of aerial navigation would be pleased to see the author put his theories to the test of practice.

The last paper presented at the meeting was a contribution by Prof. A. E. Elliott, of Cardiff, on receiver and condenser drop. It is a subject that deserves far more consideration and discussion by members of the Section than they were able to give on hearing it read rapidly at the end of the meeting. Papers of this nature should be read at one meeting, and the discussions adjourned until another; or perhaps it would be better to distribute them two or three months before the meeting, and dispense with reading altogether. A joint meeting of Sections A and G would afford the appropriate audience for considering the subject of Prof. Elliott's memoir.

BOTANY AT THE BRITISH ASSOCIATION.

THE President (Mr. Thiselton-Dyer) exhibited photographs and specimens of a large cedar (*Cedrus Deodara*, Loud.) from Kew, which had been struck and completely shattered by lightning on August 10. It was pointed out that the main stem had been in part blown into matchwood by the violence of the shock, and branches were torn off with large portions of the trunk adhering to their base. Prof. Oliver Lodge took part in the discussion as to the probable explanation of the unusual nature of the explosion, which seemed to have been centrifugal, the stem having been disrupted from the centre, and not merely stripped superficially.

Prof. Bretland Farmer described a set of wax models illustrating the typical forms passed through, and the chief variations exhibited, by the chromosomes during the division of the nucleus in the spore-mother cells of plants. The wax employed is made of a mixture of one part of white wax, with five parts of paraffin, the melting point of which is about 50° C.

THALLOPHYTA.

Experimental studies in the variation of yeast cells, by Dr. Emil Chr. Hansen (Copenhagen). The author gave an account of his earlier and more recent investigations. Among the latter he especially dwelt on those in which, by one treatment, varieties were produced that gave more, and by another treatment less, alcohol than their parent cells. He pointed out that the observed variations could be grouped under certain rules. From his researches on the agencies and causes to which variation is due, he found that temperature was the most influential external factor.[1]

A false *Bacterium*, by Prof. Marshall Ward, F.R.S.

On the formation of bacterial colonies, by Prof. Marshall Ward, F.R.S.

On the structure of bacterial cells, by Harold Wager. In this paper an account was given of the present state of our knowledge of the cells of bacteria. Reference was made to the observations of Schottelius, Migula, De Bary, Bütschli, and others. The author showed that it is possible to demonstrate in the majority of bacterial cells the presence of two substances, one of which may be regarded as protoplasmic in nature, and a second, which stains deeply when acted upon by fuchsin and kindred staining substances, and which may be regarded as nuclear. It was pointed out that this nuclear substance does not possess the structure of nuclei in the cells of higher plants.

Note on the occurrence in New Zealand of two forms of Peltoid *Trentepohliaceæ*, and their relation to the lichen *Strigula*, by A. Vaughan Jennings. The *Trentepohliaceæ* which form epiphyllous cell-plates are at present known only from the tropics. They have been recorded from South America, India, Ceylon, and the East Indies, but not up to the present time from New Zealand. The author gave a summary of previous literature, and described two forms found by himself in New Zealand. (1) *Phycopeltis expansa*, sp. nov. This species forms wide-spreading yellow cell-plates on the leaves of *Nesodaphne*; it bears two kinds of sporangia, and is often associated with brown fungus hyphæ growing between the cell rows, but not affecting the growth of the alga. On the other hand, when attacked by different hyphæ, the result is the formation of the lichen *Strigula*, which in Ceylon was shown by Ward to have for its algal element *Mycoidea parasitica*, Cunn. (2) *Phycopeltis nigra*, sp. nov. On leaves of *Nesodaphne* and fronds of *Asplenium falcatum*. Two distinct varieties of this species were described. The plant is never attacked by fungus hyphæ, and never takes any part in lichen formation, even when on the same leaf with *Phycopeltis expansa* and the associated *Strigula*.

BRYOPHYTA AND PTERIDOPHYTA.

On a supposed case of symbiosis in *Tetraplodon*, by Prof. F. E. Weiss. The author exhibited specimens of *Tetraplodon* from the Cuchullin Hills in Skye, where it was found plentifully on animal excreta. In September he found many of the patches mixed with an orange-coloured *Peziza*, which did not appear to have in any way injured the moss plants. The rhizoids of the moss, however, contained in many cases fungal hyphæ closely resembling those of the *Peziza*, and though present in the cells of the moss, these latter did not seem to be injured by them. He suggested that this might be an instance of symbiosis; the moss, as in the case of other green plants, making use of the fungal hyphæ to obtain its nutriment from the organic material. The ultimate proof of such a case of symbiosis would, however, necessarily depend upon culture experiments, which he understood were now being made by another observer.

Remarks on the Archesporium, by Prof. F. O. Bower, F.R.S. Prof. Bower pointed out that the recognition of the archesporium as consistently of hypodermal origin cannot be upheld, and quoted as exceptions *Equisetum*, *Isoetes*, *Ophioglossum*, and especially the leptosporangiate ferns. He laid down the general principle that the sporangia, as regards their development, should be studied in the light of a knowledge of the apical meristems of the plants in question. Where the apical meristems are stratified, the archesporium is hypodermal in the usual sense; where initial cells occur, the archesporium is derived by periclinal divisions of superficial cells. Intermediate types of meristem show an intermediate type of origin of the archesporium. He cited as an illustrative case that of *Ophioglossum*, admitting that the hypodermal band of potential archesporium, which he had previously described, does not occur always or in all species. But so far from thus giving up the case for a comparison with *Lycopodium*, he holds that as *Ophioglossum* has a single initial cell in stem and root, it would be contrary to experience to expect or demand a hypodermal archesporium. (The details will shortly be published elsewhere, with illustrations.)

On the prothallus and embryo of *Danæa*, by G. Brebner. Mr. Brebner gave an account of the prothallus and sexual organs of *Danæa simplicifolia*, Rudge, as the result of investigations made on some material from the Botanic Gardens in British Guiana. He pointed out that there is a close similarity between the *Danæa* and the other two genera of the *Marattiaceæ*, *Angiopteris* and *Marattia*, of which the prothallus has been previously described. An interesting fact was noted as regards the prothallus rhizoids, which possess a distinctly septate structure, and so far resemble a moss protonema. Possibly similar septate rhizoids may be found in the other marattiaceous genera. The development of the antheridia of *Danæa* agrees in the main with that in *Marattia* and *Angiopteris*:

[1] A fuller account of Dr. Hansen's work will be published in the *Annals of Botany*.

the material did not allow of any developmental study of the archegonia. The concentric bundle of the primary embryonic stem shows an endodermal layer. On the whole the author found in *Danæa* a complete agreement, in all essential features, with *Angiopteris* and *Marattia*, as regards prothallus, reproductive organs, and embryo development.

PHYSIOLOGY, &c.

The localisation, the transport and *rôle* of hydroycanic acid in *Pangium edule*, Reinw., by Dr. M. Treub (Buitenzorg, Java).—Five years ago Dr. Greshoff made the remarkable discovery that the poisonous substance contained in great quantities in all the parts of *Pangium edule*, was nothing else than hydrocyanic acid. This interesting chemical discovery was the starting-point of Dr. Treub's physiological investigations. In microchemical researches hydrocyanic acid presents a considerable advantage as compared with the great majority of substances to be detected in tissues by reagents; namely, that the Prussian blue reaction, easily applicable in microchemical research, gives completely trustworthy results. The appearance of Prussian blue in a cell may be accepted as certain proof of the previous occurrence in the cell of hydrocyanic acid, no other substance producing the same reaction. The leaves prove to be the chief factories of hydrocyanic acid in *Pangium*, though there are other much smaller local factories of this substance in the tissues of other organs. The hydrocyanic acid formed in the leaves is conducted through the leaf-stalks to the stem, and distributed to the spots where plastic material is wanted. The acid travels in the phloem of the fibro-vascular bundles. Dr. Treub regards the hydrocyanic acid in *Pangium edule* as one of the first plastic materials for building up proteids; he thinks it is, in this plant, the first detectable, and perhaps the first formed product of the assimilation of inorganic nitrogen. In accordance with this hypothesis, the formation of hydrocyanic acid in *Pangium* depends, on the one hand, on the presence of carbo-hydrates or analogous products of the carbon-assimilation, and, on the other hand, on the presence of nitrates. These two points were proved, or at least rendered acceptable, by a great number of experiments made by Dr. Treub in the Buitenzorg Gardens. (The details of this investigation will be found in a paper appearing in the forthcoming number of the *Annales de iardin botanique de Buitenzorg*.)

On the diurnal variation in the amount of diastase in foliage leaves, by Prof. Reynolds Green, F.R.S. The diastase which is present in foliage leaves varies in amount during the day, being greatest in the early morning, and least after sunset. The cause of the variation has been ascertained to be chiefly, if not entirely, due to the action of the sunlight. The author showed last year, at the Oxford meeting, that diastatic extracts exposed to sunlight or electric light, without the interposition of any form of screen, have their activity largely impaired, the damage amounting sometimes to 70 per cent. Experiments made upon the living leaf of the scarlet-runner showed a similar destructive action of the light, the amount of destruction only amounting, however, to about 10 to 20 per cent. The author attributes this difference to the screening action of the proteids in the cells of the leaf.

On cross and self fertilisation, with special reference to pollen prepotency, by J. C. Willis. The time has passed for regarding self-fertilisation as being always necessarily harmful in itself, and it is now recognised as a regular feature in the life-history of many plants. There are many species of plants in which both self and cross pollination occur nearly, or quite, simultaneously, and it is very desirable to know what happens in these cases. Darwin's experiments render it probable that prepotency of foreign pollen is usual. The author's experiments have been devoted to a study of the relative chemical attraction of "own" and "foreign" pollen by the same stigma (chiefly in gelatine and agar cultures), and have given negative results. It seems probable, putting together all the various known facts, that prepotency, where it occurs, is due to actions set up after the pollen tubes have entered the stigma, these actions tending to favour the growth of the "foreign" pollen-tubes, and to check that of the "own" pollen.

PALÆOBOTANY.

The chief results of Williamson's work on the Carboniferous plants, by Dr. D. H. Scott, F.R.S. The origin and history of the late Prof. Williamson's researches on the Carboniferous flora were briefly traced. His great work, chiefly, though not entirely, contained in his long series of memoirs in the *Philosophical Transactions* of the Royal Society, consisted in thoroughly elucidating the structure of British fossil plants of the Coal period, and thus determining, on a sound basis, the main lines of their affinities.

Four of the principal types investigated by Williamson were selected for illustration—the *Calamarieæ*, the *Sphenophylleæ*, the *Lyginodendreæ*, and the *Lycopodiaceæ*.

(1) The *Calamarieæ*.—Williamson's great aim, which he kept in view all through, was to demonstrate the essential unity of type of the British Calamites, *i.e.* that they are all Cryptogams, of equisetaceous affinities (though sometimes heterosporous), but possessing precisely the same mode of growth in thickness by means of a cambium, which is now characteristic of Dicotyledons and Gymnosperms. His researches have given us a fairly complete knowledge of the organisation of these arborescent Horse-tails.

(2) The *Sphenophylleæ*, a remarkable group of vascular Cryptogams, unrepresented among living plants, but having certain characters in common both with *Lycopodiaceæ* and *Equisetaceæ*, are now very thoroughly known, owing, in a great degree, to Williamson's investigations. The discovery of the structure of the fructification, absolutely unique among Cryptogams, was in the first instance entirely his own.

(3) The *Lyginodendreæ*.—The existence of this family, which consists of plants with the foliage of ferns, but with stems and roots which recall those of Cycads, was revealed by Williamson. This appears to be the most striking case of an intermediate group yet found among fossil plants.

(4) The *Lycopodiaceæ*.—Williamson added enormously to our knowledge of this great family, and proved conclusively that *Sigillaria* and *Lepidodendron* are essentialy similar in structure, both genera, as well as their allies, being true Lycopodiaceous Cryptogams, but with secondary growth in almost all cases. He demonstrated the relation between the vegetative organs and the fructification in many of these plants, and by his researches on *Stigmaria*, made known the structure of their subterranean parts. The different types of *Lepidodendron*, of which he investigated the structure, were so numerous, as to place our knowledge of these plants on a broad and secure foundation. (The paper was illustrated by lantern-slides, partly from Williamson's figures, and partly original.)

On a new form of fructification in *Sphenophyllum*, by Gra. Solms-Laubach (Strassburg). Graf Solms gave a brief sketch of the history of our knowledge of the fructification of the Carboniferous genus *Sphenophyllum*. He described the type of strobilus originally named by Williamson *Volkmannia Dawsoni*, and subsequently placed by Weiss in the genus *Bowmanites*; this fructification has recently been shown by Williamson and Zeiller to belong to *Sphenophyllum*. The author proceeded to give an account of a new form of strobilus recently obtained from rocks of Culm age in Silesia; this shows certain important deviations from the fructifications previously examined. In the *Sphenophyllum* strobili from the Coal-Measures the axis bears successive verticils of coherent bracts, the sporangia are borne singly at the end of long pedicels twice as numerous as the bracts, and arising from the upper surface of the coherent disc near the axil. In the Culm species, *Sphenophyllum Römeri*, sp. nov., the bracts of successive whorls are superposed and not alternate, as described by other writers, in the Coal-Measure species; a more important feature of the new form is the occurrence of two sporangia instead of one on each sporangiophore or pedicel.

In the course of his remarks, Graf Solms referred to the unique collection of microscopic preparations of fossil plants left by Prof. Williamson; he emphasised in the strongest terms the immense importance of the collection, and pointed out how every worker in the field of Palæozoic botany must constantly consult the invaluable type specimens in the Williamson cabinets.

On English amber, by Dr. Conwentz (Danzig). The author of this paper gave an account of the Baltic and English amber, and its vegetable contents. After describing the different forms of Tertiary amber, he referred to the occurrence of succinite on the coasts of Essex, Suffolk, and Norfolk; the specimens being usually found with seaweed, thrown up by the tides. Occasionally pieces have been met with weighing over two pounds. Dr. Conwentz described the method of examining the plant fragments enclosed in amber, and compared the manner of preservation with that of recent plant sections mounted in Canada balsam. The amber was originally poured out from the roots, stems, and branches of injured or broken trees, in the form of resin, which on evaporation became thickened, and finally assumed the form of succinite or some similar substance. For the most part the fossil resin has been derived from the stems and roots of coniferous trees of the genus *Pinus*. In addition to the exceptionally well-preserved tissues of coniferous trees, the Baltic amber has yielded remarkable specimens of monocotyledonous and dicotyledonous flowers. Some of the most striking examples were illustrated by means of the excellent coloured plates from Dr. Conwentz' monographs on the Baltic amber.

The Wealden flora of England, by A. C. Seward. Mr. A. C. Seward, after referring to the various species described by Mantell, Carruthers, Starkie Gardner, and others, from the Wealden strata of England, briefly described a large number of plants from the British Museum collection. During the last few years Mr. Rufford, of Hastings, has obtained an extremely valuable and rich collection of plants from Ecclesbourne, Fairlight, and other localities; and these have now become the property of the nation. The following species are at present known from the Wealden of England; some of these have already been figured in the first volume of the catalogue of the Wealden flora, and the remainder are dealt with in the forthcoming second volume:—*Algites valdensis*, sp. nov., *A. catenelloides*, sp. nov., *Chara Knowltoni*, sp. nov., *Marchantites Zeilleri*, sp. nov., *Equisetites Lyelli*, Mant., *E. Burchardti*, Dunk., *E. Yokoyamæ*, sp. nov., *Onychiopsis Mantelli* (Brong.), *O. elongata* (Geyl.), *Acrostichopteris Ruffordi*, sp. nov., *Matonidium Göpperti* (Ett.), *Protopteris Witteana*, Schenk., *Ruffordia Göpperti* (Dunk.), *Cladophlebis longipennis*, sp. nov., *C. Albertsii* (Dunk.), *C. Browniana* (Dunk.), *C. Dunkeri* (Schimp.), *Sphenopteris Fontainei*, sp. nov., *S. Fittoni*, sp. nov., *Weichselia Mantelli* (Brong.), *Tæniopteris Beyrichii* (Schenk.), *T. Dawsoni*, sp. nov., *Sagenopteris Mantelli* (Dunk.), *S. acutifolia*, sp. nov., *Microdictyon Dunkeri*, Schenk., *Dictyophyllum Römeri*, Schenk, *Leckenbya valdensis*, gen. et sp. nov., *Tempskya Schimperi*, Cord., *Cycadites Römeri*, Schenk., *C. Saportæ*, sp. nov., *Dioonites Dunkerianus* (Göpp.), *D. Brongniarti* (Mant.), *Nilssonia Schaumburgensis* (Dunk.), *Otozamites Klipsteinii*, (Dunk.), *O. Göppertianus* (Dunk.), *Zamites Buchianus* (Ett.), *Zamites Carruthersi*, sp. nov., *Anomozamites Lyellianus* (Dunk.), *Cycadolepis*, *Carpolithes*, *Androstrobus Nathorsti*, sp. nov., *Conites elegans* (Carr.), *C. armatus*, sp. nov., *Bucklandia anomala* (Stokes and Webb), *Fittonia Ruffordi*, sp. nov., *Bennettites Saxbyanus*, Brown, *B. Gibsonianus*, Carr., *B.* (*Williamsonia*) *Carruthersi*, sp. nov., *Yatesia Morrisii*, Carr., *Withamia Saportæ*, gen. et sp. nov., *Becklesia anomala*, gen. et sp. nov., *Dichopteris*, sp., *Sphenolepidium Kurrianum* (Schenk.), *S. Sternbergianum* (Dunk.), *Pagiophyllum crassifolium* (Schenk.), *Brachyphyllum obesum*, Heer, *B. spinosum*, sp. nov., *Pinites Solmsi*, sp. nov., *P. Dunkeri*, Carr, *P. Mantelli*, Carr, *P. patens*, Carr., *P. Carruthersi*, Gard., &c.

SCIENCE IN THE MAGAZINES.

THE personal reminiscences of Huxley, contributed by Mr. George W. Smalley to the current number of *Scribner*, will bring up pleasant memories to those who were honoured by the friendship of the departed naturalist, and they form an affectionate tribute "to the memory of one of the truest men who ever lived, one of the manliest, and in all points the noblest." There is in the article so much real testimony to Huxley's greatness, that every student of science will appreciate it. "The emancipation of thought," truly says Mr. Smalley, "that is Huxley's legacy to his century—that was his continual lesson of intellectual honesty." Against those who criticised Huxley's philosophical learning we quote these words: "In truth he was a very expert metaphysician, with an extraordinary knowledge of the literature of metaphysics and philosophy. . . . Huxley was a student, and more than a student, of Descartes. He has written the best short book in existence on Hume. He was a pupil of Aristotle, and therefore not a Platonist. Hobbes taught him much; Berkeley was to him a great thinker; Locke, Butler, and the short list of really great names in English philosophy were all his familiars, while among the great Germans there was, I think, none whom he did not know well—Kant, Hegel, Fichte, and all that illustrious line, not excepting Schopenhauer." But Huxley's claim to recognition as one of the world's foremost thinkers, now unhappily lost to us, need not be enlarged upon here. "He will be remembered as the great physiologist, the great student, the great controversialist, the great thinker and writer. That he will be remembered need not be doubted. The world, it may still be said, does not willingly let die the memory of those who have made it a better world to live in, whose lives as well as whose teachings have been lessons of devotion, of high aims, of wide accomplishments, of honourable purpose; whose achievements are written imperishably in the annals of their own time. Huxley was one of these, and his monument in his life's endeavour. There will be no need to inscribe Right Honourable upon his tomb. The name he bore through life will serve both for epitaph and eulogy."

There are other articles in *Scribner* which will interest the readers of NATURE. One of these is a fully illustrated description of the new Chicago University, by Mr. Herrick. Magnificent buildings have been erected, and an endowment of over £1,200,000 has been bestowed in the short period of four years, as well as a generous annual budget for current expenses. This phenomenal generosity, together with the fact that there will be no question of adequate support as fresh opportunities for development occur, point to the University of Chicago as a great and growing centre of intellectual activity. In some respects the system of the University resembles that of our older Universities, but others—such as the emphasis placed upon the doctor's degree, investigation, research, &c., and the activity of the graduate schools—point to the German University as the prevailing influence. It will astonish many of our schoolmen to know that "the graduates in residence this year—in all over three hundred—form more than one-third of the entire body of students, a larger number than at any other American University. This preponderance of graduate students has been brought about by several reasons: the emphasis placed upon the advanced courses under the leadership of such heads of departments as Profs. Dewey, Hale, von Holst, Laughlin, Michelson and Nef, not to mention others; the special privileges and distinctions granted to graduates (for example, in many departments only graduate students are allowed in the special departmental laboratories, the £6000 annually offered in fellowships and scholarships; and the equal privileges accorded to women. It is a truism that the most distinctive move in American college life of the last decade has been in the sudden interest in post-graduate study. But hitherto in Western institutions, whether college or so-called university, has had the means to provide liberally for advanced studies." It will be clear from this quotation, and more clear from a perusal of the article, that the University of Chicago is developing in the right directions towards scholarship and new knowledge. Chicago people seem to have the cause of higher education at heart, and they are devoting their best energies, as well as generous financial support, to the magnificent institution which has so quickly sprung into existence, and which has such a great future before it.

The third article of scientific interest in *Scribner* is on "Domesticated Birds," by Prof. N. S. Shaler, and is beautifully illustrated.

The sixth of Mr. Herbert Spencer's papers on professional institutions, contributed to the *Contemporary*, deals with the evolution of men of science and philosophers, and will, therefore, be of exceptional interest to our readers. So far as the series has as yet gone, it has been shown that the institutions dealt with were probably derived from the priesthood. Whatever may be the opinion with regard to the connection between the medical profession and priestcraft, it will be generally conceded that astronomy received its first impulse from the exigencies of religious worship. Extracts given by Mr. Spencer from Rawlinson, Layard, and Maury show clearly how closely religion and science (especially astronomical science) were mingled by the Babylonians. With the Egyptians, too, there is abundant evidence to prove an intimate connection between their science and their religion; and the connection is established by the fact that "in every temple there was . . . an astronomer who had to observe the heavens." Astronomy was thus an outgrowth of religion, and the natural knowledge accumulated by the priests formed the beginnings of sciences in Egypt, Assyria, and India. The Greeks imported this knowledge; in other words, they obtained their early science in a slightly developed state. Of the indebtedness of the Greek philosophers to the Egyptian priests there is no doubt whatever, and Mr. Spencer clearly makes out that obligation. The development of Greek science, however, is only in a small measure ascribed to the priesthood, the advances being more of secular than of sacred origin. "During those centuries of darkness which followed the fall of the Roman Empire," says Mr. Spencer, "nothing to be called science existed. But when, along with gradual reorganisation, the re-genesis of science began, it began as in earlier instances among the cultured men—the priesthood." The man of science and the philosopher have gradually differentiated from the clerical class, one to deal with the concrete and the other to be concerned with abstract matters, and now the distinction between the two is tolerably definite. Simultaneously a subdivision of the body of scientific men has gone on, until we reach these days of minute specialisation. And finally, we have the combination of the units in such institutions as the Royal Society and British Association, and in the serial scientific publications which are general in their scope. In addition to the admirable article summarised in the foregoing, Mr. Spencer contributes to the *Contemporary* a brief note in reply to Prof. Weismann.

A suggestive paper, by Dr. A. R. Wallace, on "The Expressiveness of Speech," appears in the *Fortnightly*. The paper contains a number of interesting facts which point to mouth-gesture as a factor in the origin of language. Here is Dr. Wallace's idea: "In our own language, and probably in all others, a considerable number of the most familar words are so constructed as to proclaim their meaning more or less distinctly, sometimes by means of imitative sounds, but also, in a large number of cases, by the shape or the movements of the various parts of the mouth used in pronouncing them, and by peculiarities in breathing or in vocalisation, which may express a meaning quite independent of mere sound-imitation." Anthropologists and philologists should be interested in the many facts which Dr. Wallace has brought together in support of his view.

Limits of space prevent us from giving more than brief descriptions of the remaining articles of scientific interest in the magazines received. In *Science Progress*, Mr. F. H. Neville traces recent progress in the study of alloys; galvanotropism in tadpoles is described by Dr. A. Waller, F.R.S.; the chromatophores of animals, by Mr. W. Garstang; the space relation of animals, by Dr. A. Eiloart; and the synthesis of proteids, by Prof. W. D. Halliburton, F.R.S. *Chambers's Journal* has short popular papers on "Horseless Carriages," "New Methods of Illumination," and "Cotton-Seed Oil." In *Good Words* we notice an article on "Falconry," by Mr. R. B. Lodge, illustrated by two photographs from life—one showing a peregrine and partridge, and the other a goshawk and rabbit. The two plates are finely engraved, but we think their value would have been greater had they been photographic reproductions from the original negatives. The *Humanitarian* is distinguished by a psychical article entitled "Dynamic Thought," by Prof. W. F. Barrett; and the *National Review* has a paper in which Selbornians will find pleasure, by the Hon. Mrs. R. Boyle. In addition to the magazines named in the foregoing, we have received the *Sunday Magazine* and *Longman's*.

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UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Five candidates, namely, R. A. Berry, G. Joyce, H. C. Sheringham, W. M. Tod, and B. N. Wale, have been successful in the recent examination in the science and art of agriculture, and have received the University diploma.

Mr. Charles Smith, Master of Sidney Sussex College, and author of several much-used mathematical text-books, was on October 1 admitted to the office of Vice-Chancellor for the current academical year. The outgoing Vice-Chancellor, Mr. A. Austen Leigh, in his parting address to the Senate, referred in sympathetic terms to the loss sustained by the University in the death of Prof. Cayley and of Prof. Babington. He announced that the latter had bequeathed to the University his large and valuable collection of plants. A part of the address was devoted to a description of the difficulties, chiefly financial, which have attended the inception of the Sedgwick Memorial Museum of Geology. The satisfactory progress made with the extension of the Cavendish Laboratory, now approaching completion, was made a matter of congratulation.

Two scholarships in Natural Science, one of £70 and one of £40 a year, will be competed for at Sidney Sussex College on December 12 to 14. Candidates are to make preliminary application to the tutor, Mr. G. M. Edwards.

The late Prof. Babington has left to the University his botanical library as well as his valuable collection of plants.

Mr. H. F. Baker, of St. John's, and Mr. J. E. Edwards, of Sydney, have been appointed the Moderators, and Mr. R. A. Herman, of Trinity, and Mr. H. W. Richmond, of King's, the Examiners for the Mathematical Tripos of 1896.

Dr. Glaisher has been appointed an Elector to the Isaac Newton Studentship in Astronomy.

A complete series of lectures for agricultural students, under the Cambridge and Counties Agricultural Education Scheme, has been arranged for three terms of the academical year. The syllabus is published in the *University Reporter* of October 8.

THE first Entrance Scholarship in Natural Science, of the value of £150, into St. Thomas's Hospital Medical School has been awarded to Mr. Frank B. Skerrett; the second, of the value of £60, being divided between Messrs. Walter B. Fry, George W. Hare, and Alfred B. Lindsey, bracketed equal. The Entrance Scholarship, value £50, for students from the Universities, has been awarded to Mr. Percy W. G. Sargent, St. John's College, Cambridge.

AT Guy's Hospital, the Entrance Scholarship in Science, of the value of £150, has been awarded to Mr. P. W. L. Camps, and the Second Entrance Scholarship in Science, of the value of £60, has been awarded to Mr. S. Hodgson.

THE Treasury has decided that the annual grant of which King's College, London, was deprived under the late Government may be restored to the college next year without any stipulation as regards tests.

SCIENTIFIC SERIALS.

American Meteorological Journal, September.—Synchronous or simultaneous geographical distribution of hourly wind velocities in the United States, by Dr. F. Waldo. This article is part of a memoir prepared for the U.S. Weather Bureau, and is supplementary to one which appeared in the *Journal* for July (NATURE, p. 335). Charts are drawn for midnight and noon, for the extreme months of January and July, for about the centre of the United States, and afford a comprehensive view of the synchronous wind conditions and relations as regards the average velocities. This method of representation obviates the necessity of a lengthy text.—The origin and work of marine meteorology, by Lieut. W. H. Beehler, U.S.N. The author deals more particularly with the history and development of this service in the United States, from the appointment of Lieut. Maury as Superintendent of the U.S. Naval Observatory, in 1844, which led to the Maritime Conference held at Brussels in 1853. The numerous charts published by the American Office formed the basis of the useful wind charts subsequently issued by the Meteorological Department of the Board of Trade, during Admiral FitzRoy's lifetime, and which were widely distributed among seamen. The U.S. Hydrographic Office was established in 1866, and in 1893 there were nearly 3000 observers co-operating with it. The outcome of this was the publication of the Pilot Chart of the North Atlantic Ocean, to which we have often had occasion to refer. About 4000 copies of this chart are distributed monthly, and among other things they have done much towards bringing about the general recognition of the value of the use of oil to still the waves, by which numbers of vessels have been saved from total loss.

Bulletin of the American Mathematical Society (vol. i. No. 10, July 1895).—This closing number of vol. i. contains, in addition to the usual list of new publications and the index, a list of the published papers read before the Society during the year, together with the places of their publication.—Mr. J. M. Brooks gives a clear account of Lie's work on continuous groups *à propos* of Scheffers' edition of the Vorlesungen über Continuirliche Gruppen mit geometrischen und anderen Anwendungen. "The importance of the group idea itself has long been recognised in its application to the theory of substitutions, and some continuous transformations, such as the pedal transformation, were in use before Lie's work, but were used without their connection with the group idea being discovered, and the discovery and the presentation of the results of it in a systematic form are due to Prof. Lie." Dr. Scheffers has aimed at giving in outline the general theory, and he indicates some lines in which it may be applied.—Prof. J. Harkness, in a review of the second volume (second edition) of Jordan's "Cours d'Analyse de l'école Polytechnique," which is devoted to the integral calculus, fully analyses its contents, and pronounces it to be "a substantially new contribution to mathematical literature." "From beginning to end the reader feels that he is being guided by a master-hand." —Prof. E. Hastings Moore writes on a theorem concerning *p*-rowed characteristics with denominator 2 (of Prym's "Untersuchungen über die Riemann'sche Thetaformel und die Riemann'sche Charakteristikentheorie," 1882).—A note on the Transitive Substitution Groups of degree 12, by Dr. G. A. Miller, mentions that Camille Jordan in the *Comptes rendus* (vol. lxxv. p. 1757) states that there are *three* primitive groups of degree 12, excluding the groups which contain the alternating group. Dr. Miller has found *four* multiply transitive primitive groups of this degree, excluding the two groups containing the alternating group. The proof is given in the present note.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 30.—M. A. Cornu in the chair.—The Perpetual Secretary read a letter from M. J. B. Pasteur, announcing the death of his father, Louis Pasteur, who died at Villeneuve-l'Étang (Garches), on September 28, 1895. M. A. Cornu then expressed the deep feeling of loss in the Academy, and recalled the greatness of the work accomplished by Pasteur. As a mark of respect and sorrow the Academy adjourned after receiving the correspondence.—Remarks on the subject of Lord Salisbury's discourse "on the real limits of our science," by M. Émile Blanchard. The author recalls his work in contradiction to the theory of the origin of species advanced by Darwin, and maintains that no single instance has ever been brought forward in answer to his challenge which can be held to verify the assumption that one species may be produced from another by any form of selection.—On glycosuria following ablation of the pancreas, by M. R. Lépine. The sugar contents of the urine have been determined, and glycosuria traced during the first thirty hours, operating on dogs without the use of anæsthetics or morphine.—A study of the mechanical theory of heat, by M. Ch. Brun, has been printed in the correspondence.—The evaporation of liquids and the great capillary theories, by M. G. Van der Mensbrugghe. Most liquids evaporate spontaneously in the air. The consequences follow: (1) The liquid layer whence particles are continually being detached to form vapour cannot have the same density as the liquid in the interior of the mass, otherwise there would be an abrupt passage from the liquid state to vapour; it must, therefore, be admitted that the density of the superficial layer decreases towards the exterior. All capillary theories, supposing liquids incompressible (Laplace), or of the same density throughout (Gauss), are therefore inadequate. (2) When the mass considered is very small (bubbles, liquid films), evaporation causes loss of a perceptible fraction of the total weight. Hence capillary theories regarding a liquid mass as having an invariable volume (Poisson) must be condemned. (3) The constant renewal of the free surface of the superficial layer proves, without possible doubt, that this layer is not in equilibrium. What confidence can then be placed in the theories of Laplace, Gauss, and Poisson, and the works of contemporary analysts (Neumann, Mathieu, Van der Waals, Resal, and Poincaré), who formally suppose a liquid mass in equilibrium? After calling attention to the defects of former theories, the author quotes his own theory, derived from a consideration of molecular forces, as giving a sufficient explanation of these consequences.—On a new nitrogenous manure, calcium cyanate, by M. Camille Faure. It is asserted that calcium cyanate can be produced in large quantity in the electric furnace by heating lime and charcoal intensely in an atmosphere of nitrogen, and oxidising the product by air. The cyanate contains a greater proportion of assimilable nitrogen than nitrate, and can be used as a manure.—Syntheses by means of cyanacetic esters, by M. T. Klobb—Constitution of acids produced in the oxidation of inactive campholenic acids, by M. A. Béhal. The acid $C_6H_{10}O_4$ is dissymmetric dimethylsuccinic acid; the acid $C_7H_{12}O_4$ is one of the two dimethylglutaric acids having the two methyls attached to the same carbon atom, probably $CO_2H.C(CH_3)_2.CH_2.CH_2.CO_2H$. The author claims priority for his work against that of Tiemann.—On the effects of the synodic and anomalistic revolutions of the moon on he distribution of pressures in spring, by M. A. Poincaré.—On a double night ascension (balloon) made on September 4, by MM. G. Hermite and Besançon. Two balloons made voyages from Paris in opposite directions, starting at the same time. The currents observed and used are described, together with details of the voyages.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—A Hand-book to the Birds of Great Britain: Dr. R. B. Sharpe, vol. 2 (Allen).—Climbing in the British Isles: W. P. H. Smith and H. C. Hart, II. Wales and Ireland (Longmans).—Practical Proofs of Chemical Laws: V. Cornish (Longmans).—An Introduction to the Study of Seaweeds: G. Murray (Macmillan).—Catalogue of the Library of the Royal Geographical Society: Dr. H. R. Mill (Murray).—Dynamics: Prof. P. G. Tait (Black).—Farm Foods, or the Rational Feeding of Farm Animals: Prof. E. v. Wolff, translated by H. H. Cousins (Gurney).—The Gold Mines of the Rand: F. H. Hatch and J. A. Chalmers (Macmillan).—The Fauna of British India, including Ceylon and Burma; Birds, Vol. 3: W. T. Blanford (Taylor and Francis).—Popular History of Animals for Young People: H. Scherren (Cassell).—Moral Pathology: Dr. A. E. Giles (Sonnenschein). —The Splash of a Drop: Prof. A. M. Worthington (S.P.C.K.).—Simple Methods for detecting Food Adulteration: J. A. Bower (S.P.C.K.).—Biology Notes, Vol. 1 (Chelmsford) —Einführung in das Studium der Bakteriologie: Dr. C. Günther, Vierte Auflage (Leipzig, Thieme).—Natural History of Selborne: Gilbert White, 2 Vols. illustrated (Macmillan).—The Scientific Foundations of Analytical Chemistry: Prof. W. Ostwald, translated by Dr. G. M'Gowan (Macmillan).—The Structure of Man: Dr. R. Wiedersheim, translated by H. and M. Bernard (Macmillan).—Weather and Disease: A. B. MacDowall (Graphotone Company).—Old Farm Fairies: H. C. McCook (Hodder and Stoughton).

PAMPHLETS.—Les Limites Actuelles de Notre Science: Marquis de Salisbury, translated by W. de Fonvielle (Paris, Gauthier-Villars).—Reaction!: K. Pearson (Reeves).—Guide to the Collections of Rocks and Fossils belonging to the Geological Survey of Ireland: A. McHenry and W. W. Watts (Dublin, Thom).—A Supplement to a Revised Account of the Experiments made with the Bashforth Chronograph: F. Bashforth (Cambridge University Press).—Ein Brauner Tschimpanse im Dresdner Zoologischen Garten: A. B. Meyer (Berlin, Friedländer).

SERIALS.—Journal of the Royal Agricultural Society of England, Vol. vi. Part 3 (Murray).—Natural History of Plants: Kerner and Oliver, Part 16 (Blackie).—Mind, October (Williams and Norgate).—Transactions of the Perthshire Society of Natural Science, Vol. 2, Part 2 (Perth).—Geological Magazine, October (Dulau).—Morphologisches Jahrbuch, 23 Band, 1 Heft (Leipzig, Engelmann).—Bulletin de la Société Impériale des Naturalistes de Moscou, 1895, No. 2 (Moscou).—Geographical Magazine, October (Stanford).—Story of the Heavens: Sir R. S. Ba l, Part 1 (Cassell).—Ethnologisches Notizblatt, Heft 2 (Berlin, Haack).—Bulletin de l'Académie Royale des Sciences de Belgique, 65e Année, No. 8 (Bruxelles).—American Naturalist, October (Philadelphia).—Annals of Scottish Natural History, October (Edinburgh, Douglas).—Memoirs and Proceedings of the Manchester Literary and Philosophical Society, Vol. 9, No. 6 Manchester).—Science Progress, October (Scientific Press).—Illustrated Archæologist, and Reliquary, October (Bemrose).—Travaux de la Société des Naturalistes de St. Pétersbourg, Vol. xxiii. (St. Pétersbourg).

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