THURSDAY, OCTOBER 6, 1898.

NORTH AMERICAN BIRDS.

Bird Studies, an Account of the Land Birds of Eastern North America. By W. E. D. Scott. 4to, pp. xii + 363. (New York and London: G. P. Putnam's Sons, 1898.)

IF it be permissible to judge from the books with which they are respectively supplied, there must be an inherent constitutional difference between the English and the American reader of popular bird-lore. In almost all the numerous works written for the benefit of the former there is a more or less rigid adherence to a systematic arrangement of some kind or other. As we have had previous occasion to remark, American books, on the other hand, are characterised by their partiality for methods of arrangement other than systematic. Personally we confess to a deep-rooted prejudice in favour of the English plan; but if American readers find this too cut and dried for them, and prefer some less inelastic classification, little fault can be found with the writers who endeavour to gratify their taste.

In his preface the author tells us that the present volume is an invitation to a more intimate acquaintance with the land birds of Eastern North America. And since under that somewhat vague geographical expression he includes not only the portion of the continent lying east of the Mississippi together with Lake Winnipeg and the western border of Hudson Bay, but also the whole of Greenland and the islands which naturally group themselves with the mainland of the region, it is obvious that the fauna to be dealt with is a very extensive one.

In place of a systematic classification, the birds, which range from the ordinary song-birds to the quails, have been made to group themselves around a series of familiar stations. We have, in the first place, the birds frequenting the house and homestead, followed by those to be met with along the highways and lanes, and these again succeeded by the denizens of the woods and the inhabitants of fields and meadows. Finally, we have the marsh and swamp birds, together with those to be found along the margins of streams and ponds. Not that the true water-birds are included, since of these the author proposes to make a companion volume, should his present effort meet with a satisfactory reception on the part of the public. At the end of the volume is given a systematic table of all the species treated.

If a miscellaneous arrangement of some kind or another be inevitable, the one selected is, perhaps, among the least open to criticism. There is, however, considerable difficulty in certain cases whether a bird should be assigned to one group or another, and there is the decided objection that nearly allied forms are often widely sundered. More serious is the absence of any attempt on the part of the author to lift his readers above the level of mere collectors and observers, and to point out that the bird-fauna of the extensive tract under consideration contains elements pertaining to more than one zoological province. There is, for example, no indication that the one species of humming-bird found in Eastern North America is essentially an immigrant from the South American fauna, and as strange to the Holarctic fauna as is the armadillo met with in Texas. The inclusion, too, of rare stragglers from Europe is certainly a mistake in a work of this nature; the most glaring instance being the introduction of the common kestrel, on the strength of a single specimen obtained in Massachusetts.

Another point open to criticism is the popular nomenclature of certain species. In the review of another work on American birds, attention has been already drawn in this journal to the inconvenience arising from the application of the names of well-known European birds to totally different American species; but this sinks into insignificance when compared with the practice of using a name belonging to a South American bird for a North American songster. In the Argentine and other parts of South America there exists a well-known group of *Dendrocolaptidæ*, universally termed oven-birds (*Furnarius*); and it is accordingly in the highest degree inconvenient to employ the same title for a North American representative of the *Mniotiltidæ*, especially when the bird in question (*Seiurus aurocapillus*) has the alternative name of golden-crowned thrush.

The descriptions of the various birds referred to seem for the most part well adapted for popular use; and the author's practice of frequently italicising one or more of the leading distinctions is decidedly worthy of commendation. We are also fully in accord with the author when he says that the meaning of colour-descriptions can only be fully grasped by observation and experience, seeing that no two describers will ever designate one particular shade of red or other colour by precisely the same term. And if this be true of colour, still more is it so with regard to song, which Mr. Scott regards as inexpressible, either in words or by instruments.

With regard to the numerous photogravures with which the volume is illustrated, the author states that these have been prepared under his own immediate supervision. "Some," he writes, "are taken from live birds, others from dead ones, some are from stuffed birds; others from prepared skins. All are faithful and accurate pictures, just what the camera presents, with its keen interpretation." This is candid, and enables the reader without much difficulty to arrive at the nature of the subjects for the different photographs. Although by no means all on the same level, these latter are on the whole of a high standard of excellence, and serve to render the volume attractive not only to students of bird-life, but to lovers of nature in general. Among the most successful effects, mention may be made of the purple finch (p. 49), the screech-owl (p. 72), and the nest of the flicker (p. 176). Interspersed in the text are a number of photographs of dead birds, for the most part lying on their backs, with their feet in the air. Although these may be valuable as aids to the identification of the species, to our own mind they convey a somewhat melancholy impression, especially in the case of song-birds, which should be the incarnation of life and joy.

Limitations of space have probably been the reason that the author's descriptions of habits are for the most part brief; and this is the more to be regretted seeing that he writes in a manner well calculated to attract the attention of his readers. Apparently he is one of those who think that everything has been arranged for the best in this best of possible worlds. For example, after stating that, owing to its parasitic habits, maledictions are poured down on the devoted head of the cowbird by all, he proceeds as follows :—

"This may be to an extent warranted, but the fact that the great laws of nature have developed a necessity for such a bird seems to bespeak for it at least patient and careful consideration. There are few, if any, unmixed evils allowed to survive in the great struggle for existence, but the good results are not always patent even to the most careful student."

With the exception of undue weight, owing to the employment of heavily clayed paper, the style in which the book is produced is worthy of all praise, and renders it an attractive addition to the library or drawing-room table. Probably its circulation in this country will be somewhat limited ; but in the land of its birth the volume should command an extensive sale, which we may hope will be sufficient to induce the author to favour the public with its promised companion. R. L.

THE CASE AGAINST VACCINATION.

A Century of Vaccination, and what it teaches. By W. Scott Tebb, M.A., M.D. (Cantab), D.P.H. (London : Swan Sonnenschein and Co., Ltd., 1898.)

DR. TEBB says that on the assumption that the father of a family ought to be able to form a judgment upon vaccination, a practice established and enforced by law, he will attempt in the work before us to discuss a great question in an unbiassed fashion. In this attempt he is not altogether successful. After stating that he does not reject, or even attack the belief that a certain degree of immunity in the case of certain diseases is conferred by a first attack, he goes on to draw a distinction between the immunity conferred by small-pox and that conferred by cow-pox. He appears to beg the whole question by accepting, as conclusively proved by Dr. Creighton and Prof. Crookshank, the proposition that cow-pox is a disease radically different from that from which it is said to protect. This point is one, however, that no amount of asseveration can settle, and most people prefer to be guided by the results of recent experiments rather than by polemical statement.

In a piece of rather clever special pleading, Dr. Tebb makes a statement that

"should there be an epidemic in a locality where 85 per cent. of the population are vaccinated, it is obvious that the 95 per cent. of the population should escape the epidemic, assuming, as before indicated, that a maximum of 5 per cent. attacked by it will largely coincide with the 85 per cent. vaccinated, and thus vaccination gains credit, but it will be objected if the 5 per cent. attacked coincide, in however small a degree, with the 15 per cent. unvaccinated, this is strong testimony to the risk of being unvaccinated, and so no doubt it would be but for the fact that in localities where the vaccination law is vigorously carried out the unvaccinated as a class will be found to consist largely of the outcasts of society, nomads whom the law has failed to reach, and of weakly children who, on account of their health, have been excused the operation. This class, therefore, is likely to furnish a disproportionate number of the victims of the epidemic ; and thus again the prophylactic acquires reputation."

This, as we have said, is nothing more than special pleading, especially when Dr. Tebb attributes bias to those who have to do with the collection and arrangement of the statistics on which vaccination arguments are based. It is for this reason that we refer to the bias imported into this controversy by Dr. Tebb at the very outset. Further, one cannot help feeling that the imputation by the author of the term "public endowment practice" indicates a state of mind not conducive to the calm and dispassionate consideration of this very important question. For example, he speaks of a "body of officials ostensibly paid to promote the practice of vaccination, but also, partly at least, paid to vindicate it theoretically and to explain away its failures and its accompanying disasters." "Take away," he says, "first the compulsory law, and then take away (if vested interest is not too strong for you) the endowment of the practice, and when this has been done medical men will find themselves, for the first time since 1803, free to discuss the vaccination question as a scientific one on its own merits." This is imputing motives with a vengeance—motives of a most sordid character. When an author holds such an opinion, no question with which he deals can be reasonably or profitably discussed.

After going carefully over "A Century of Vaccination," and granting the absolute accuracy of every stated fact put forward in this work, we are compelled (and we believe that most people will agree with us on this point) to come to the conclusion that Dr. Scott Tebb, if he started in an absolutely unfettered condition of mind, has been very easily brought to his present position, and that his marshalling of facts has been of such a one-sided character, that he has been enabled to argue far too readily from the special and the isolated to the general. He has placed his isolated facts in one scale and has left out the accumulated knowledge of all kinds that appears to tell against his theory, and has then struck a balance, of course in favour of the argument for which he is contending. So convinced are we on this point, that we are confident that it would be a safe plan for those who believe in the efficacy of vaccination to place this work in the hands of most anti-vaccinators, and ask them to read it on the condition that they would also read the context of many of the quoted passages ; we believe such a course could have but one result. It may be stated generally that in the summary and conclusion Dr. Scott Tebb entirely misses or ignores the position taken up by those who are in favour of vaccination. He mixes up the risk to the individual with the risk to the community—a good system of vaccination with a system carelessly carried out ; he bases the statement that it is valueless entirely on the assumption that cow-pox and small-pox are in no way generically related ; and, putting aside the question of immunity as the result of an attack of small-pox, he contends that cow-pox is a specifically different disease, and can therefore exert no protective influence against small-pox. However, as we have already stated, those who read Dr Tebb's book will, unless we are much mistaken, remain vaccinators ; whilst those who are already convinced in the opposite direction may be brought to consider the question from another standpoint, if they will only read a little wider into the context than the author allows them to do in his work. We do not wish to impugn Dr. Tebb's absolute honesty in this matter; we are only astonished that, with the materials at his disposal, much of which he has evidently read very carefully, he has arrived at the position indicated in this work.

OUR BOOK SHELF.

The Heat Efficiency of Steam Boilers: Land, Marine, and Locomotive. With tests and experiments on different types, heating value of fuels, analyses of gases, evaporation, and suggestions for testing boilers. By Bryan Donkin, M.Inst.C.E. Pp. xvi + 311. (London: Charles Griffin and Co., Ltd., 1898.)

THE main value of this book will undoubtedly lie in the tables, which fill about 100 of its pages, and give in an admirably complete form the results of no less than 405 tests of the efficiency of steam boilers of almost every type. The labour of collecting the material must have been great, and the author has selected with judgment the information needed, practically everything wanted is to be found in the twenty-six columns of the tables, and no useless matter has been incorporated. The only addition which might have been made with advantage is the temperature of the feed-water, especially in those cases where no economiser was in use. Useful summary tables are given on pp. 116, 117 and 118, and in chapter xiii. the author discusses the general conclusions to be drawn from these trials, but without coming to any definite decision. As pointed out in the book, the wide variations in the efficiency of the same type of boiler when worked under different conditions makes it impossible to lay down any general laws, though the graphic representation on p. 223 of the relationship between efficiency and rates of evaporation per square foot of heating surface per hour, is of much value, and should be of use to the designer.

In reference to the calculation of the heating value of coal by Dulong's formula, there can be no doubt that it gives results which are too small when compared with calorimeter tests; the figures will be found, however, to agree much better when in the calculation no deduction is made from the hydrogen for the portion assumed, apparently without reason, to be chemically united with the oxygen. A valuable chapter is that dealing with the transmission of heat through boiler plates, because Blechynden's and Durston's recent experiments on this important question are given in a very clear and concise fashion for reference.

The author hardly devotes enough space to the description of the instruments for analysing furnace gases and their use, and those unfamiliar with the appliances and their working will find it difficult to teach themselves much by merely reading these paragraphs; they might well have been amplified since, as the author points out, the accurate analysis of the gases is the most important, and certainly the most difficult, point in boiler testing.

In addition to dealing with boiler testing, the author describes many of the important accessories which have been introduced of recent years to reduce the cost of steam generation, such as mechanical stokers, patent grates, economisers, superheaters, &c., and much information as to the value of these devices will be found in the chapters devoted to them. The author may be congratulated, for his book is one which cannot fail to be a standard reference work to all engaged either in boiler construction or in steam generation. An admirable little bibliography finishes up a series of useful appendices which give full directions for carrying out boiler trials.

H. B.

A Text-book of Geodetic Astronomy. By John F. Hayford, C.E. (New York: John Wiley and Sons. London: Chapman and Hall, Ltd., 1898.)

WE must confess that the examination of this book has proved a little disappointing. This disappointment was probably inevitable from the circumstances in which the book has been produced, and the object which it is intended to serve. It appears that in the Cornell University the students of civil engineering devote five hours a week during one term to the study of astronomy. In this short space of time it is found impossible to master the contents of such a book as Chauvenet or other recognised standard work, and to meet this difficulty this book is put forward, not on the ground that it contains as much information as a student should acquire, but as much as he can acquire in the short time at his disposal. The sacrifice of thoroughness and completeness to the necessities of a particular University course can neither meet with general approval nor result in the production of a satisfactory treatise.

The title scarcely describes the character or the purpose of the book, which is mainly devoted to the practical determination of stellar positions by means of portable instruments. Considered from this point of view, and as showing in detail the methods employed in the United States Coast and Geodetic service, the book is not without its interest. On its practical side, we can conceive that it would be of use to those who have carefully read the theoretical; but to regard it as an efficient substitute for Chauvenet, would be to make a great mistake in the training of the student. The mathematical processes are, the author tells us, purposely omitted; but it would seem that other things besides mathematics have been omitted, which one would expect to meet in a work of this description. We should hope to find here a discussion of the figure of the earth, and, as a practical matter of great importance, a description of the method of measuring a base line. These matters are passed over entirely, and other important, but minute, results of observation get a very bare mention. For instance, to the variation of latitude only a page and a half is devoted. Pendulum experiments and their results do not come within the scope of the book. On the other hand, we get a fairly good account of the sextant, the transit, the zenith telescope, of the determination of the errors of these instruments, and the method of combination of observations. Some astronomical tables are added which are likely to prove useful.

Machine Drawing. Book 2. Part i. Machine Tools. By Thomas Jones, M.I.Mech.E., and T. Gilbert Jones, M.Sc. (Vic.). (London and Manchester: John Heywood, 1898.)

THIS work is intended "for the use of engineering students in science and technical schools and colleges." It contains twenty-five lithographed plates, upon which are represented the elevations and details of important machine tools in actual use by expert engineers at the present time. The plates include drawings of a drilling machine, planing machine, stroke slotting machine, stroke shaping machine, and forms of gearing. The complete drawings of the three first-named machines are coloured, and all of them are well executed. With the explanatory text the engineering student will find the work instructive and of real assistance.

A Student of Nature. By R. Menzies Fergusson, M.A. Pp. 246. (London: Alexander Gardner, 1898.)

THE late Rev. Donald Fergusson was many-sided in his pursuits, and among his pleasures was the study of natural history. One of the sections of the present volume contains the papers written by him on rural life and scenes, and they show that he was filled with "deep feeling" by nature and its wild life, but neglected the minute examination of natural objects essential to scientific study.

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.*]

Undercurrents in the Strait of Bab-el-Mandeb.

AN interesting observation has recently been made by one of H.M. surveying vessels, and I forward the Preface to the account of the details published by the Hydrographic Department, which contains the principal facts, and also the Analysis of the observations, both of which may be of interest to some of your readers.

W. J. L. WHARTON.

Hydrographic Department, Admiralty, Whitehall, London, S.W., September 27.

UNDERCURRENTS IN THE STRAIT OF BAB-EL-MANDEB.

IT has long been known that in the Bosporus and Dardanelles when the surface water sets strongly from the Black Sea to the Mediterranean, the lower strata of the water for a certain height from the bottom sets strongly in the opposite direction.

While in this instance it is probable that the many large rivers which discharge their waters into the Black Sea have a share in producing the surface current, the observations by which the undercurrent was revealed appeared to plainly indicate that the surface drift, caused by the generally prevailing N.E. wind heaping the water up in the south-western part of the Black Sea, was the main factor.

The somewhat similar conditions which occur in the strait of Bab-el-Mandeb offered another opportunity of observation on this interesting form of oceanic circulation, and for many years such observations have been a desideratum.

In this strait for nearly half the year a more or less strong easterly wind prevails, driving much water before it into the Red Sea, and, great as is the evaporation from the surface of that sea, which must be made up wholly by an inflow of water through the strait of Bab-el-Mandeb, it appeared on the whole probable that during this season the phenomenon of the Dardanelles would be repeated.

The observation is, however, difficult. The water is deep, over 100 fathoms; the sea generally heavy; there is a tidal current to complicate matters; and it seemed doubtful whether the somewhat crude apparatus which served to unravel the movement of the lower strata in the shallower and smoother Dardanelles would give good results in this locality.

Nevertheless, Captain W. Usborne Moore was directed to attempt it in H.M.S. *Penguin* in 1890, but the results, while showing that the under strata were not running with the surface, were two ambiguous to afford much definite information.

The possession, however, of a deep-sea current meter, originally devised by Lieutenant Pilsbury, U.S.N., and considerably altered after a series of experiments by Captain Usborne Moore in the English and Færoe Channels, seemed to offer a chance of more success.

Lieutenant and Commander Gedge, commanding H.M. surveying ship *Stork*, was therefore directed to endeavour to get further observations in Bab-el-Mandeb by means of this instrument, and has admirably and most successfully carried them out.

On January 19, 1898, the *Stork* was anchored in 118 fathoms about seven miles S.W. by W. from Perim Island, and remained constantly observing, during daylight, for four days, when the parting of the cable brought the series to a close. Had not the wind been unusually light, varying from force 3 to 6, it is probable that the observations could not have been continued so long.

The observations are appended (in publication quoted), but the broad result may be briefly stated.

There was a permanent current on the surface setting into the Red Sea of about $1\frac{1}{2}$ knots per hour.

There was at 105 fathoms depth a permanent current setting outwards of probably the same velocity.

The tidal stream was about $1\frac{1}{4}$ knots at its maximum, and flowed for about twelve hours each way, as might be expected from the fact that in this locality there is practically only one tide in the day.

Analysis of Tidal Streams observed in the Large Strait of Bab-el-Mandeb by H.M.S. Stork *in January* 1898.

Time of tide at Perim.	At surface.		At 5 fms.		At 25 fms.		At 50 fms.		At 75 fms.		At 105 fms.	
	Direction.	Rate.	Direction.	Rate.	Direction.	Rate.	Direction.	Rate.	Direction.	Rate.	Direction.	Rate.
High water ...	N.W. $\frac{1}{2}$ W.	$2\frac{1}{4}$	N.W. by W.	$3\frac{1}{4}$	N.W.	3	Slack	—	—	—	—	—
1h. after ...	N.W. $\frac{1}{2}$ W.	$2\frac{3}{4}$	N. $\frac{1}{2}$ W.	$3\frac{1}{3}$	—	—	S. by E.	$\frac{1}{4}$	Variable	—	—	—
2 ,, ...	N.W.	$2\frac{3}{4}$	N.W.	4	N.W.	2	N.W. by W.	$\frac{2}{3}$	—	—	—	—
3 ,, ...	N.W. $\frac{1}{2}$ W.	$2\frac{1}{3}$	N.W. by N.	3	—	—	N.W. by N.	$\frac{1}{4}$	N.N.W. $\frac{1}{2}$ W.	$\frac{1}{2}$	—	—
4 ,, ...	N.W.	2	N.W. by N.	$2\frac{1}{2}$	N.N.W. $\frac{1}{2}$ W.	2	N.W.	$1\frac{2}{3}$	N. $\frac{1}{2}$ E.	1	S. by W.	$\frac{1}{4}$
5 ,, ...	N.W.	$1\frac{3}{4}$	N. by W.	2	—	—	N.N.E,	$\frac{1}{2}$	N. by E. $\frac{1}{2}$ E.	$\frac{3}{4}$	S. by W.	$1\frac{1}{4}$
6 ,, ...	N.W. $\frac{1}{2}$ W.	$1\frac{1}{4}$	N.W. $\frac{1}{2}$. N.	$\frac{3}{4}$	N.W. $\frac{3}{4}$ W.	1	E. by S.	$\frac{1}{2}$	S.S.E.	$\frac{2}{3}$	South	$1\frac{1}{3}$
7 ,, ...	N.W. $\frac{1}{2}$ W.	$\frac{3}{4}$	N.W.	$\frac{1}{2}$	N.N.W.	$\frac{1}{2}$	West	1	—	—	S. E. $\frac{1}{2}$ S.	$1\frac{1}{2}$
8 ,, ...	W.N.W.	$\frac{1}{2}$	S.W. $\frac{1}{2}$ W.	$\frac{1}{2}$	—	—	South	$1\frac{1}{2}$	S.E. by E.	$1\frac{1}{3}$	S.S.E. $\frac{1}{2}$ E.	3
9 ,, ...	W.N.W.	$\frac{1}{4}$	W.N.W.	$\frac{1}{2}$	Slack.	—	S.S.E.	1	S.E.	1	S.S.E. $\frac{1}{2}$ E.	$2\frac{1}{2}$
10 ,, ...	N.N.W.	$\frac{1}{4}$	N.W.	$\frac{1}{4}$	E. by N.	$\frac{1}{2}$	—	—	S.S.E. $\frac{1}{2}$ E.	$1\frac{1}{2}$	E.S.E.	$1\frac{3}{4}$
11 ,, ...	North	$\frac{1}{4}$	N.N.W.	$\frac{1}{2}$	S.E.	$\frac{1}{2}$	S.E.	1	E. by S.	$2\frac{1}{4}$	—	—
12 ,, ...	N.W.	$\frac{3}{4}$	N. by E.	$\frac{1}{2}$	—	—	—	—	—	—	—	—
13 ,, ...	N.W. by N.	$1\frac{3}{4}$	—	—	N.W. by N.	$\frac{3}{4}$	—	—	E.S.E.	2	S.E. by E.	$1\frac{3}{4}$

This tidal stream prevails to the bottom, with variations of strength.

Somewhere about 75 fathoms is the dividing line between the two permanent currents, but it would require a longer series of observations to determine this point with any precision.

Fourier's Series.

IN all expositions of Fourier's series which have come to my notice, it is expressly stated that the series can represent a discontinuous function.

The idea that a real discontinuity can replace a sum of continuous curves is so utterly at variance with the physicists' notions of quantity, that it seems to me to be worth while giving a very elementary statement of the problem in such simple form that the mathematicians can at once point to the inconsistency if any there be.

Consider the series

$$y = 2\,[\sin x - \tfrac{1}{2}\sin 2x + \tfrac{1}{3}\sin 3x - \ . \ . \ . \ ]$$

In the language of the text-books (Byerly's "Fourier's Series and Spherical Harmonics") this series "coincides with $y = x$ from $x = -\pi$ to $x = \pi$ . . . Moreover the series in addition to the continuous portions of the locus . . . gives the isolated points $(-\pi, 0)$ $(\pi, 0)$ $(3\pi, 0)$, &c."

If for x in the given series we substitute $\pi + \epsilon$ we have, omitting the factor 2,

$$-y = \sin\epsilon + \tfrac{1}{2}\sin 2\epsilon + \tfrac{1}{3}\sin 3\epsilon + + \frac{1}{n}\sin n\epsilon + \ldots$$

This series increases with n until $n\epsilon = \pi$. Suppose, therefore, $\epsilon = k\frac{\pi}{n}$, where k is a small fraction. The series will now be nearly equal to $n\epsilon = k\pi$, a finite quantity even if $n = \infty$.

Hence the value of y in the immediate vicinity of $x = \pi$ is not an isolated point $y = 0$, but a straight line $-y = nx$.

The same result is obtained by differentiation, which gives

$$\frac{dy}{dx} = \cos x - \cos 2x + \cos 3x - \ldots$$

putting $x = \pi + \epsilon$ this becomes

$$-\frac{dy}{dx} = \cos\epsilon + \cos 2\epsilon + \cos 3\epsilon + \ldots + \cos n\epsilon +$$

which is nearly equal to n for values of $n\epsilon$ less than $k\pi$.

It is difficult to see the meaning of the tangent if y were an isolated point. ALBERT A. MICHELSON.

The University of Chicago Ryerson Physical Laboratory, September 6.

Helium in the Atmosphere.

C. FRIEDLÄNDER and H. Kayser have independently claimed to have found helium in the atmosphere. On examination of some photographs of the spectrum of neon I have identified six of the principal lines of helium, which thus establishes beyond question the presence of this gas in the air. The amount present in the neon it is, of course, impossible to estimate, but the green line (wave-length 5016) is the brightest, as would be expected from the low pressure of the helium in the neon.

E. C. C. BALY.

University College, London, Gower Street, W.C., September 28.

THE discovery of helium lines in the spectrum of neon, by Mr. E. C. C. Baly, will necessitate a modification of the views we have expressed in our communication to the British Association at Bristol. We there estimated the density of neon at 9·6, allowing for the presence of a certain proportion of argon unavoidably left in the neon. As it contains helium, however, this is probably an under-estimate. It is unfortunately not possible to form any estimate of the amount of helium mixed with the neon from the relative intensity of spectrum lines, as has been already shown by Dr. Collie and one of us; we do not despair, however, of removing a large part, if not all of this helium, by taking advantage of the greater solubility of neon than helium in liquid oxygen.

The presence of helium, however, in no way alters our view as to the position of neon in the periodic table. The number 9·6 implies an atomic weight of 19·2; and a somewhat higher atomic weight would even better suit a position between fluorine, 19, and sodium, 23. WILLIAM RAMSAY.

University College, London, MORRIS W. TRAVERS.
Gower-street, W.C., September 28.

Chance or Vitalism?

I AM glad to see that Prof. Karl Pearson has called attention to Prof. Japp's address at Bristol. Only that one does not like to criticise adversely a presidential address, I would at the time have pointed out the weakness in the argument that Prof. Pearson criticises. He does not go nearly so far in this criticism as the circumstances warrant. It is conceded that right- and left-handed crystals of quite sensible size are produced sufficiently separated to be seen and handled as separate crystals. Now assuming, what there is every reason otherwise to think quite probable, that life started from some few centres, the chances are, not that it was equally divided between right- and left-handed forms, but that one or other of these forms preponderated. In fact, if life started from a single centre, it *must* have been either right- or left-handed. Hence the fact adduced only shows, what was otherwise very probable, that life started from a small number of origins, possibly only one.

Another reason for either a right- or left-handed structure in living organisms on the earth, and one which diminishes the force of the foregoing argument for a small number of origins, is that it probably started either in the northern or in the southern hemisphere, and in either case the rotation of the sun in the heavens may be a sufficient cause for a right- or left-handed structure in an organism growing under its influence.

GEO. FRAS. FITZGERALD.

Trinity College, Dublin, September 27.

IN his presidential address to Section B of the British Association, Prof. Japp argues the necessity of supposing a "directive force," or intelligence, to have guided the formation of the first asymmetric substance. "Vitalism," which at one time was supposed to regulate the physiology and even the mechanics of organised beings, has passed more and more from the foreground, till, in the vision of some it remains only as a point in the vast distance of time at the origin of life. Is it to disappear altogether?

A sensible quantity of a mixture of enantiomorphs contains an enormous number of molecules. Chance determines the relative proportion present of right- and left-handed forms. Each molecule, having resulted from the action of symmetric forces, has an even chance of being of one or the other. Hence, the improbability of there being present a great preponderance of one form over the other is so great, that it is inconceivable that an optically active solution could result. To the above contention of Prof. Japp, the reply is made by Prof. Karl Pearson, in NATURE of September 22, that a chance result, however improbable, will occur, if sufficient opportunity be allowed. He postulates the vast ages of the earth's history. May we not, however, invoke chance to deal with masses instead of molecules, and thus perhaps substitute weeks for ages?

Let us consider a solution, in which the numbers of right- and left-handed molecules are very approximately equal, and which is consequently optically inactive. In the slow evaporation of the solvent, the right- and left-handed nuclei, about which the substance crystallises, will *most probably* be evenly distributed. Their number will be extremely small in comparison with that of the molecules, and, as chance determines their distribution, it is not so highly improbable—it is at least conceivable—that the crystals will be unevenly grouped. Suppose such to take place and a partial re-solution, roughly in the lines of the distribution of the two varieties of crystals—a not very improbable event—and we have an optically active solution. Chance has here acted the part played by organised matter in the person of M. Pasteur, by selecting and rejecting the oppositely formed crystals.

Is it yet possible to deny that the first ancestor of lævorotatory protein could have been built up from an asymmetric substance, separated in some such way as the above, by the play of chance upon the natural working of symmetric forces?

CLEMENT O. BARTRUM.

17 Denning Road, Hampstead, N.W., September 24.

The Moon's Course.

MAY I refer Sir S. Wilks to the simple and beautifully written autobiography of James Ferguson, F.R.S., self-taught mechanician and astronomer? I will quote a passage.

"Soon afterwards" (the previous date was 1743) "it appeared to me, that although the moon goes round the earth, and that the sun is far on the outside of the moon's orbit—yet the moon's motion must be in a line—that is, always concave toward the sun: and upon making a delineation representing her absolute path in the heavens—I found it to be really so. I then made a simple machine for delineating both her path, and the earth's, on a long paper laid on the floor. I carried the machine and the delineation to the late Martin Folkes, Esquire, President of the Royal Society, on a Thursday afternoon. He expressed great satisfaction at seeing it, as it was a new discovery, and took me that evening to the Royal Society, where I showed the delineation and the method of doing it. When the business of the Society was over, one of the members desired me to dine with him the next Saturday at Hackney, telling me that his name was Ellicott, and that he was a watchmaker. I accordingly went and was kindly received by Mr. Ellicott, who then showed me the very same kind of delineation and part of the machine by which he had done it, telling me that he had thought of it twenty years before. I could easily see by the colour of the ink and paper that it must have been done many years. He then told me, what was very certain, that he had neither stolen the thought from me, nor had I from him; and from that time till his death, Mr. Ellicott was one of my best friends."

The editor of my copy of Ferguson's works, "David Brewster, A.M., 1803," adds that James Ferguson was elected a Fellow of the Royal Society without paying the usual admission fees. This honour he shared with Sir Isaac Newton and Mr. Thomas Simson, the self-taught mathematician. Two Scottish philosophers—David Hume and James Ferguson—died in 1776, both leaving autobiographies of singular beauty and pathos. Our own Huxley, who like James Ferguson was afflicted with "an ineradicable tendency to try to make things clear," has done the same in recent times. Two questions instantly present themselves: (1) On how many distinguished men has this honour been conferred by the Royal Society since these times? and (2), Is there a "watchmaker" now in that learned body?

J. HUGHES HEMMING.

Kimbolton, September 24.

A Case of Inherited Instinct.

I THINK the interesting cases mentioned by Captain Hutton on p. 411 will hardly bear the interpretation he puts upon them. In New Mexico three genera of *Stenopelmatinæ* are common, viz., *Stenopelmatus*, *Centhophilus* and *Udeopsylla*. These locusts are nocturnal, and live under logs or in holes in the ground during the day. It is natural, therefore, that they should be attracted by any dark place, such as a cave. The species of *Centhophilus*, like the crickets, are found in houses, which are well adapted to their tastes. There is no new instinct, or revival of a dormant one, exhibited in this choice. Similarly, in Colorado I have found the species of *Centhophilus* to live in mines, which are practically caves of recent origin.

The cave-seeking instinct, therefore, has been practically continuous, and if in New Zealand one genus (*Pachyrhamma*) lives in caves, while its ally (*Gymnoplectron*) is arboreal, it is probable that the former retains the instincts of their common ancestor, while the latter has lost them, so far as the arboreal habit is concerned.

T. D. A. COCKERELL.

Mesilla Park, New Mexico, U.S.A., September 15.

Maggots in Sheep's Horns.

IN a letter which appeared in your issue of September 29, Captain Traherne writes under the heading of "Horn-feeding Larvæ," of maggots of about half an inch in length and of a white colour, having been found in the horns of a newly killed sheep, which he had obtained in India, but where there were no perceptible signs of perforation. These were not the larvæ of a Lepidopterous insect, but of one of the Diptera, known as *Œstrus ovis*, a well-known parasite. The fly lays her eggs in the region of the anterior nares, and the larvæ penetrate the nasal passage, finding their way into the turbinal bones, and from thence into the frontal cavity to the base of the horns. Captain Traherne does not say how far up the horn he found them; they are not usually found beyond the base, but as a rule locate themselves at the back of the throat, where they feed on the mucous substance. They are not horn-feeders. *Œstrus ovis* is distributed pretty generally wherever sheep are to be found.

Mr. Austen, of the British Museum (Nat. Hist.), showed me some very fine specimens, both of the fly and the larvæ.

W. H. MCCORQUODALE.

"Luminous Clouds," or Aurora?

SURELY the "luminous clouds" reported from Cornwall on September 10, in your issue of September 29, were auroral. It is a pity if no other record of altitude has been made, when one observation of such precision is available. I myself have a fairly good record of the upper edge of the bright arch, low down in the N.W. on the previous evening at 11 p.m., as seen from Croydon. If others have a record of this, a comparison might be of value.

It may be worth noting the very probable recurrence of auroræ on the evenings beginning with the 6th inst., when the solar revolution produces the conditions of the last magnetic outbreak, so far as the aspect of the sun is concerned. I have been much struck by this recurrence in working up a series of unpublished auroral observations from York, dating back to 1832.

112 Wool Exchange, E.C., September 30.

J. EDMUND CLARK.

A Hairless Rat.

I SHOULD like to draw the attention of your readers to a peculiar case which may be worth notice.

About ten days ago a man employed at the Ordnance Store Department, Stonehouse, brought me what he termed a "real curio." It was a rat, adult though not very old, without any hair on its body. It was caught in an ordinary trap at the Victualling Yard, and it is still alive, active and, to all appearance, healthy.

In appearance the rat is of a brownish colour, and with the exception of its whiskers, which are normal, and an occasional long woolly hair on the body, it is quite hairless. When at rest the skin is thrown into numerous small folds or corrugations, and its colour is heightened by the dirt which collects in these folds. In active movement the folds disappear. The tail, except an inch at the base, is normal in appearance, though devoid of hair. The ears appear rather larger than usual, and the eyes are somewhat prominent.

On communicating with the Superintendent of the Zoological Society's Gardens, I was referred to a paper by J. S. Gaskoin, in the *Proceedings* of the Zoological Society for 1856. A precisely similar case is there described, concerning four mice captured at Taplow in 1854. One of these gave birth to five young, shortly after capture, and these resembled the parent in every respect. There is no plate in the copy of the *Proceedings* that I have referred to, and the only difference in the description of the mice which does not fit my specimen is the colour of the ears, which are light coloured.

T. V. HODGSON.

Municipal Museum, Plymouth, September 29.

THE DYNAMICAL THEORY OF REFRACTION, DISPERSION AND ANOMALOUS DISPERSION.[1]

THE dynamical theory of dispersion, as originally given by Sellmeier,[2] consisted in finding the velocity of light as affected by vibratory molecules embedded in ether, such as those which had been suggested by Stokes[3] to account for the dark lines of the solar spectrum. Sellmeier's mathematical work was founded on the simplest ideal of a molecular vibrator, which may be taken as a single material particle connected by a massless spring or springs with a rigid lining of a small vesicle in ether. He investigated the propagation of distortional waves, and found the following expression (which I give with slightly altered notation) for the square of the refractive index of light passing through ether studded with a very large number of vibratory molecules in every volume equal to the cube of the wave-length:—

$$\mu^2 = 1 + m\frac{\tau^2}{\tau^2 - \kappa^2} + m_{,}\frac{\tau^2}{\tau^2 - \kappa_{,}^2} + m_{,,}\frac{\tau^2}{\tau^2 - \kappa_{,,}^2} + \&c.$$

where τ denotes the period of the light; κ, $\kappa_{,}$, $\kappa_{,,}$ &c., the vibratory periods of the embedded molecules on the supposition of their sheaths held fixed; and m, $m_{,}$, $m_{,,}$ &c., their masses. He showed that this formula agreed with all that was known in 1872 regarding ordinary dispersion, and that it contained what we cannot doubt is substantially the true dynamical explanation of anomalous dispersions, which had been discovered by Fox-Talbot[4] for the extraordinary ray in crystals of a chromium salt, by Leroux[5] for iodine vapour, and by Christiansen[6] for liquid solution

[1] Abstract of part of the substance of a communication by Lord Kelvin, G.C.V.O., to Section A of British Association at Bristol, on September 9.

[2] Sellmeier, *Pogg. Ann.*, vol. 145, 1872, pp. 399, 520; vol. 147, 1872, pp. 386, 525.

[3] See Kirchhoff-Stokes-Thomson, *Phil. Mag.*, March and July 1860.

[4] Fox-Talbot, *Proc. Roy. Soc. Edin.*, 1870–71.

[5] Leroux, *Comptes rendus*, 55, 1862, pp. 126–128.

[6] Christiansen, *Ann. Phys. Chem.*, 141, 1870, pp. 479, 480; *Phil. Mag.*, 41, 1871, p. 244; *Annales de Chimie*, 25, 1872, pp. 213, 214.

of fuchsin, and had been experimentally investigated with great power by Kundt.[1]

Sellmeier himself somewhat marred[2] the physical value of his mathematical work by suggesting a distinction between refractive and absorptive molecules ("refractive und absorptive theilchen"), and by seeming to confine the application of his formula to cases in which the longest of the molecular periods is small in comparison with the period of the light. But the splendid value of his formula for physical science has been quite wonderfully proved by Rubens (who, however, inadvertently quotes[3] it as if due to Ketteler). Fourteen years ago Langley[4] had measured the refractivity of rock-salt for light and radiant heat of wave-lengths (in air or ether) from ·43 of a mikron to 5·3 mikrons (the mikron being 10^{-6} of a metre, or 10^{-4} of a centimetre), and without measuring refractivities further, had measured wave-lengths as great as 15 mikrons in radiant heat. Within the last six years measurements of refractivity by Rubens, Paschen, and others, agreeing in a practically perfect way with Langley's through his range, have given us very accurate knowledge of the refractivity of rock-salt and of sylvin (chloride of potassium) through the enormous range of from ·4 of a mikron to 23 mikrons.

Rubens began by using empirical and partly theoretical formulas which had been suggested by various theoretical and experimental writers, and obtained fairly accurate representations of the refractivities of flint-glass, quartz, fluorspar, sylvin, and rock-salt through ranges of wave-lengths from ·4 to nearly 12 mikrons.[5] Two years later, further experiments extending the measure of refractivities of sylvin and rock-salt to radiant heat of wave-lengths up to 23 mikrons, showed deviations from the best of the previous empirical formulas increasing largely with increasing wave-lengths. Rubens then fell back[6] on the simple unmodified Sellmeier formula, and found by it a practically perfect expression of the refractivities of those substances from ·434 to 22·3 mikrons.

And now for the splendid and really wonderful confirmation of the dynamical theory. One year later a paper by Rubens and Aschkinass[7] describes experiments proving that radiant heat after five successive reflections from approximately parallel surfaces of rock-salt and again of sylvin, is of mean wave-length 51·2 and 61·1 mikrons respectively. The formula which Rubens had given in February 1897, as deduced solely from refractivities measured for wave-lengths of less than 23 mikrons, made μ^2 negative for radiant heat of wave-lengths from 37 to 55 mikrons in the case of reflection from rock-salt, and of wave-lengths from 45 to 67 mikrons in the case of reflection from sylvin! (μ^2 negative means that waves incident on the substance cannot enter it, but are totally reflected).

1 Kundt, *Pogg. Ann.*, vols. 142, 143, 144, 145, 1871–72.
2 *Pogg. Ann.*, vol. 147, 1872, p. 525.
3 *Wied. Ann.*, vol. 53, 1894, p. 267. In the formula quoted by Rubens from Ketteler, substitute for $\mu\infty$ the value of μ found by putting $\tau = \infty$ in Sellmeier's formula, and Ketteler's formula becomes identical with Sellmeier's. Remark that Ketteler's "M" is Sellmeier's "$m\kappa^2$" according to my notation in the text.
4 Langley, *Phil. Mag.*, 1886, 2nd half-year.
5 Rubens, *Wied. Ann.*, vols. 53, 54, 1894–95.
6 Rubens, *Wied. Ann.*, vol. 60, 1896–97, p. 454.
7 Rubens and Aschkinass, *Wied. Ann.*, vol. 64, 1898.

A FOURTH SPECIMEN OF "NOTORNIS MANTELLI," OWEN.

NATURALISTS in New Zealand have this week been thrown into a great state of excitement by the capture of the fourth entire specimen of this very rare flightless Rail.

On August 8 I received a telegram informing me of the acquisition, and asking advice as to its preservation. Fortunately, a skilled taxidermist is attached to the Otago Museum, and I was able to arrange that the bird should be sent to that institution: it arrived two days later, and its remains are now in my care.

The last specimen of *Notornis* was captured twenty years ago; and it was almost universally considered by Maories, as well as by whites, to be extinct; hence the interest that attaches to the present specimen.

It may not be uninteresting to naturalists at home to be reminded of some facts in the history of *Notornis* as recorded in Buller's "Birds of New Zealand." The name was originally bestowed by Owen on some fossil bones discovered in the North Island, New Zealand.

Some years later (1849), Mr. W. Mantell was able to secure a freshly killed specimen, taken in the south-west of the Middle Island (the southern of the two main islands of New Zealand). This bird, the skin of which is in the British Museum, was declared by competent ornithologists at home to be identical with the fossil form. The second specimen was killed by Maories in 1851, and its remains are also in the National Collection. The third specimen was obtained nearly thirty years later, in 1879, and was purchased for the Dresden Museum. (From an examination of the bones Dr. A. B. Meyer declared it to be distinct from the fossil form, and named it *N. hochstetteri*.) These three specimens were killed at three spots about 100 miles apart, in very rugged country. Later, an incomplete skeleton was discovered, which is at present in the Otago Museum.

The bird recently killed is thus the fourth specimen seen in the flesh, and its future fate is at present uncertain. It was killed by a dog in the bush adjoining Lake Te Anau, in the same district as the other three specimens.

I have examined and made sketches of its viscera, which, like all parts of the bird, are carefully preserved for the owner. The specimen is a young female, in excellent health and splendid plumage.

During the present month I have been fortunate enough to obtain, on deposit, an egg of the Moa—the third or fourth, I believe, in anything like a complete condition. Although the egg is much broken, one side remains practically complete; the pieces of the other side had fallen inwards, and are embedded in the sand within the shell. The egg was discovered in a sandy deposit, and when it reached me was partially enveloped in sand. This has been removed, as far as safety would permit, from the more complete side of the egg, and the whole was thoroughly soaked in weak gelatine to bind sand and shell together. The specimen closely agrees in size and shape with the cast, which is familiar in all museums, and alongside of which it is now on exhibition. As in the case of the eggs previously discovered, it was one of a pair; the other was unfortunately broken, on handling, by those concerned in its excavation.

W. BLAXLAND BENHAM.

Dunedin, August 14.

A LIVING REPRESENTATIVE OF THE OLD GROUND-SLOTHS.

ALL naturalists will unite in congratulating Señor Florentino Ameghino on the remarkable discovery it has been his good fortune to make. It appears that several years ago he was informed by Ramon Lista—a traveller in Patagonia—of an encounter with a strange nocturnal beast, which, after being fired at and apparently hit, succeeded in escaping unharmed. It was described as like an Indian pangolin in size and form, but with the skin covered with greyish red hairs instead of scales; and from the rapidity with which it disappeared among the bushes, seemed to have been an animal of comparatively active habits. Till quite recently, nothing more had ever been heard of the strange creature seen by Lista in Santa Cruz; most of those to whom the story was narrated receiving it with more or less marked incredulity.

A short time ago, however, Señor Ameghino was shown a number of fresh ossicles from Patagonia, of somewhat smaller size than coffee-berries, which he at once recognised as comparable with the somewhat larger bones commonly found in association with the remains of certain species of *Mylodon* from the pampean deposits of the Argentine, and which have always been regarded as indicating the presence of a dermal armour in those animals. These ossicles, it appears, were extracted from a badly preserved body-skin, which seems to have been exposed for some time to the action of the weather, and consequently to have become considerably discoloured. In thickness this skin measured about two centimetres; and its hardness and toughness were such that it could be cut only with a chisel or hatchet. In its deeper layer were embedded the ossicles; and in those places where it was least damaged it was covered with coarse reddish grey hair, from 4 to 5 centimetres in thickness.

The skin evidently belonged to an animal hitherto unknown to science; and, in spite of the absence of the limbs, the presence of the ossicles seems to afford decisive evidence that it indicates an existing small representative of the ground-sloths, more or less intimately related to the typical group of the genus *Mylodon*. Moreover, in the colour of the hair it agrees with Lista's description of his unknown animal, which he confidently asserted to be an Edentate. Señor Ameghino seems, therefore, to be fully justified in regarding the two specimens as pertaining to one and the same species, and that species to be a living representative of the *Megalotheriidæ*, hitherto known only in the fossil. For this animal the name of *Neomylodon listai* is proposed, but the specific title should be amended to *listæ*.

Dermal ossicles are only known to be developed in certain species of *Mylodon* and *Glossotherium*, and have not been detected among the remains of the smaller ground-sloths characteristic of the Patagonian formations. The presumption accordingly is that the new animal is more or less closely allied to these genera, from which, indeed, its right to distinction has yet to be demonstrated.

This animal is doubtless nocturnal, and also of rare occurrence, and some time may therefore probably elapse before a perfect specimen is obtained. Till that event happens naturalists must be content with the fact that a survivor of the old ground-sloths exists in the interior of Patagonia.

REPORT ON A NATIONAL PHYSICAL LABORATORY.

THE Committee appointed in August, 1897, to consider the desirability of establishing a National Physical Laboratory have issued their report. The Committee consisted of Lord Rayleigh, F.R.S. (chairman), Sir Courtenay Boyle, K.C.B., Sir Andrew Noble, K.C.B., F.R.S., Sir John Wolfe Barry, K.C.B., F.R.S., Prof. W. C. Roberts-Austen, C.B., F.R.S., Mr. Robert Chalmers, Prof. A. W. Rücker, F.R.S., Mr. Alexander Siemens, and Dr. T. E. Thorpe, F.R.S. The questions referred to them were as follows:—

"To consider and report upon the desirability of establishing a National Physical Laboratory for the testing and verification of instruments for physical investigation; for the construction and preservation of standards of measurement; and for the systematic determination of physical constants and numerical data useful for scientific and industrial purposes—and to report whether the work of such an institution, if established, could be associated with any testing or standardising work, already performed wholly or partly at the public cost."

The following are extracts from the report of the Committee:—

In general, the committee are of opinion that the appliances and facilities of the Standards Office and of the Electrical Standardising Laboratory are fairly adequate for the performance of their statutory duties. They understand, however, that on account of the want of means for the chemical analysis of the materials used in the construction of standards, those offices would find some difficulty, without extraneous assistance, with regard to any new standards that might be required.

They further desire to point out that many physical constants and data and numerical expressions are necessarily used in connection with standards and the standardising of instruments. Some of the data now in use at the Standards Office are known to require correction, and in the case of others further investigations appear to be desirable. There is, however, no legal obligation on the Board of Trade to establish new data and numerical expressions, and, in consequence of the smallness of the staff of the office the work of the Department is limited to that which is strictly enjoined by the Acts of Parliament. The Department is at the present time chiefly dependent for more exact knowledge on such investigations as may be undertaken at the Bureau International des Poids et Mesures at Paris, or by foreign institutions similar to that contemplated in this country.

There is much evidence that further facilities are needed by the public for standardising and verifying of instruments, both for scientific and commercial use; and also that it would be of great benefit to trade if means were provided for the public testing of the quality of certain classes of materials. In particular the committee desire to draw attention to the evidence which has been laid before them as to the difficulties arising in certain Government departments in their dealings with contractors and others which might be overcome by the establishment of an independent testing authority. It would neither be necessary nor desirable to compete with or interfere with the testing of materials of various kinds as now carried out in private or other laboratories; but there are many special and important tests and investigations into the strength and behaviour of materials which might be conducted with great advantage at a laboratory such as is contemplated in the reference. As illustrations we may mention investigations into the behaviour of metals and other substances under continuous or alternating stresses, which investigations are not, so far as we know, conducted at the present time at any testing institution in this country, and which could only be undertaken with satisfactory and authoritative results at a public laboratory.

For many years the testing of certain instruments has been carried out at the Kew Observatory under the direction of the Kew Observatory Committee of the Royal Society. There is much evidence that the existence of these tests has been of great benefit to both science and industry. On the one hand it enables the maker to give, or the purchaser to obtain, an independent and trustworthy statement as to the quality of the instrument. On the other hand, the existence of the tests has led in many cases to a marked improvement of the instruments; and similar results may be anticipated by an extension of these facilities to other branches of industry.

The Kew Observatory is a Government building leased to the Royal Society at a nominal rent, situate in the Old Deer Park, Richmond, which is Crown property. The institution has no endowment, the Gassiot Fund producing about 470*l.* per annum. From the Meteorological Office it receives annually 400*l.*, part of which is the ordinary grant made to a first-class meteorological station, the remainder being for scientific assistance. The fees received for the verification and testing of instruments amount to about 2000*l.* per annum. The institution is self-supporting, and has usually a small annual balance which is devoted to scientific investigation and to the extension of the work, including the erection of new buildings, when required. The funds at the disposal of the Observatory Committee are, however, quite inadequate to any considerable extension of its operations. The work done with restricted means has been very useful. The total number of instruments annually verified or tested is about 22,000. Among these are included watches, thermometers, sextants, barometers, and other apparatus used for scientific or industrial purposes. Evidence was given of the beneficial effect which Kew has exerted on the watchmaking trade, and it is noteworthy that this is due to the introduction of tests for which there was little or no previous demand on the part of the trade, though there is now keen competition among the best makers to secure a high place in the report which is annually issued.

In the opinion of the committee the principles which underlie the proposal for the establishment of a national physical laboratory have been tested on a comparatively small scale at the Kew Observatory with the most satisfactory results.

In addition to the physical constants and numerical *data* needed in connection with standards, there are numerous facts, a knowledge of which would be of great value to science and industry. The determination of such data usually involves an investigation as to the method of making the determination, and a considerable expenditure of skilled labour in carrying out the determination. The committee are of opinion that, although the former part of this work will in general be initiated by individual experimenters of great skill and originality, it may in special cases be usefully undertaken by a public body. It is rather to the improvement in the details of the method of making the determination that they think that the work of a public institution will for the most part be directed. This cannot usually be carried out by private investigators on account of the expense and the length of time over which the experiments must extend. The scientific reputation to be gained is often incommensurate with the labour involved; and even when the results are of industrial importance in many cases they cannot be protected by patents.

There is evidence that many questions of this nature are partially investigated for technical purposes by private persons, the results being not infrequently kept secret. More complete investigations carried out at a public institution and freely published would often be of great service to industry, and there is reason to believe that a large part of the cost of such work might be defrayed by the persons directly interested in the results.

One difficulty in connection with a scheme for the determination of constants and data arises from the fact that the number of subjects which might be pressed for investigation would be very large. The opinion was, however, generally expressed by the witnesses that a strong governing body would have no difficulty in selecting those branches of work which were the most important, and that it would be possible to confine the work of the proposed institution, if established, within moderate limits. Nearly all the witnesses, also, have expressed the opinion that those interested in industry as well as persons devoted to the study of pure science would be willing that the Royal Society should be ultimately responsible for the management of the proposed institution, provided that industry were adequately represented on the governing body, and that the choice of the members of that body, though nominated by the Council of the Royal Society, were not confined to Fellows of the Society.

After consideration of the evidence the committee have come to the conclusion that an institution should be established for standardising and verifying instruments, for testing materials, and for the determination of physical constants. Work useful both to science and industry could therein be performed for which no adequate provision is at present made, either in this country or at the Bureau International des Poids et Mesures. Such work could not, or, at all events, in all probability would not, be undertaken by individual workers, or by institutions primarily devoted to education. In the opinion of the committee the proposed institution should be established at the national expense on lines similar to, though not at present on the scale of, the Physikalisch-technische Reichsanstalt referred to above. The possibility of future extension should, however, be kept in view from the first.

To secure the efficient performance of the work, the committee are of opinion that the director of the institution should be a man of high scientific attainments, and should act under a governing body containing representatives of both science and industry. The director should not be called upon or allowed to undertake work not connected with the institution except with the consent of the governing body. He would require the support of an adequate staff. As regards locality, while it is desirable that the institution should be near London, it is necessary that the site be free from mechanical and electrical disturbance.

Among the most important questions considered by the committee was whether the proposed institution should be founded independently or should be a development of an existing institution. The duties of the Board of Trade, as custodian of certain standards, are defined by statute, and the committee consider that it is undesirable to alter existing arrangements in this respect. They are of opinion that the proposed laboratory if established should be managed by a governing body constituted and appointed as hereinafter described, and should not be under the direct control of a Government department. They recommend that the Board of Trade, as custodian of the standards, should be placed in close connection with the said governing body.

The character of the work done at the Kew Observatory suggests that all that is really necessary might be attained by the development of that institution.

RECOMMENDATIONS.

(1) That a public institution should be founded for standardizing and verifying instruments, for testing materials, and for the determination of physical constants.

(2) That the institution should be established by extending the Kew Observatory in the Old Deer Park, Richmond, and that the scheme should include the improvement of the existing buildings, and the erection of new buildings at some distance from the present observatory.

(3) That the Royal Society should be invited to control the proposed institution, and to nominate a governing body, on which commercial interests should be represented, the choice of the members of such body not being confined to Fellows of the society.

(4) That the permanent secretary of the Board of Trade should be an *ex officio* member of the governing body; and that such body should be consulted by the Standards Office and the Electrical Standardising Department of the Board of Trade upon difficult questions that may arise from time to time or as to proposed modifications or developments.

NOTES.

IN connection with the forthcoming conference upon an International Catalogue of Scientific Literature, a reception will be held at the Royal Society on Monday next, October 10. A dinner has been arranged by the President for Fellows of the Society and their friends who are interested in the subject of the Catalogue. It will take place at the Hôtel Métropole on Tuesday, October 11.

IN connection with the opening of the winter session of the Charing-cross Hospital Medical School on Monday, Prof. Rudolf Virchow, Director of the Berlin Pathological Institute, delivered the second of the Huxley lectures, his subject being "Recent Advances in Science, and their Bearing on Medicine and Surgery." Lord Lister, President of the Royal Society, occupied the chair, and a large number of members of the medical profession, and distinguished men of science were present. Prof. Virchow was most cordially received, and his address, printed in another part of this number, was followed with deep interest and attention.

MR. T. MELLARD READE informs us that the gypsum boulder, weighing at least thirteen tons, found in the Boulder Clay of Great Crosby, and described in a previous number of NATURE (p. 132), has been presented to the District Council by Mr. Peters, and is now being moved from its original bed with the intention of erecting it in an open space in Liverpool Road, Great Crosby. A concrete platform has been prepared to receive the boulder. From the depth of the clay pit in which it lay, and its great weight and irregular form, the lifting, carriage and setting up of the boulder is one of considerable difficulty. The boulder will be protected with wrought-iron railings, and no doubt will prove an object of abiding interest to the neighbourhood and to geologists generally.

NEWS has been received from Sitten (Canton Valais, Switzerland) that, on Monday, Captain Spelterini attempted the passage over the Alps in his balloon the *Vega*. He was accompanied by Prof. Heim, of Zürich, Dr. Mauer, director of the Meteorological Bureau of Zürich, and Dr. Biederman, of Warsaw. The balloon contained 3268 cubic metres of gas, was nearly 200 feet in height, and was capable of carrying a weight of 110,000 kilos, or about 100 tons. Owing to unfavourable winds, the object of crossing the Alps was not attained. The balloon was carried in the wrong direction, and descended near Dijon in France. It reached a height of 6300 metres (20,670 feet).

Attention has already been called to the fact that the executors of the late Baron von Mueller are collecting donations for the erecting upon his grave in the St. Kilda Cemetery, Melbourne, of a monument worthy of his fame. The monument is of grey granite, 23 feet in height, all highly polished, and will stand in the centre of a grave-plot 12 feet square, planted out with choice specimens of the Australian flora. We are now informed that the distinguished phytologist's supplemental volume of the "Flora Australiensis," upon which he had worked for years, and was preparing for the press at the time of his death, is to be published, together with two volumes on his administration as director of the Botanical Gardens, Melbourne, and embracing a biography and complete bibliograph of his writings. The executors would feel favoured by the loan of any of his letters, or the communication of incidents in the Baron's life which friends may deem worthy of notice in the biography. Subscriptions and letters should be addressed "Rev. W. Potter, 'Vonmueller,' Arnold Street, South Yarra, Melbourne, Australia."

We regret to see the announcement of the death of Dr. J. E. T. Aitchison, F.R.S., Brigade-Surgeon (retired) of H.M. Bengal Army, at the age of sixty-three.

Mr. Charles F. Brusch has sent us a copy of a paper read by him before the American Association, on August 23, upon a new gas which he has detected in the atmosphere, and designated *Etherion*. We shall refer to this paper later, when we receive a spectroscopic demonstration of the existence of the new gas.

Referring to the death of M. Gabriel de Mortillet, the well-known naturalist and anthropologist, the *Athenæum* says that he was born in 1821 at Meylan, and educated at Chambéry and Paris. He left France in 1849 to escape imprisonment for a socialistic publication, retiring to Savoy and Switzerland, where he arranged the museums of Annecy and Geneva. In 1856 he took scientific work in Italy; in 1864 he returned to Paris, and founded a periodical dealing with the primitive history of man. Henceforth he was occupied with organising congresses of prehistoric anthropology and archæology. He was appointed curator of the Museum of Antiquities at St. Germain in 1868, and in 1875 he helped to found the Anthropological School at Paris, of which he was subsequently professor. Among his numerous books may be mentioned studies on the mollusca and geology of Savoy, the sign of the cross before Christianity, the potters of the Allobroges, and the prehistoric problem, while his work in learned periodicals was extensive.

An exhibition of optical, mathematical, and scientific instruments is being held this week at the Mansion House, under the auspices of the Worshipful Company of Spectacle Makers, of which the Lord Mayor, Lieut-Col. H. D. Davies, M.P., is the master. The formal opening ceremony was performed on Monday afternoon, under the presidency of the Lord Mayor. The exhibits comprise a number of ancient as well as modern scientific instruments. Mr. Lewis Evans (of King's Langley) displays, *inter alia*, seven astrolabes of the fourteenth to the seventeenth centuries, and a large number of portable sun dials from England, France, Germany, Italy, &c., showing the development of the various types from the fifteenth century to the present time. Among other exhibits are the maximum and minimum thermometers used by Captain Ross in his various voyages round the world. The exhibition will be opened daily until Saturday inclusive, from two o'clock until nine, and a band will play every evening between five and eight o'clock.

The announcement that *Natural Science* will cease at the close of the present year, will be received with regret by students of biological sciences in many parts of the world. The periodical has taken a high place among monthly reviews of scientific progress, and it will be widely missed. The cessation of the journal could be prevented if some one with sufficient time and means will come forward to take over the responsibilities of the present editor, who announces that "all stock, appurtenances, and goodwill" will be handed over to any scientific man who is prepared to take over the responsibility, and continue the journal as an independent organ. It is to be hoped that this opportunity will not be missed, and that the journal will not be permitted to drop out of existence.

An interesting description of the electric railway on the Jungfrau, the first section of which was opened a few days ago, appears in the *Electrician* of September 23 and September 30, and from it we derive the following particulars:—The existing Wengern Alp Railway—a rack and pinion railway driven by steam locomotives—starts from Lauterbrunnen and ascends the Wengern Alp to the Little Scheidegg (an elevation of 6770 feet above sea-level) from whence it descends on the other side of the mountain to Grindelwald. The Jungfrau electric railway starts from the Little Scheidegg station of the Wengern Alp Railway and ascends the Jungfrau from the north side. There will be seven stations in all—namely, Little Scheidegg, Eiger Glacier (7610 feet), Eiger Wand (9220 feet), Eismeer (10,360 feet), Jungfraujoch (11,210 feet), Lift (13,430 feet), Summit of Jungfrau (13,670 feet). On the section of the line already opened there is only a distance of about 85 yards in tunnel, but from the Eiger Glacier onwards the railway will not touch the surface except at the stations. Almost immediately after leaving the Little Scheidegg station the gradient is 10 per cent., and this is increased to 20 per cent. at about half-way to the Eiger Glacier station. From this station the gradient increases to the maximum of 25 per cent. and the line enters the long tunnel, about 450 yards of which has been driven up to the present. The remaining stations from Eiger Wand onwards will be built within the rock, and it is intended to fit them with restaurants and sleeping accommodation for those passengers who may wish to break the journey. From the Eiger Wand and Eismeer stations there will be no egress on to the mountain, and tourists will merely be able to enjoy the view from windows or balconies, but from the Jungfraujoch station it will be possible to go out on to the Jungfraufirn and sledge over the perpetual snowfield to the Aletsch Glacier. The Jungfrau line is one of the most interesting applications of three-phase transmission and distribution yet made. Water-power is made use of in the valley to generate three-phase current at 7000 volts, and this is transmitted by means of overhead wires to transformer stations at the Little Scheidegg and the Eiger Glacier, where it is transformed to 500 volts by means of stationary transformers. Not only is electrical energy employed for traction purposes but also for lighting, heating, and for working the rock-drills used in the tunnels. The permanent way is built on the Strub rack system, and the locomotive truck geared to it carries two induction motors driven directly by the 500-volt three-phase current. The passenger cars, which are not pulled but pushed by the locomotive, are built for forty passengers. It is estimated that the railway will be completed by 1904.

IT must now be accepted as one of the established facts of medicine that in almost all outbreaks of human plague rats are affected by a similar disease both before and during the epidemic. In an article upon the plague in Calcutta, Dr. F. G. Clemow points out in the *Lancet* that the evidence that the two diseases are the same is of exactly the same character as that which has established the identity of human and bovine tuberculosis, and there seems to be but little more reason for suspension of judgment in the one case than in the other. It may therefore be accepted that plague in man and plague in the rat are, as far as our present knowledge of the two diseases goes, one and the same disease. Evidence has also been published that the disease may attack other animals than the rat, such as dogs, pigs, pigeons, and domestic fowls. Some interesting evidence pointing to the possibility that rats were the means of introducing the plague infection into Calcutta, is given by Dr. Clemow. Before the date of the first recognised case of plague in man, intimation was received at the Health Office that a number of dead rats had been found in an office situated near the river; and a little later, other dead rats were found in a street close to and parallel with the river and in the warehouses of a shipping company near to the wharfs where ships unload. The occurrence seems to have been so unusual as to have at once attracted attention, and the premises were cleansed and disinfected. Some of these animals were examined at the municipal laboratory, and cultures of the plague bacillus were obtained from them. Right from the beginning of the outbreak dead rats in large numbers have been found in various parts of Calcutta, but more particularly in and near houses where cases of human plague had occurred.

IN a report to the Administrator of St. Vincent, dated September 14, Mr. H. Powell, Curator of the Botanic Garden, Kingstown, gives some trustworthy meteorological statistics relating to the recent hurricane in that Colony. He states that the barometer gave timely indication of the coming storm; at 3h. p.m. on September 6 the corrected reading was 29·926 inches, and at 3h. p.m. on the 10th the mercury had fallen to 29·838 inches. This reading caused alarm, and cautionary notices were issued to various centres for dissemination. At 5h. 55m. the next morning the reading was 29·724 inches, and the wind was blowing in fitful gusts from N. and N.W. At 9h. a.m., the usual hour for recording observations, the reading was 29·606 inches, and the wind was rushing from N. to W. At 10h. a.m. the barometer had fallen to 29·539 inches, and the storm had commenced in earnest, the wind blowing from N.N.E. and W., and increased in such force at 11h. a.m. that the largest trees were uprooted. By 11h. 40m. the barometer had fallen to 28·509 inches, after which time there was almost a dead calm for about three-quarters of an hour. The rain gauge was emptied, and 4·94 inches were found to have fallen between 9h. a.m. and noon. At about 12h. 25m. p.m. the wind suddenly commenced to blow from S., and increased in force every minute. Trees and houses which had withstood the first part of the hurricane were now hurled to the ground, the wind force far exceeding that of the forenoon; this continued till about 2h. 30m. p.m., when the wind slackened considerably. During the lull between 11h. 40m. and 12h. 30m. the barometer remained steady at 28·509 inches, and then commenced to rise slowly, and afterwards rose as rapidly as it had previously fallen; at 3h. p.m., the usual recording hour, it had risen to 29·533 inches. Up to this time the rain had fallen in torrents, but the gauge had been overturned. The total rainfall measured was over 9 inches in the twenty-four hours, and it was estimated that another 5 inches was lost by the upsetting of the gauge. Distant thunder and lightning were recorded at intervals during the morning and afternoon. Persons living in St. Vincent who remember the "Great Hurricane" of August 11, 1831, state that the recent one was in every way far more destructive.

BY a decree dated August 30 last, the Belgian Government has separated the astronomical from the meteorological service (see NATURE, vol. lvi. p. 183), each of these departments being placed under a responsible scientific director; while administrative duties, care of instruments, library, &c., are to be under the control of an inspector. The astronomical service is placed under M. C. Lagrange, and meteorology under M. A. Lancaster, each of whom will submit a report quarterly to the Minister of the Interior upon the work of his particular department.

THE record of an active and useful life is contained in a memoir of Dr. T. Sterry Hunt, F.R.S., by Mr. James Douglas, read before the American Philosophical Society in April last, and just published in separate form by Messrs. MacCalla and Co., Philadelphia. As a chemist Dr. Hunt was prominent nearly half a century ago, not only in the field of original investigation, but as one of the first interpreters of the new chemistry then being taught by Gerhardt. As a geologist his work was almost confined to the crystalline and palæozoic rocks, and he brought his chemical knowledge to bear upon the geological problems concerning their genesis. Mr. Douglas's memoir contains a number of interesting notes. The following extract from a letter written by Hunt from Paris in 1855 is of interest in connection with the production and cost of aluminium at the present time:—"I bring you some aluminium with a little note from Ste. Claire Deville, the discoverer. As for aluminium, it is still very rare; perhaps 100 lbs. have been made by Deville for the Emperor, who has defrayed from his own purse the experiments. Rousseau, the greatest fabricant of rare chemicals in France, sells it, however, at three and a-half cents a grain—the price of gold—and everybody buys specimens of it at that price, so that he can hardly supply the demand." In Mr. Douglas, Dr. Hunt's work has found an appreciative recorder.

THE British Mycological Society held a most successful meeting, under the auspices of the Dublin Naturalists' Field Club, at Dublin, from September 19-24. Prof. Johnson arranged a most interesting series of excursions to Houth, Powerscourt, Brackenstown, Ballyarthur, The Woodlands, Lucan, and Dunran, and his labours were rewarded by more than 100 species being added to the published list of Mr. Greenwood Pim of "the fungi of the counties of Dublin and Wicklow." Some rare fungi were collected, including *Amanita strobiliformis*, *Naucoria erinacea*, *Polyporus Wynneæ* and *Hypocrea splendens*. Interesting papers were read by the President, Dr. C. B. Plowright, on "Notes and comments on the Agaricineæ of Great Britain," "A clover destroying Fungus," "Eriksson's cereal rusts"; Mr. H. Wager, on "A parasitic fungus on Euglena"; Mr. Greenwood Pim, "Notes on new and rare moulds"; "Dr. McWeeney, "Observations on two sclerotia occurring on the stems of potato"; and Mr. Soppitt, "Notes on rare Uredineæ."

THE *Agricultural Gazette of New South Wales* for July contains an interesting account, by Mr. J. H. Maiden, Government Botanist at Sydney, of a botanical exploration of Mount Kosciusko, the highest mountain in Australia, 7328 feet above the level of the sea. Even at midsummer (January 1897) the temperature was only 1·5° above the freezing point at noon, and the climate of the mountain is not adapted for a sanatorium, as has been suggested, owing to the searching southwesterly winds. A list of the species gathered is given, the most largely represented orders being the Rununculaceæ, Leguminosæ, Myrtaceæ, Compositæ, and Gramineæ. There is no mention in the list of any species of Saxifragaceæ or Primulaceæ, and only one each is recorded of Crassulaceæ and Gentianaceæ.

In a "Note on Stokes's Theorem," Mr. A. G. Webster contributes to the *Proceedings* of the American Academy of Arts and Sciences, xxxiii. 20, a very simple proof of the expressions for the components of the curl of a vector point-function in terms of orthogonal curvilinear coordinates, which he obtains without the laborious process of transformation from rectangular axes.

The *Revue générale des Sciences* has brought to light a new student of geometry in the form of Father Cyprien, of the Monastery of Mount Athos. This monk, who turns out to have been formerly a well-known explorer, Prince C. Wiasemsky, contributes to the pages of the *Revue* an interesting note on what he calls the "transinscribed spheres" of regular polyhedra, viz. spheres touching the edges of polyhedra, and various relations between the radii of spheres transinscribed to the regular tetrahedron, cube, octohedron, dodecahedron, and icosahedron are established.

Prof. Oreste Murani contributes to the *Rendiconti* del R. Istituto Lombardo, xxxi. 4, some interesting observations on stationary Hertzian waves as studied with the use of a coherer. The experiments were undertaken with a view of elucidating the phenomenon of multiple resonance indicated by the experiments of Sarasin and De la Rive, who by using resonators of different sizes had obtained indications of waves of different lengths. Instead of a resonator, Prof. Murani used a coherer, whose distance from the metallic reflector could be varied. On the hypothesis that the waves given off by the oscillator were simple waves, it would be natural to expect that the galvanometric deviations due to the coherer should vanish at the nodes and become a maximum at the loops. The actual observations, however, give no indications of such maxima and minima, thus favouring the view that the radiations emitted by the primary are not simple, but are composed of an infinity of waves of different periods.

The invention of the kinematograph has led to a large demand for films, and these of considerably greater length than was previously required. We read in the *British Journal of Photography* (September 23) that the Eastman Kodak Company of Rochester, New York, have contracted to manufacture three photographic films of a length of 50,000 feet each, *i.e.* 9 miles 826 yards 2 feet long. These films have been ordered by Mr. Dunn for use in a machine of the kinetoscope type, the "Cellograph," of which he is the inventor. It is interesting to note the cost of such strips. The Eastman Company, according to the same account, charges 10,000 dollars for each roll, making in all 30,000 dollars for 150,000 feet, or about 1000 dollars a mile. It is possible now literally to take photographs by the mile.

A catalogue of the scientific works in the Royal Zoological Anthropological-Ethnographical Museum in Dresden has been prepared under the direction of Dr. A. B. Meyer, and is published by Messrs. R. Friedländer and Son, Berlin. The works are arranged alphabetically according to authors, and systematically in subjects.

Helminthologists will welcome the contributions to the anatomy and histology of Nemertean worms, which Dr. Böhmig publishes in the current number of the *Zeitschrift für Wissenschaftliche Zoologie.* Two species are described in detail; the one (*Stichostemma græcense*) discovered by Dr. Böhmig himself six years ago in a freshwater pond in the botanic gardens of Graz; and the other (*Geonemertes chalicophora*), found by Prof. von Graff in one of the hot-houses of the same gardens in 1879. The same number of the *Zeitschrift* contains also a paper, by W. Karawaiew, on the changes which the internal organs of ants undergo during their metamorphosis. The observations recorded were made on female larvæ of *Lasius flavus*, and are chiefly of a histological nature.

A paper on induction coils, read by Mr. A. Apps before the Röntgen Society, and one by Dr. J. Macintyre on contact breakers, appear in the *Archives* of the Roentgen Ray (vol. iii. No. 1), together with a report of the discussions which took place upon them at the meeting at which they were read. Unstinted praise is awarded to the excellent mechanical construction and performance of British-made instruments. Thus, "The possessor of a good induction coil made by our leading instrument-makers should cherish it as the violin-player cherishes his Stradivarius or his Guarnerius." Mr. T. C. Porter gives an extended account of his researches on Röntgen rays, already briefly described by him in these columns; Mr. Campbell Swinton summarises some of his recent work; and Drs. Norris Wolfenden and F. W. Forbes-Ross describe the action of Röntgen rays upon the growth and activity of bacteria and micro-organisms.

The second edition of a "Catalogue of Scientific and Technical Periodicals," by Prof. H. Carrington Bolton, has just been published by the Smithsonian Institution. The catalogue contains particulars concerning the principal independent periodicals of every branch of pure and applied science published in all countries from 1665 to the present time. Medicine has been excluded from the list, but anatomy, physiology, and other branches of medical science have been admitted. The periodicals are arranged in alphabetical order, and they number nearly nine thousand. The date of publication of each volume of the journals entered in the catalogue is shown by means of chronological tables, by the use of which it is possible to find the date of a given volume in a given series, or the number of a volume when the date is known. The periodicals are indexed according to subjects, as well as arranged alphabetically according to their titles. The preparation of the volume (which runs into 1247 pages) must have involved an immense amount of work, and men of science will be grateful to the Smithsonian Institution for the new edition of this useful bibliography of the scientific press.

The following are among the forthcoming publications announced by Mr. Wilhelm Engelmann (Leipzig):—"Repetitorium der Zoologie," by Karl Eckstein, second revised edition; "Catalogus Hymenopterorum hucusque descriptorum systematicus et synonymicus," by C. G. de Dalla Torre, Volumen iv. Braconidae; "Monographieen afrikanischer Pflanzen-Familien-und-Gattungen," edited by A. Engler, i. Moraceae (excl. Ficus), prepared by A. Engler; ii. Melastomataceae, prepared by E. Gilg; "Elemente der Mineralogie begründet," by Carl Friedrich Naumann. Thirteenth completely revised edition by Ferdinand Zirkel, second part, completion of the work; "Kritik der wissenschaftlichen Erkenntnis Eine vorurteilsfreie Weltanschauung," by Dr. Heinrich von Schoeler; "Grundriss der Psychologie," by Prof. Wilhelm Wundt, third revised edition; "Untersuchungen über Strukturen," by Prof. O. Bütschli; "Grundriss einer Geschichte der Naturwissenschaften," by Friedrich Dannemann, vol. ii.; "Monographie der Turbellarien," by Ludwig von Graff, vol. ii.; "Handbuch der Blütenbiologie," founded upon Hermann Müller's work, by Paul Knuth; vol. ii. second part, Lobeliaceae bis Coniferae; "Die Vegetation der Erde Sammlung pflanzen-geographischer Monographieen," edited by A. Engler and O. Drude, vol. iii. Caucasus, by G. E. Radde.

Mr. Edward Arnold announces:—"Lectures on Theoretic and Physical Chemistry," by G. R. Van 't Hoff, translated by Prof. R. A. Lehfeldt; "An Experimental Course of Chemistry for Agricultural Students," by T. S. Dymond; "Elementary Physical Chemistry," by Ch. Van Deventer, with an introduction by G. R. Van 't Hoff, translated by Prof. R. A. Lehfeldt; "An Illustrated School Geography," by Dr. Andrew J. Herbertson; and a new edition of "Animal Life and Intelligence," by Prof. C. Lloyd Morgan.—Messrs. G. Bell and Sons' list includes: "Domestic Hygiene," by Dr. W. A. Williams.—Messrs. J. and A. Churchill's announcements include: "A Synopsis of Surgery," by R. F. Tobin; and a new edition of Squire's "Companion to the British Pharmacopœia."—Messrs. Harper and Brothers' list contains: "A Thousand Days in the Arctic," by F. G. Jackson, 2 vols., illustrated.—Mr. W. Heinemann promises: "A View of the World in 1900," a new geographical series, edited by H. J. Mackinder, in 12 vols.: (1) "Britain and the North Atlantic," by the editor; (2) "Scandinavia and the Arctic Ocean," by Sir Clements R. Markham, F.R.S.; (3) "The Mediterranean and France," by Elisée Reclus; (4) "Central Europe," by Dr. Joseph Partsch; (5) "Africa," by Dr. J. Scott Keltie; (6) "The Near East," by D. G. Hogarth; (7) "The Russian Empire," by Prince Kropotkin; (8) "The Far East," by Archibald Little; (9) "India," by Colonel Sir Thomas Holdich; (10) "Australasia and Antarctica," by Dr. H. O. Forbes; (11) "North America," and (12) "South America," by American authorities.—Messrs. Smith, Elder, and Co. will publish: A new edition, with additional plates, of "Electric Movement in Air and Water," by Lord Armstrong, F.R.S.

The additions to the Zoological Society's Gardens during the past week include a Green Monkey (*Cercopithecus callitrichus*) from West Africa, presented by Mr. Cecil Alden: a Ring-tailed Coati (*Nasua rufa*) from South America, presented by Mr. W. C. Way; six Spotted Tinamous (*Nothura maculosa*) from Buenos Ayres, presented by Mr. Ernest Gibson; two Chameleons (*Chamæleon vulgaris*) from North Africa, presented by Mr. W. F. H. Rosenberg; three young Lions (*Felis leo*, ♂ ♂ ♀) from Africa, a Sumatran Rhinoceros (*Rhinoceros sumatrensis*, ♀) from Malacca, two Emus (*Dromæus novæ-hollandiæ*), ten Cunningham's Skinks (*Egernia cunninghami*), a Black and Yellow Cyclodus (*Tiliqua nigro-lutea*) from Australia, a Jardine's Parrot (*Pœocephalus gulielmi*) from West Africa, a Red-sided Eclectus (*Eclectus pectoralis*) from New Guinea, two Reticulated Pythons (*Python reticulatus*) from the East Indies, deposited; a Common Sandpider (*Tringoides hypoleucus*), two Little Ringed Plovers (*Ægialitis curonica*), European, purchased.

OUR ASTRONOMICAL COLUMN.

The Large Sun-spot.—The spot on the solar disc which appeared on September 3 last at the eastern limb, and which, when on the central meridian (September 9), was the probable origin of the aurora and magnetic storm, has again (September 30) made its appearance on the eastern limb, having been of sufficient dimensions to last a period of rotation of the sun. The spot is accompanied by several others of smaller size, and its umbra is divided into three separate parts, which form objects of interesting observation. Even in one day considerable changes have been noted to have taken place in the smaller spots in its neighbourhood, although the large one has not shown any marked change. It will be interesting to know whether another aurora and concurrent magnetic storm will be observed and recorded when the spot reaches the central meridian (which will take place on October 6), as was the case at its last meridian passage.

New Teaching Observatory for the Californian University.—We have received a circular from the director (Mr. A. O. Leuschner) of the students' observatory of the University of California, from which we make the following brief summary:—The trustees of the "Phebe Hearst Architectural Plan for the University of California" have inaugurated an international competition to secure the most suitable plan for the erection of new buildings in place of the present ones on the University grounds at Berkeley. The buildings are to satisfy every need of a modern University of the highest rank. Among these buildings will be an astronomical observatory especially adapted to the training of young men and women for the profession of astronomy in all its branches, and its equipment will be such as best to serve the purposes of the highest instruction in all branches of astronomy. It is stated that the new observatory is not meant to conflict with the Lick Astronomical Department of the University, for there students are only admitted who are supposed to have shown a marked ability for observation and independent research, and who receive from the astronomers a higher inspiration, and are guided by them in their first investigations in such special lines as can be best carried on at the Lick Observatory. While the main feature of the Berkeley department will be to give proper instruction to its students, the equipment of the observatory is proposed to be sufficiently complete to give ample opportunity for the higher work of research that the instructors and advanced students may be in a position to undertake. The object of the circular is, as the writer mentions, "to state in detail my ideas concerning the proposed new observatory, and to seek the advice of men prominent in the science of astronomy and in astronomical instruction elsewhere." That the observatory will be fully equipped and suitable for the work intended to be accomplished there will be little doubt, and the question of cost is evidently a minor detail, for the Trustees of the Plan invite opinion and request "suggestions irrespective of cost which . . . will better adapt the new observatory for the purposes which it is to serve."

Some of the instruments suggested are: an equatorial refractor of an aperture not greater than 16 inches; four smaller telescopes ranging from 6–10 inches aperture, one being a reflector; complete accessories for visual photographic, spectroscopic and photometric work; a 4-inch meridian circle, and four transit and zenith telescopes. The circular gives also details of the sizes of all the rooms for the instruments, laboratories, lectures, library, &c., which it is proposed to build.

Annual Report of the Cambridge Observatory.—In his report to the Observatory Syndicate, which covers a period twelve months ending May last, Sir Robert Ball states that the meridian instrument of the observatory has been devoted especially to the perfection of a complete catalogue (which is ready for the press), by re-observing stars of which a single observation had only been obtained. It has also been employed in the determination of accurate places of a list of occultation stars at the request of Colonel Tupman. The Northumberland equatorial has been occasionally used for examining fixed stars and planets, but is chiefly employed when visitors are admitted.

The work of the Newall telescope has been continued by Mr. H. F. Newall on the same lines as in former years, namely, the determination of the velocities of stars in the line of sight as measured photographically. The stars chiefly used were those of the solar type. In all 111 photographs of sixty minutes' exposure each were obtained, giving material for the determination of velocity of forty-four stars. Twenty of these stars were of magnitudes greater than 2·5, and are included in the Potsdam observations made in 1888–91; the remainder lie between magnitudes 2·5 and 4·0, and were fainter than could be successfully dealt with at Potsdam. Of these plates eighty-three have been measured once, and twenty twice.

The report further states that the new photographic telescope is now finished at Sir Howard Grubb's works, and that the building to house it has been practically completed.

Annual Publication of the Observatory of Rio de Janeiro for 1898.—This yearly publication of the Astronomical Observatory of Rio de Janeiro is the fourteenth of the present series, and will be found to contain a great deal of useful information in addition to the ordinary data usually found in astronomical almanacs. There will be found tables for the reduction of meteorological observations, and for calculating altitudes from barometric observations by the methods of Laplace, Bessel, Cruls, Weilenmann: meteorological observations for several towns, such as Rio de Janeiro, Santa Cruz, Uberaba, contained in Part vi., which also includes the magnetic elements observed at Brazil by the Holland Commission. The last section is devoted to some miscellaneous data, and contains, among other matters, tables for determining, rapidly and approximately, the elements of a triangulation by the method proposed by Mr. Francis Galton.

RECENT ADVANCES IN SCIENCE, AND THEIR BEARING ON MEDICINE AND SURGERY.[1]

THE honour of being invited to deliver the second Huxley Lecture has deeply moved me. How beautiful are these days of remembrance which have become a national custom of the English people! How touching is this act of gratitude when the celebration is held at the very place wherein the genius of the man whom it commemorates was first guided towards its scientific development! We are filled not alone with admiration for the hero, but at the same time with grateful recognition of the institution which planted the seed of high achievement in the soul of the youthful student. That you, gentlemen, should have entrusted to a stranger the task of giving these feelings expression seemed to me an act of such kindly sentiment, implying such perfect confidence, that I at first hesitated to accept it. How am I to find in a strange tongue words which shall perfectly express my feelings? How shall I, in the presence of a circle of men who are personally unknown to me, but of whom many knew him who has passed away and had seen him at work, always find the right expression for that which I wish to say as well as a member of that circle itself could? I dare not believe that I shall throughout succeed in this. But if, in spite of all, I repress my scruples it is because I know how indulgently my English colleagues will judge my often incomplete statements, and how fully they are inclined to pardon deficiency in diction if they are convinced of the good intentions of the lecturer.

PROFESSOR HUXLEY'S WORK.

I may assume that such a task would not have been allotted to me had not those who imposed it known how deeply the feeling of admiration for Huxley is rooted within me, had they not seen how fully I recognised the achievements of the dead master from his first epoch-making publications, and how greatly I prized the personal friendship which he extended towards me. In truth, the lessons that I received from him in his laboratory—a very modest one according to present conditions—and the introduction to his work which I owe to him, form one of the pleasantest and most lasting recollections of my visit to Kensington. The most competent witness of Huxley's earliest period of development, Prof. Foster, presented in the first of these lectures a picture of the rapidly increasing extension of the biological knowledge, which must have excited not only our admiration, but also the emulation of all who study medicine. Upon me the duty is incumbent of incorporating with this presentment the newer strides of knowledge and of stating their influence upon the art of healing. So great a task is this that it would be presumptuous even to dare to attempt its accomplishment in a single lecture. I have decided, therefore, that I must confine myself to merely sketching the influence of biological discoveries upon medicine. In this way also will the example of Huxley be most intelligible to us. I must here make a confession. When I tried to ascertain how much time would be required to deliver my lecture as I had prepared it, I found, to my regret, that its delivery would occupy nearly double the time assigned to me. I had therefore to reduce it to about half of its original dimensions. This could only be done by means of very heroic cuts, seriously damaging in more than one place my chain of ideas. If, therefore, you should find, gentlemen, that my transitions from one point to the other occasionally are of a somewhat sudden and violent character, I trust you will bear with me and remember that, if you should take the trouble of reading my address afterwards, you will be less shocked than you may be to-day by my statements when they appear in print.

THE BEGINNINGS OF BIOLOGY.

Huxley himself, though trained in the practical school of Charing-cross Hospital, won his special title to fame in the domain of biology. As a matter of fact, at that time even the name of biology had not come into general use. It was only recently that the idea of life itself obtained its full significance. Even in the late middle ages it had not sufficient strength to struggle through the veil of dogmatism into the light. I am glad to be able to-day for the second time to credit the English nation with the service of having made the first attempts to define the nature and character of life. It was Francis Glisson, who, following expressly in the footsteps of Paracelsus, investigated the *principium vitæ*. If he could not elucidate the nature of life, he at least recognised its main characteristic. This is what he was the first to describe as "irritability," the property on which the energy of living matter depends. How great was the step from Paracelsus to Glisson, and—we may continue—from Glisson to Hunter! According to Paracelsus, life was the work of a special *spiritus*, which set material substance in action, like a machine; for Glisson, matter itself was the *principium energeticum*. Unfortunately, he did not confine this dictum to living substances only, but applied it to substance in general, to all matter. It was Hunter who first announced the specific nature of living matter as contrasted with non-living, and he was led to place a *materia vitæ diffusa* at the head of his physiological and pathological views. According to the teaching of Hewson and Hunter, the blood supplied the plastic materials of physiology as well as the plastic exudates of pathology. Such was the basis of the new biological method, if one can apply such an expression to a still incomplete doctrine, in 1842, when Huxley was beginning his medical studies at Charing-cross Hospital. It would lead too far afield were I to recount in this place how it happened that I myself, like Huxley, was early weaned from the pernicious doctrines of humoral pathology.

THE DEVELOPMENT OF BIOLOGY.

When Huxley himself left Charing-cross Hospital, in 1846, he had enjoyed a rich measure of instruction in anatomy and physiology. Thus trained, he took the post of naval surgeon, and by the time that he returned, four years later, he had become a perfect zoologist and a keen-sighted ethnologist. How this was possible, any one will readily understand who knows from his own experience how great the value of personal observation is for the development of independent and unprejudiced thought. For a young man who, besides collecting a rich treasure of positive knowledge, has practised dissection and the exercise of a critical judgment, a long sea-voyage and a peaceful sojourn among entirely new surroundings afford an invaluable opportunity for original work and deep reflection. Freed from the formalism of the schools, thrown upon the use of his own intellect, compelled to test each single object as regards properties and history, he soon forgets the dogmas of the prevailing system and becomes first a sceptic, and then an investigator. This change, which did not fail to affect Huxley, and through which arose that Huxley whom we commemorate to-day, is no unknown occurrence to one who is acquainted with the history, not only of knowledge, but also of scholars. We need only point to John Hunter and Darwin as closely-allied examples. The path on which these men have achieved their triumphs is that which biology in general has trodden with ever-widening strides since the end of last century—it is the path of genetic investigation. We Germans point with pride to our countryman who opened up this road with full conviction of its importance, and who directed towards it the eyes of the world—our poet-prince Goethe. What he accomplished in particular from plants others of our fellow-countrymen achieved from animals—Wolf, Meckel, and our whole embryological school. As Harvey, Haller, and Hunter had once done, so these men began also with the study of the "ovulum," but this very soon showed that the egg was itself organised, and that from it arose the whole series of organic developments. When Huxley, after his return, came to publish his fundamental observations he found the history of the progressive transformations of the contents of the egg already verified; for it was by now known that the egg was a cell, and that from it fresh cells, and from them organs, arose. The second of his three famous papers—that on the relationship between man and the animals next beneath him—limned in exemplary fashion the parallelism in the earliest development of all animal beings. But beyond this it stepped boldly across the border-line which tradition and dogma had drawn between man and beast. Huxley had no hesitation in filling the gaps which Darwin had left in his argument, and in explaining that "in respect of

[1] The second Huxley lecture, delivered by Prof. R. Virchow at the opening of the winter session of Charing Cross Hospital Medical School, on October 3. Reprinted from the *Times*.

substance and structure man and the lower animals are one." Whatever opinion one may hold as to the origin of mankind, the conviction as to the fundamental correspondence of human organisation with that of animals is at present universally accepted.

Omnis Cellula e Cellula.

. . . The greatest difficulty in the advance of biology has been the natural tendency of its disciples to set the search after the unity of life in the forefront of their inquiries. Hence arose the doctrine of vital force, an assumption now discarded, but still revealing its influence from time to time in isolated errors. No satisfactory progress can be made till the idea of highly-organised living things as units had been set aside; till it was recognised that they were in reality organisms, each constituent part of which had its special life. Ultimate analysis of higher animals and plants brings us alike to the cell, and it is these single parts, the cells, which are to be regarded as the factors of existence. The discovery of the development of complete beings from the ova of animals and the germ-cells of plants has bridged the gap between isolated living cells and complete organisms, and has enabled the study of the former to be employed in elucidating the life of the latter. In a medical school where the teaching is almost exclusively concerned with human beings this sentence should be writ large:—"The organism is not an individual, but a social mechanism." Two corollaries must also be stated—(1) that every living organism, like every organ and tissue, contains cells; (2) that the cells are composed of organic chemical substances, which are not themselves alive. The progress of truth in these matters was much retarded by that portion of Schwann's cell-theory which sought to establish the existence of free cell-formation, which really implied the revival of the old doctrine of spontaneous generation. This belief was gradually driven out of the domain of zoology, but in connection with the formation of plastic exudates found a sanctuary in that of pathology. I myself was taught the discontinuity of pathological growths—a view which would logically lead back to the origin of living from non-living matter. But enlightenment in this matter came to me. At the end of my academical career I was acting as clinical assistant in the eye department of the Berlin Hospital, and I was struck by the fact that keratitis and corneal wounds healed without the appearance of plastic exudation, and I was thus led to study the process of inflammation in other non-vascular structures, such as articular cartilages and the intima of the larger vessels. In no one of these cases was plastic exudation found, but in all of them were changes in the tissue cells. Turning next to vascular organs, and in particular those which are the common seats of exudation processes, I succeeded in demonstrating that the presence of cells in inflammatory exudates was not the result of exudation, but of multiplication of pre-existing cells. Extending this to the growth in thickness of the long bones—which was ascribed by Duhamel to organisation of a nutricious juice exuded by the periosteal vessels—I was thus eventually able to extend the biological doctrine of *omnis cellula e cellula* to pathological processes as well; every new formation presupposing a matrix or tissue from which its cells arise and the stamp of which they bear.

Heredity.

Herein also lies the key to the mystery of heredity. The humoral theory attributed this to the blood, and based the most fantastic ideas upon this hypothesis; we know now that the cells are the factors of the inherited properties, the sources of the germs of new tissues and the motive power of vital action. It must not, however, be supposed that all the problems of heredity have thus been solved. Thus, for instance, a general explanation of theromorphism, or the appearance of variations recalling the lower animals, is still to be found. Each case must be studied on its merits, and an endeavour made to discover whether it arose by atavism or by hereditary transmission of an acquired condition. As to the occurrence of the latter mode of origin, I can express myself positively. Equally difficult is the question of hereditary diseases; this is now generally assumed to depend on the transmission of a predisposition which is present, though not recognisable, in the earliest cells, being derived from the paternal or maternal tissues. But the most elaborately constructed doctrines as to the hereditariness of a given disorder may break down before the discovery of an actual *causa viva*. A notable example of this is found in the case of leprosy, the transmission of which by inheritance was at one time so firmly believed in that thirty years ago a law was nearly passed in Norway forbidding the marriage of members of leprous families. I myself, however, found that a certain number of cases at any rate did not arise in this way, and my results were confirmed by the discovery of the leprous bacillus by Armauer Hansen. In a moment the hereditary theory of the disease was overthrown and the old view of its acquirement by contagion restored. Precisely the same happened a few decades earlier with regard to favus and scabies. Another instructive condition is that known as Heterotopia in which fragments of tissues or organs are found dwelling in a situation other than that which is normal to them. This is particularly the case with certain glands, such as the thyroid and suprarenal, but is also known with cartilage, teeth, and the various constituents of dermoids. It no doubt occurs by process of transplantation, the misplaced tissues developing no new properties, but merely preserving their normal powers of growth. The attempt to generalise from this fact and to attribute all tumour-formation to this cause carries the idea beyond its proper scientific limits.

Parasitism and Infection.

With regard to the subject of parasitism, the progress of scientific observation was retarded for centuries by the prevalence of the assumption made by Paracelsus that disease in general was to be regarded as a parasite. Pushed to its logical conclusion, this view would imply that each independent living part of the organism would act as a parasite relatively to the others. The true conception of a parasite implies its harmfulness to its host. The larger animal parasites have been longest known, but it is not so many years since their life-history has been completely ascertained and the nature of their cysts explained, while an alternation of generations has been discovered in those which are apparently sexless. Very much more recent is the detection of the parasitic protozoa, by which the occurrence of the tropical fevers may be explained. As yet we have not complete knowledge as to their life-history, but we hold the end ot the chain by which this knowledge can be attained. The *élite* of the infectious diseases are, however, the work of the minutest kind of parasitic plants, bacteria, the scientific study of which may be said to date from Pasteur's immortal researches upon putrefaction and fermentation. The observation of microbes under exact experimental conditions, and the chemical investigation of their products opened up the modern field of bacteriology, a science among the early triumphs of which were the discoveries of the bacilli of tubercle and Asiatic cholera by Robert Koch. In connection with this subject, three important landmarks require comment. One is the necessity for distinguishing between the cause and the essential nature of infectious diseases, the latter of which is determined by the reaction of the tissues and organs to microbes. Secondly, there is the relation between the smaller parasites and the diseases determined by them. This may be summed up in the general word (introduced by Prof. Virchow himself) "infection." But to assume that all infections result from the action of bacteria is to go beyond the domain of present knowledge, and probably to retard further progress. The third point is the question as to the mode of action of infection. It is only the larger parasites whose main effect is the devouring of parts of their hosts; the smaller act mainly by the secretion of virulent poisons. The recognition of this latter fact has led to the brilliant work of Lister on the one hand, and to the introduction of serum-therapeutics on the other.

Antiseptic Surgery.

It would be carrying coals to Newcastle were I to sketch in London the beneficial effects which the application of methods of cleanliness has exercised upon surgical practice. In the city wherein the man still lives and works who, by devising this treatment, has introduced the greatest and most beneficent reform that the practical branches of medical science have ever known, every one is aware that Lord Lister, on the strength of his original reasoning, arrived at practical results which the new theory of fermentative and septic processes fully confirmed. Before any one had succeeded in demonstrating by exact methods the microbes which are active in different diseases, Lister had learnt, in a truly prophetic revelation, the means by which protection against the action of putrefactive organisms can be attained. The opening up of further regions of clinical medicine to the knife of the surgeon and a perfect revolution in the basis of therapeutics have been the consequence. Lord Lister, whom I am proud to be able to greet as an old friend, is already and always will be reckoned amongst the greatest benefactors of the human race. May he long be spared to remain at the head of the movement which he called into existence.

ARTIFICIAL IMMUNISATION.

It remains for me to say a word concerning the other great problem, the solution of which the whole world is awaiting with anxious impatience. I refer to the problem of immunity and its practical corollary, artificial immunisation. It has already happened once that an Englishman has succeeded in applying this to the definite destruction of at least one of the most deadly infectious diseases. Jenner's noble discovery has stood its trial as successfully, except in popular fancy, as he hoped. Vaccine is in all hands; vaccination is, with the aid of Governments, spreading continually. Pasteur also laboured with determination; others have followed him, and the new doctrine of anti-toxins is continually acquiring more adherents. But it has not yet emerged from the conflict of opinions, and still less is the secret of immunity itself revealed. We must become well accustomed to the thought that only the next century can bring light and certainty on this point. Prof. Virchow, having referred with pride to the influence of cellular pathology in modern treatment, entailing, as it does, the principle of destroying the focus of disease by early operation, concluded his lecture in these words:—May the Medical School of Charing-cross Hospital continue upon the newly-opened path with zeal and good fortune. But may its students at the same time never forget that neither the physician nor the naturalist dares to dispense with a cool head and a calm spirit, with practical observation and critical judgment.

CHEMISTRY AT THE BRITISH ASSOCIATION.

ALTHOUGH no epoch-making discoveries can be recorded amongst the contributions to the Chemical Section this year, the work of the Section was full of interest and attraction. A very wide range of subjects was included in the programme, and the presence of many past-presidents of the Section added very considerably to the success of the meeting. The announcement of the discovery of two new elements, *Monium* and *Xenon*, must constitute a record for the first two days of the meeting, although new elements, especially amongst the rarer earths and gases, hardly excite the interest that similar discoveries did some years back. Monium is described in Sir William Crookes' address. It is an added element culled "from the waste heaps of the mineral elements," characterised by a group of distinctive lines in the ultra-violet end of the spectrum, and having an atomic weight of about 118, between those accepted for yttrium and lanthanum respectively. "Xenon" was described by Prof. Ramsay and Dr. Travers in their paper on "The extraction from air of the companions of Argon and on Neon." It accompanies krypton and metargon in the last fractions of liquefied argon, and is easily separated from the latter on account of its higher boiling point. It remains behind after the other two gases have evaporated, and is the heaviest of the three gases. Xenon, "the stranger," shows an analogous spectrum to argon, but differing entirely in the position of the lines. With the ordinary discharge the gas shows three lines in the red, and about five very brilliant lines in the blue; while with the jar and spark-gap these lines disappear, and are replaced by four brilliant lines in the green, intermediate in position between the two groups of argon lines. The remainder of the paper dealt with the successful issue of the search for "an undiscovered gas"—the subject of Prof. Ramsay's presidential address to the Section at Toronto. This gas should have an atomic weight higher than that of helium by about 16 units, and lower than that of argon by about 20. The determination of the atomic weight of neon gave the figure 19·2; it would therefore follow fluorine, and precede sodium in the periodic table. Like argon and helium it is monatomic; it is present in the air in the proportion of about 1 part in 40,000. Prof. Emerson Reynolds added a note on the position of helium, argon, krypton and neon in his diagrammatic representation of the relations of the elements, and pointed out that their atomic weights as yet determined were well in accord with his representation of the periodic law. Amongst other papers on inorganic chemistry, Prof. F. Clowes gave an account of his work on the action of magnesium on cupric sulphate solutions, under the title of "Equivalent replacement of metals." The reaction was studied with both hot and cold solutions, and under various conditions of concentration. In all cases cuprous oxide is formed, and hydrogen is evolved side by side with the deposition of the copper. This evolution of hydrogen is attributed in part, but not wholly, to the presence of free sulphuric acid formed by hydrolysis of the cupric sulphate and accompanied by the separation of a basic salt. Prof. Hodgkinson and Mr. Coote, in a paper on "Alkaline chlorates and sulphates of the heavy metals," pointed out that many solid sulphates, whether containing water of crystallisation or anhydrous, give off chlorine in addition to oxygen when gently heated with potassium or sodium chlorate. A residue of the alkaline sulphate and chloride and the oxide and chloride of the metal is left behind. The evolution of chlorine and oxygen occurs at temperatures very little above 100° C. Mr. R. G. Durrant described a series of "Green cobaltic compounds" he had obtained by oxidising potassium cobaltous oxalate with hydrogen peroxide; similar results follow the oxidation of cobaltous salts in presence of glycollates, citrates, malates, lactates or succinates of the alkali metals.

In another branch of the science, physical chemistry, Prof. Sydney Young contributed a most lucid and interesting account of his researches on the "Thermal properties of gases and liquids." The subject is one which has engaged Prof. Young's attention for the past eleven years, and his descriptive summary of his labours was therefore received with special interest. One chief aim of these investigations has been to ascertain whether the generalisations of Van der Waals regarding the relations of pressure, temperature and volume for both gases and liquids, are really true, and if not, whether the observed deviations would throw any light on the modifications which must be made in Van der Waals's fundamental formula in order to bring it into accurate agreement with the experimentally determined isothermals for liquids and gases. The vapour pressures and specific volumes of a number of substances were therefore determined, both as liquid and as saturated vapour, from low temperatures to their critical points. Twenty-six substances have been examined altogether, including paraffins, benzene and its haloid derivatives, esters, alcohols and acetic acid, and the data obtained allow of a simple classification in respect to their physical constants. Amongst other points of interest the results show that the molecules of the alcohols at moderate temperatures are polymerised in the liquid, but not in the gaseous state, whilst there is polymerisation in both states in the case of acetic acid; also, that the molecules of the alcohols and acetic acid appear to be polymerised to a considerable extent at the critical point. Prof. Young also described his methods for the determination of the critical constants and of the specific volumes of both liquid and saturated vapour. Ample proof was obtained in the course of these investigations that the views of Andrews regarding the behaviour of a substance in the neighbourhood of the critical point are correct, and also that the vapour pressure of a pure substance is quite independent of the relative volumes of liquid and vapour. The method of fractional distillation of liquids adopted for the preparation of pure substances was described, and the apparatus was exhibited at work; it has thus been found quite feasible to separate perfectly pure normal and iso-pentane from American petroleum. The Earl of Berkeley described the methods he has adopted for the more exact determination of the densities of crystals, in which special precautions are taken to eliminate errors in the measurement of temperature, volume and mass, occlusion of mother liquor, and absorption of moisture. The determinations recorded were made in carbon tetrachloride, a maximum divergence of 0·04 per cent. being shown as the result of four determinations of the density of potassium carbonate crystals. Under the head of physical chemistry the joint-meeting with Section A on the "Results of the recent Eclipse expeditions," has been referred to in connection with the doings of the Physical Section. The modern photographic plate as a sensitive medium for the recording of chemical action was the subject of several interesting communications, notably that of Dr. W. J. Russell on "The action exerted by certain metals and other organic substances on a photographic plate." Some account of these researches has already been given in NATURE. Dr. Russell showed a series of slides illustrating the action of printer's ink, wood, dry copal varnish, turpentine, drying oils, essential oils and metals on a photographic plate, in the dark, and detailed his method of experiment. Actual contact is not necessary to obtain the action; it takes place also at a distance. The time required is dependent upon the temperature; in the earlier experiments it required a week to produce a developable image, but by raising the temperature to 55° C. considerable action was recorded in five minutes. Sheets of gelatine, celluloid, gutta-percha and collodion do not hinder the action, when placed as screens between the active surface and the plate. Hydrogen peroxide is regarded by Dr. Russell as most probably the active agent in all these actions, but further experiments are in progress to decide this more definitely. In a complementary paper by Mr. C. H. Bothamley, on "The action of certain substances on the undeveloped photographic image," evidence was adduced to show that printer's ink can after a time act on a photographic plate and destroy the "latent image." The vapour of hydrogen peroxide and turpentine have the same effect. Whereas, therefore, hydrogen peroxide acting for a short time or in small quantity produces a developable image, by more prolonged action or in a more concentrated form it acts as an oxidiser and destroys the image. Probably both actions take place simultaneously, and the result at any given instance depends on their relative rates. Prof. Percy Frankland contributed an additional photographic action—that of bacteria. By placing gelatine cultures of *Bacillus coli communis* and of *Proteus vulgaris*, either in juxtaposition or at a distance of half an inch from a photographic plate, definite developable images were obtained. The action is stopped by glass or mica, and is therefore not due to radiation, but to the evolution of some volatile matter which reacts with the plate. Bacterial growths which are luminous in the dark (*Photobacterium phosphorescens*) have a still greater action. The investigation is to be extended to other organic structures vegetable and animal, living and dead. Amongst these contributions may be included an account by Dr. J. H. Gladstone and Mr. Hibbert of their further work on "The absorption of the Röntgen rays by chemical compounds," which dealt chiefly with their attempts to perfect quantitative methods of estimating the comparative densities of their radiographs. Mr. Hibbert also described an instrument he had devised for ascertaining the relative grades of the Röntgen rays.

Applied chemistry received attention under various headings. Special local interest naturally centred in Dr. J. Gordon Parker's paper on "Recent advances in the tanning industry," in which the lack of scientific methods amongst the tanners of this country was sternly criticised. Dr. Parker referred to the employment of extracts in tanning as a marked advance which had also brought about improved methods of estimating the tanning value of the materials employed in the industry, but bateing and "puering" of hides by means of dog and hen excrement was stigmatised as a standing disgrace to the leather trade. American and continental tanners appear to be far ahead of their English brethren in respect to the extraction of tanning materials in the tanyard. The cold extraction processes employed here mean loss and waste. Analyses of over 300 samples of so-called waste-spent tan from forty tanyards in Great Britain having shown an average of over 9 per cent. of available tannic acid. With valonia alone this represents a loss of 1*l.* 13*s.* 4*d.* a ton, about 500,000*l.* annually. In Germany and America warm extraction, which means practically complete extraction, has proved successful. The fear of darker colour in leather from the use of warm extracts is much exaggerated; as the temperature of extracting is raised, more colouring matter is dissolved, but it is difficultly soluble, and much of it is re-deposited on cooling. Mr. Vernon Harcourt exhibited and described his new "10-candle pentane lamp," which was most favourably commented on by Prof. Vernon Boys as a standard of light. Mr. Vernon Harcourt pointed out the advantages of a 10 or 16-candle standard for testing illuminating gas, over that now employed, and also the need of a large but compact standard flame. The burner is supplied with a mixture of air and gaseous pentane from a reservoir placed on a bracket at the top of the lamp. As this mixture falls down a siphon tube connecting the reservoir and the lamp, fresh air enters the former, which is provided with cross partitions, causing the air to travel backwards and forwards over the surface of the pentane and to mix with a proportion of pentane, which varies in amount with the external temperature. The arrangement of the lamp is such, however, that the variation in the proportion of pentane does not affect the output of light. There is a casing round the burner with a conical top which steadies the flame, the upper part of which is drawn together in a long brass chimney which cuts off the light of this part of the flame. The lamp is so constructed that a cool air current issues through the middle of the argand burner, which thus gives a steady flame 60–70 mm. high, having an illuminating value of rather more than ten candles. By adjusting the tube which receives the top of the flame at a height of 47 mm., the light shed horizontally is reduced to exactly ten candles. Comparisons made between four different lamps showed concordant results, their values being also in accord with the one-candle pentane standard. Prof. Emerson Reynolds's experiment, illustrating "The effect on the acetylene flame of varying proportions of carbon dioxide in the gas," was of considerable interest. The experiment had arisen from a chance observation by Mr. Goodwin that expired air when mixed with acetylene appeared to increase the luminosity of the acetylene flame, and also to decrease the tendency to deposit carbon in the burners. More careful study had shown that 5–8 per cent. of carbon dioxide in the gas decreased the smokiness of the flame, and especially prevented the clogging of the burners. The increase in illuminating power was certainly not marked, but the mixture containing 5 per cent. of carbon dioxide gave as much light as the acetylene itself, and therefore there is a gain to this extent per volume of acetylene burned. The action of the carbon dioxide was regarded as probably due to its exerting some oxidising effect.

Agricultural chemistry was dealt with in the report of the Committee on the Carbohydrates of Cereal Straws, and by Dr. Luxmoore, who described a scheme of analysis for Dorsetshire soils, which is to be carried out with the view of obtaining a general knowledge of the soils of the county. Dr. Armstrong also contributed a preliminary report of the Committee established last year for the promotion of agriculture. Dr. Gladstone's report on the "Teaching of science in elementary schools" was followed by an interesting discussion, and Dr. Armstrong gave a suggestive account of methods he had adopted for training children in methods of original inquiry under the title of "Juvenile research." Reports were submitted by the several committees of the Section, which will be published *in extenso* in the *Transactions* of the Association. Amongst these, those on the action of light upon dyed colours, on isomeric naphthalene derivatives, on the wave-length tables of the spectra of the elements, on the bibliography of spectroscopy, and on the electrolytic methods of quantitative analysis were a continuation of previous work. Two new Committees were formed, one to investigate the relation between the absorption spectra and constitution of organic substances, and the other on the chemical and bacterial examination of water and sewage, especially in reference to establishing a uniform method for recording results. The sewage problem was also treated of by Dr. Rideal, in a paper on "Standards of purity for sewage effluents."

Organic chemistry received a fair share of attention, several papers of importance and interest being read. Prof. Noetling, of Mülhausen, described a new series of colours he had obtained from amidated aromatic amidines, the first series of amidine colours prepared. Dr. Laurie and Mr. Strange showed the results they have obtained in studying the cooling curves of fatty acids. The curve, which is very characteristic for pure fatty acids, such as palmitic and stearic, shows a marked change if 1 per cent. of another fatty acid is present, and when a larger proportion of the second acid is introduced a second latent-heat point is developed, the curve showing a discontinuity below the solidifying point of the mixture. The curves given by these mixtures indicate a reproduction of the phenomena observed by Prof. Roberts-Austen in the case of certain alloys. Messrs. Fenton and Jackson showed that the oxidation of polyhydric alcohols in presence of ferrous iron proceeds on analogous lines to that of tartaric acid, "glycerose," the mixture of glyceraldehyde and dihydroxy-acetone being formed from glycerol; whilst Dr. Morrell and Mr. Crofts recorded a corresponding result on the oxidation of glucose, the alcohol group next to the aldehyde group being oxidised. The contributions in this branch of chemistry are usually too technical to interest many of the followers of the Association, but this year all organic chemists felt a special debt of gratitude to the President of the Section, Prof. Japp, not only for the value of his address to them, but also for the manner in which he had placed the methods and limitations of modern organic chemistry before a far wider field of scientific workers.

GEOLOGY AT THE BRITISH ASSOCIATION.

SO far as Section C was concerned, the Bristol meeting of the British Association was decidedly successful. The attendance at the sectional meetings was above the average, and the interest well sustained, a larger proportion than usual of the papers and reports being of a character to give rise to discussions on broad general principles, for which these occasions are pre-eminently adapted.

In some cases these discussions were curtailed from lack of time, and there was a little discontent among the more steadfast adherents to the indoor work of the meeting that the whole of the papers should have been crowded into four days, and the Saturday and Wednesday half-day sessions dispensed with. But in a region so rich in geological interest it was desirable that every opportunity for outdoor investigation should be given to the members of the Section, especially as the weather during the meeting was singularly favourable for field-work. The popularity of the short afternoon excursions arranged for Friday, Monday and Tuesday, under the leadership of Prof. C. Lloyd Morgan and Mr. H. Pentecost, to classical sections in the vicinity of Bristol, proved that to the visiting geologists the chance of inspecting the best exposures under competent guidance was at least of equal importance to the indoor proceedings. These afternoon excursions have, during the last three or four years, become an important feature in the arrangements of the Section, and though it has been sometimes objected that they are detrimental to the attendance indoors during the later stages of the daily session, it is doubtful whether such be really the case. The difficulty of holding together an audience of notable dimensions when the sitting of the Section is prolonged late into the afternoon was felt at these meetings long before the institution of the short excursions.

The papers and reports submitted to the Section are too numerous for adequate mention, and special reference can only be made here to such as possessed wide interest or led to much debate. As frequently happens, some of the papers containing the most solid and original work attracted the least discussion.

At the opening day of the sectional meeting, after the presidential address, Prof. C. Lloyd Morgan gave a clear general account of the more interesting features of the local geology, dealing especially with the places to be visited during the excursions. The lantern slides by which this address was illustrated were unfortunately almost invisible owing to the insufficient darkening of the room.

Mr. E. Wethered followed with a paper on "The building of the Clifton rocks," in which he contended for the importance of certain micro-organisms in the formation of the local limestones. These "incrusting organisms," along with other forms which he described, all hitherto usually held to be of inorganic origin, are regarded by Mr. Wethered as organic growths, to which in some cases the structure of the limestone is due; and these he considers to be serviceable aids in identifying the strata. At a later session Mr. Wethered brought forward a second paper on "The work of incrusting organisms in the formation of limestone," in which he urged the claims of Girvanella and allied forms in the production of the oolitic structure in Jurassic rocks. Both papers were illustrated by beautiful lantern slides of rock-slices prepared by the author. These papers gave rise to lively discussions, in which by some speakers the organic origin of some of the structures was strenuously denied; in his able reply, Mr. Wethered claimed that a thorough investigation of his slides by a committee of experts would convert the partial recognition which his views had already won into a thorough-going acceptance of all his conclusions.

Mr. A. Strahan brought before the meeting an account of the results of the revision of the South Wales Coal-field by the Geological Survey, showing the great advances which have been made in our knowledge of the structure of this important area, and the methods adopted for representing the new information upon the maps.

In a paper on "The comparative action of sub-aërial and submarine agents in rock decomposition," Mr. T. H. Holland, of the Geological Survey of India, drew attention to the wide-reaching difference between the manner of decomposition of the crystalline and igneous rocks in Southern India and in Europe, especially in the degree of hydration of the minerals. This difference, he thought, might be due to the absence of submarine action in the central portion of Southern India during the later geological periods, so that the rocks have been affected only by sub-aërial weathering, and deeper portions of the earth's crust have, by long denudation, been exposed at the surface than in Europe.

Friday's session was opened by a suggestive discourse by Prof. O. C. Marsh, on "The comparative value of different kinds of fossils in determining geological age," in which the claims of the vertebrates, wherever they existed, were pressed as being the best for the purpose. As a side-issue, Prof. Marsh drew renewed attention to the Jurassic affinities of the English Wealden fauna, so that his paper provided almost unlimited scope for discussion. Most of the speakers on the subject, while acknowledging that the main point of Prof. Marsh's contention might be theoretically correct, dwelt upon the practical difficulties to the field-geologist in the collection and determination of vertebrate remains, and urged that this must prevent these fossils being used for zonal purposes except in rare instances. Another paper which provoked an interesting discussion was that of Prof. J. F. Blake, on "Aggregate deposits and their relation to zones." The author proposes the term "aggregate deposits" for strata in which fossils characterising more than one zone occur together in the same rock-band. He considers that in such deposits the fossils do not lie in their natural position, but have been swept together tumultuously by strong currents. In the debate on this paper, while general approval of the term "aggregate" was expressed, there was much difference of opinion as to the manner in which such deposits had accumulated, and it was suggested that Prof. Blake had included strata of diverse origin in his proposed classification.

The two papers contributed by Mr. T. Groom, on "The age and geological structure of the Malvern and Abberley Ranges," were good examples of careful stratigraphical investigation, and were well received. Mr. Groom's conclusions are that the Malvern axis was not an island in Cambrian and Silurian seas as generally supposed, but that it was elevated chiefly by Upper Palæozoic crustal movements and its folds belong to the Great Hercynian system formed towards the close of the Carboniferous Period. At the same session Mr. E. Greenly announced the discovery of Arenig shales beneath the Carboniferous rocks near the Menai Bridge, and in another paper described a clear case of boulder-uplift at Llandegfan, Menai Straits, where a train of blocks has been raised about 300 feet in the distance of one mile. Mr. Greenly also called attention to the impending destruction by quarrying operations of the most important portion of the drift section of Moel Tryfaen, and his suggestion that a committee should be appointed for the purpose of securing, while there was yet time, photographic and other records of this celebrated section was at once acted upon, and a small grant was obtained to cover the expenses.

In his paper on "The age and origin of the granite of Dartmoor, and its relations to the adjoining strata," Mr. A. Somervail put forward the view that the intrusion of the granite in question took place after the folding of the Lower Culm strata, but before the Upper Culm series was deposited. In the discussion, while the importance of Mr. Somervail's conclusions was acknowledged, the speakers generally expressed themselves unable to form an opinion until the fuller details of the sections on which the author based his views should be published.

The first paper taken on Monday was that of Mr. R. Etheridge, on "The relation and extension of the Franco-Belgian Coal-field to that of Kent and Somerset." After reviewing the history of the discovery of coal at the Dover boring, where it is expected that the Coal Measures will shortly be reached by the shafts now being sunk, Mr. Etheridge proceeded to discuss the general bearing of this discovery and the probable extension of the southern coal-fields under the Secondary rocks. A new section recently obtained by a deep exploratory boring at Brabourne, near Ashford, was then described, where after passing through Lower Greensand, Wealden, Portlandian, Kimeridge Clay, Corallian, Oxford Clay, Lower Oolites, and Middle and Lower Lias, red conglomerates believed by the author to be Old Red Sandstone have been encountered at a depth of 1875 feet from the surface. The Jurassic strata in this section are about 450 feet thicker than at Dover. In the discussion on this important paper, Prof. Boyd Dawkins and Mr. W. Whitaker both expressed doubts whether the Old Red Sandstone age of the lowest portion of the Brabourne section could be considered sufficiently established; and the former speaker stated that he fully expected some of the Kentish borings would draw blank, but others would succeed, and all would supply valuable information. Sir John Evans called attention to the fact that in one section in Belgium, where the Palæozoic strata were extremely folded, Coal Measures had been met with beneath a wedge of Old Red Sandstone. Mr. E. Wethered suggested that the Coal Measures showed a tendency to become less and less productive when traced eastward from the South Wales basin; and Prof. Louis asked how the supposed horizontality of the Dover Coal Measures could be explained, while in their supposed prolongation in Belgium they were so greatly disturbed. Mr. Etheridge, in concluding the discussion, thought there could be no doubt that the bottom rock at Brabourne was Old Red Sandstone, and remarked on the evidence now forthcoming for the continuous underground extension of this formation from Bristol across the south of England, under London and parts of Kent, into Belgium.

The next paper was that of Dr. Marsden Manson, of Sacramento, Cal., on "The laws of climatic evolution"—a highly speculative attempt to explain the Glacial Period as a critical and unique stage in the evolution of this and other planets when the climate passed from "internal" to "external" control. According to Dr. Manson, the climatal conditions of all times preceding the Glacial Period were determined by planetary heat, and were independent of latitude; but the dissipation of the continuous cloud-envelope, through the loss of the planetary heat by which it had been sustained, brought about a new set of conditions. After a Glacial Period, due to the more rapid cooling of the land than the sea, a gradual rise of temperature along with a zonal distribution of climate would occur, through the trapping of solar heat by the lower layers of the atmosphere. This latest of the many ingenious attempts which have been made, on both sides of the Atlantic, to explain the Glacial Period was admirably presented by the author to a large audience, but was subjected to severe criticism in the discussion, the general feeling being that such speculations scarcely fell within the scope of Section C.

Prof. E. Hull brought before the meeting a wide subject of more tangible character, in a paper on "The sub-oceanic physical features of the North Atlantic." By tracing out the depth-contours of the Admiralty Charts, Prof. Hull showed that the British and continental submarine platform breaks off abruptly in a "Grand Escarpment" at depths varying from 100 to 250 fathoms. This escarpment, from 6000 to 7000 feet high, is, according to Prof. Hull, indented by deep bays and old river-channels, the latter, almost cañon-like in places, often prolongations of the river valleys of the existing land. These and other submarine features lead him to agree with Spencer and Upham that the whole area of the North Atlantic to a depth of 10,000 feet was a land surface at a very recent period, and that the conditions of the Glacial Epoch may be thus explained. This paper was followed by another on the same subject by the President of the Section, in which it was shown that the exaggeration of the vertical scale made Prof. Hull's diagrams misleading as to the slopes of the supposed escarpments and submerged river-valleys; and evidence was adduced to prove that extensive earth-movements were frequently in progress on the edge of the continental platform. Hence, it was urged, the features to which Prof. Hull had called attention might possibly be due to subterranean causes, a view which was shared by several speakers in the subsequent debate.

On the subject of earth-movement, Prof. J. Milne presented the report of the Committee for Seismological Investigation; and Mr. R. D. Oldham, of the Geological Survey of India, gave a lucid description, illustrated by lantern slides, of the Great Indian Earthquake of 1897. The surface indications of faulting and overthrusting which characterised this earthquake were very clearly demonstrated.

At the opening of Tuesday's meeting the President, in exhibiting a portrait of the late E. Wilson, referred feelingly to the loss which geological science had sustained by Mr. Wilson's untimely death, and other speakers bore testimony to his painstaking and self-denying services to the Bristol Museum.

On behalf of Prof. H. F. Osborn, who had expected to attend the meeting but was at the last moment prevented, an exhibit was made of some beautiful water-colour drawings of restorations of *Brontosaurus*, *Phenacodus*, and other extinct vertebrates, executed by Mr. C. Knight for the Museum of Natural History of New York. A brisk discussion sprang up, in which Prof. H. G. Seeley, Prof. O. C. Marsh, Sir John Evans, Prof. W. Boyd Dawkins, Prof. W. J. Sollas, and others took part, as to the advisableness of giving reins to the imagination in the production of these restorations, upon which point widely diverse opinions were expressed.

There was scarcely sufficient time at this meeting to do justice to the carefully prepared paper by Mr. W. H. Wheeler on "The action of waves and tides on the movement of material on the Sea-coast." It was shown by Mr. Wheeler that the travel of shingle is not usually coincident with the prevailing winds, but is in the direction of the flood-tide, and is mainly due to wavelets set up by tidal action, whose total kinetic energy is very large.

Among the other papers brought before the Section were the following on cave exploration: by Mr. H. Bolton and the late E. Wilson, on the exploration of two caves at Uphill, Weston-super-Mare; by Rev. G. C. H. Pollen, on further exploration of the the Ty Newydd Caves; by Mr. T. Plunkett, on further exploration of the Fermanagh Caves; and the Report of the Committee on the fauna of caves near Singapore. Mr. P. M. C. Kermode, in the Report of the Committee for investigating the mode of occurrence of the Irish Elk in the Isle of Man, announced the discovery of a large and nearly complete skeleton of that animal near Peel. Mr. J. Lomas brought forward evidence in favour of the occurrence of worked flints in the Glacial deposits of Cheshire and the Isle of Man, but it was felt that further research was necessary before the author could be considered to have established his case. Mr. C. W. Andrews gave an account of the discovery of a portion of the skeleton of a huge Dinosaur in the Oxford Clay of Northampton. Papers were also contributed by Mr. J. R. Dakyns on the probable source of the upper Felsitic lava of Snowdon; by Mr. H. B. Woodward on arborescent Carboniferous Limestone from near Bristol; and by Mr. W. L. Addison and Mr. L. J. Spencer on crystallographic and mineralogical subjects. Several of the Reports of Committees possessed matter of much interest, especially that presented by Prof. A. P. Coleman on the Interglacial deposits near Toronto (where fresh facts of importance have been gained by excavations), and that of Prof. P. F. Kendall on Erratic Blocks; while the Committee for collecting Geological Photographs, that on Fossil Phyllopoda, and that on Life-zones in British Carboniferous rocks were all able to report steady progress in their investigations. New committees were formed and grants obtained to investigate the caves at Uphill and at Ty Newydd, and as already mentioned to preserve photographic and other records of the Moel Tryfaen section; and most of the old committees connected with this Section were re-appointed.

PHOSPHORESCENCE.[1]

IT is not possible in one lecture on phosphorescence to give any historical sketch which shall do justice to the work of those who have made a study of the phenomena. In a list of the names of the many who have enriched the subject with facts and with theories, those of Becquerel, of Stokes, and of Crookes stand out most prominently. Any attempt to make a sketch of our knowledge of phosphorescence and fluorescence must be to a very large extent an adaptation of the work and of the views of these masters.

The phenomena themselves may be divided into two main classes—those in which the evolution of light is associated with chemical change, and those in which there is no evidence of such direct alteration. In the first class the commonest instances are connected with the process of oxidation. Examples of this kind are numerous. It is hardly possible to take any very easily oxidisable substance and to fail to get some evolution of light. Phosphorus, sodium and potassium, ether, many aldehydes, and a host of organic compounds may be cited as instances. The experimental illustrations of these are not, however, suited to an audience of more than a very few. The same may be said of the examples of animal and vegetable phosphorescence. It is proposed, therefore, to deal more especially with the second class, and to limit the experiments to the cases where the light given out is visible and not of such a character as to necessitate the use of a photographic plate. This evolution of light may occur in varying conditions. In instances such as solutions of quinine and fluorescein and many solids, of which thallene is a good example, the duration of the phosphorescence is so short that it may be said to last only while

[1] A discourse delivered before the British Association on September 12, by Mr. Herbert Jackson.

light is acting. Balmain's luminous paint is an illustration of the persistence of the phosphorescent light. With many minerals, notably some fluorspars and felspars, light is given out when they are slightly heated, or in some cases only crushed.

The most brilliant phenomena are those which can be studied when many bodies are excited with electric discharges inside a Crookes' vacuum tube, while outside of a slight modification of his focus tube fairly brilliant phosphorescence can be obtained by the action of Röntgen rays upon several substances, notably upon some of the platinocyanides.

In dealing with the whole subject of phosphorescence with the view of attempting to connect all the various phenomena together, it is convenient to divide it into—the nature of the substance giving out the light, the nature of the light given out, and the nature of the exciting causes.

With regard to the nature of the substance, either very much or little might be said; very much from the details of numerous experiments with a great number of compounds, but little from the point of view of general principle. The most important question in this respect is probably the question of the relation of phosphorescence to the purity of the substance giving out the light. Experiments with carefully prepared compounds of many metals make it clear that not a few substances can be made to exhibit phosphorescence when they are so free from impurities that none can be detected by any analytical methods. In some cases, however, there is either no light given out under any of the conditions for exciting phosphorescence, or the light is so feeble that it is necessary to add impurities so as to obtain a suitable molecular condition for rendering a substance responsive to excitement. That the light given out is not to be ascribed to the impurity has been determined by many experiments with varying impurities and careful examination with the spectroscope. The further consideration of these physical and chemical conditions is better left until the other two aspects of the subject have been dealt with.

If a large number of observations be made of the phosphorescent lights given out by compounds of such metals, for example, as sodium, potassium, calcium, strontium and barium, magnesium and aluminium, it is hardly possible to avoid coming to the conclusion that the colours of these lights have a close resemblance to the colours of the lines and bands seen in the various spectra of the different metals and some of their compounds. Examination by the spectroscope confirms this conclusion in several instances. It is not suggested that the lines of the metals and the bands of their compounds are reproduced in the spectra of the phosphorescent lights. What is noticeable is that the maxima of light are grouped about these bands and lines, fading away from them and extending to other parts, so that a more or less continuous spectrum is seen with positions of greatest brilliancy. In the case of some specimens of lime these positions are well defined, and in some kinds of fluorspar the green and some red bands are well seen, either when the fluorspar is heated or when it is excited by discharge in vacuo. The questions of exact coincidence and of the shifting of the positions of the maxima of brightness seen with different compounds of the same metal need not be considered here. The intention is only to emphasise the similarity between the phosphorescent spectra of several metallic compounds and the spectra of these compounds, or of the metals in them, obtained in other ways.

In experimenting with phosphorescent compounds it is frequently noticed that specimens of the same substance in apparently the same state of purity give different colours. Confining attention for the present to lime, as a very infusible substance easily obtained in a state of purity, what follows will be made clearer by a brief consideration of the spectrum of the coloured flame produced by holding some compound of calcium, *e.g.* calcium chloride, in the flame of a bunsen burner.

The spectroscope breaks this red flame up into red, orange and green bands and a blue line. For the moment the suggestion may be taken that these differently coloured bands are indications of the existence in the flame of groups of particles of calcium compounds of varying degrees of complexity—the red being related to more complex groups, the orange to less, and so on. It seemed not unlikely that it might be possible by preparing lime from a great many calcium salts to obtain separate specimens which might preserve in the solid state some relation in their own molecular complexity to that of the salts from which they were obtained, or the conditions of decomposition of the different calcium salts might impress upon the residual limes different characters of molecular structure. The preparation of about 350 specimens of lime showed that it was quite possible to get specimens some of which phosphoresced red, some orange-red, some orange, others green, and some blue. Examination of their phosphorescent lights with the spectroscope showed, as referred to before, that the maxima of brilliancy in their spectra were grouped about the bands and lines of the usual spectrum of calcium oxide. The details of the preparation of these specimens of lime are too elaborate to enter into here, nor is it possible to do more than just to refer to their varying densities and different rates of hydration. Out of the number of specimens tried the most satisfactory were analysed to make sure that it was really lime and only lime which was being dealt with in each case. In general terms it may be said that the most complicated organic salts of calcium yielded the best attempts at lime giving blue phosphorescence, simpler bodies gave green, while the best orange was obtained from Iceland spar, and the red from specially prepared calcium carbonate. That lime yielding a blue colour was obtained from highly complicated organic salts does not contradict the former suggestion that perhaps it is really of simpler molecular structure than the others. Chemists are familiar with the conception that the complexity in structure arising from the massing of many molecules together in groups is probably often greater in bodies of apparently simple chemical composition than in those of a much more highly complicated nature.

The colours seen in the specimens of lime shown are not pure. In each one the other colours are present; thus the orange contains also the red, green and blue, only these are masked by the greater proportion of the one colour. Compare for example the light obtained from a vacuum tube containing the gas helium. In this case the colour is yellow, although the spectrum contains beautiful red, green and blue lines. If the different colours are related to varying molecular complexity in the substances, then it might be said that the lime showing a green light contains a large proportion of groupings of such a nature as to be capable of oscillating in a way to give rise to green light, and in like manner for the red, orange and blue specimens. Whether it will be possible or is in the nature of things to separate out the different kinds in a state of purity can only be decided by further experiment.

The examples of different forms of lime have been so far exhibited only under the conditions obtaining in a high vacuum with an electric discharge. Before trying to show the points in common between these phenomena and the phenomena of phosphorescence in other conditions, it may be as well to consider briefly the character of the action in a high vacuum. The suggestion which follows is not intended to be anything but an imperfect attempt to bring all the phenomena of phosphorescence into line with one another.

When a discharge passes through a vacuum there can be little doubt that the transferring medium is the residuum of gas in that partial vacuum. If the particles of this gas behave as visible masses are seen to do, they are probably attracted or are driven to the electrode, which is at high potential. Receiving the same kind of charge as this electrode, they fly off from it in that charged condition.

But if these particles consist of more than one unit, each unit, after the group has travelled a certain distance from the electrode, must repel each other unit in the same way as the whole little group was repelled from the electrode. If, however, the units making up the group are held together by that something which is called chemical attraction, a condition of strain is set up in which the electrical repulsion is striving to overcome the chemical attraction. Travelling unimpeded through the high vacuum this condition of strain would be maintained until the charged group met with something capable of discharging it. At that moment of discharge the chemical attraction would assert itself; there would be a rushing together of the units composing the group, and an over-rushing, whereby oscillations would be set up. These oscillations, considered as blows or pulses, either directly or ethereally transferred to a substance, would set it in turn oscillating in a manner fitted to its own molecular structure, and its oscillations would in their turn give rise to the undulations which appeal to our eyes as the phosphorescent light. If instead of the discharge taking place on a substance capable of responding to and absorbing most of the energy of the consequent oscillations, it were to occur on glass, platinum, or any of the materials which have been employed, it is conceivable that the oscillations would appear as short ethereal waves or, in other words, Röntgen rays. In the case of a low vacuum, or of no vacuum at all, the charged particles would discharge themselves against the intervening gas, which would in its turn respond to the rapid oscillation and give out its own particular coloured light. The expression "short ethereal waves" is used intentionally, for if there should be forthcoming experimental evidence of the complex molecular structure of a gas, it is reasonable to suppose that in a high vacuum, with consequently a high potential at the electrode, the internal electrical repulsion in a group would tend to a dissociation resulting finally in the simplest form of system capable of separate existence in those conditions. It might be expected that the oscillation frequency of so simple a system would be very high.

Here it may be stated that this comes to practically the same thing as Sir William Crookes' original conception of radiant matter.

Leaving the method of electrical excitation in vacuo for obtaining phosphorescence we may now turn to light as a source of oscillations. For the sake of simplicity it will be best to continue the experiments with the same substance, viz. lime. If this body be exposed to the light of the sun, of the electric arc, of a hydrogen flame, and of a great many other substances in a state of vigorous combustion, a phosphorescent effect is obtained, feeble in comparison with the results in vacuo, but apparently similar in kind. The best light for inducing the phosphorescence is the spark from a fairly powerful coil with a Leyden jar in circuit. Many specimens of lime go on giving out light for a considerable time after exposure. A cylinder of lime such as is used in the production of the lime-light glows quite visibly when it is rotated before a jar-spark.

The light from the sun is not so active in inducing this glow; but with suitable arrangements a fairly visible result can be obtained. The colour of the glow from most lime made from limestones is an orange-red becoming a golden orange when the lime is heated. The introduction of glass, mica or Iceland spar between the spark and the lime, cuts off the glow at once; since these bodies are opaque to the undulations to which lime of this kind responds. Quartz, rock salt, and selenite are quite transparent.

It is found that the different forms of lime which have already been exhibited in vacuum tubes yield when exposed to the jar-spark their specially coloured phosphorescent glows. But these are difficult to see; they are very faint when pure specimens of lime are used. However, there is a way out of the difficulty. The faint light scarcely visible at the ordinary temperature may be increased very considerably by raising the temperature. As an extreme instance of this a specimen of calcium sulphide may be taken. After exposure to almost any source of white light this glows with a bluish phosphorescence which becomes quite brilliant when the sulphide is heated. A similar change is noticeable in the case of the different limes. The orange, green and blue varieties exposed to a series of jar-sparks, and subsequently dusted over hot plates, give with easy visibility the colours which they exhibited in the vacuum tubes and which may, for the present, be considered as sensible indications of their molecular constitutions.

Two important considerations have to be dealt with at this point. In the first place the question arises how far one and the same light, *i.e.* one and the same oscillation frequency, will excite the different specimens of lime. Without entering into dry numerical details, it is not possible to give a complete answer to this question. In a general sense, however, it is apparently true that, although the range of frequency is large, the red and orange varieties of lime respond to oscillations less rapid than those which readily affect the varieties giving a green or blue phosphorescence. It is possible to obtain a form of lime which illustrates this experimentally. It is not easy to make. It is prepared from calcium urate by heating this for many hours to a dull red heat, and afterwards raising the temperature of the blackened mass sufficiently to burn off all the organic matter and leave only lime. The residue on analysis was shown to be really lime. Such a specimen exposed freely to jar-sparks, and afterwards heated, shows mainly an orange phosphorescence; but if glass or mica or Iceland spar be placed between the lime and the source of light, then the effect of heat is to intensify greatly a phosphorescence of a blue colour. It must be clearly understood that this blue was there before, only masked by the superior brilliancy of the orange colour; the undulations which would otherwise have affected the molecular groupings capable of giving out the orange light being cut off by the glass or mica. It would be tedious to give all the reasons for assuming that the oscillations exciting the blue phosphorescence are probably the more rapid. To some extent the transparency of glass and mica to X-rays may be taken as confirmatory; but to follow the argument out from spectroscopic evidence and measurements would involve a discussion unsuited to a lecture dealing with general questions. Referring, however, to the suggested explanation of the action taking place in a vacuum tube, it is not inappropriate to mention now that it is possible to make a specimen of lime give an orange glow in a moderate vacuum while a portion of the same specimen is exhibiting a blue glow in a high vacuum. The readiness with which this blue glow appears, and the time which it takes to develop, must be taken into account in dealing with its supposed origin, and with its relevancy with the question of the relation of the rapidity of the exciting undulation to the wave-length, *i.e.* to the colour, of the phosphorescent light. Perhaps it is advisable to leave this point for the moment, and to turn to the second consideration. This deals with the question of the duration of the phosphorescence.

At the beginning it was shown that some bodies glow only while light is acting upon them, or while they are under the direct influence of an electric discharge. In others there was a marked after-glow; while still others required the application of heat before any phosphorescence was visible, or, as in the case of the limes, before the phosphorescence was easily visible. With Balmain's luminous paint, or with any body which gives a marked phosphorescence that lasts for some time after withdrawal from the exciting influence, it can be readily shown that lowering the temperature reduces the brilliancy of the glow, but lengthens the time during which it lasts. The effect of heat has already been mentioned as vastly increasing the brilliancy; but it greatly diminishes the duration of the light. On the other hand, Prof. Dewar has shown that great reduction of the temperature will cause the phosphorescence to linger for a considerable time in many substances which had hitherto been considered as practically non-phosphorescent. The different behaviours of substances in this respect can, perhaps, be best brought under one explanation by applying the idea of a statical charge or a condition of strain to the phosphorescent substances themselves. Duration of phosphorescence would then be a measure of rapidity of discharge. If it be supposed that, the strain having been set up in the particles of a substance, these discharge themselves against one another, or rather against uncharged particles, then a substance with great freedom of transference of movement among its particles would fail to show any sign of phosphorescence; since the strain would be released or conducted away by rapid transference before a condition could be set up, out of which oscillations of sufficient amplitude could arise. With rather less freedom of movement among the particles the non-conducting state might be reached by restricting the extent of that movement by cold, as in Prof. Dewar's experiment. Still less freedom of interchange may be considered to obtain in Balmain's luminous paint, and even less in the limes, which require heating to show up their phosphorescence; while, in the case of the chlorophane and many other minerals, the condition of strain, however set up, can apparently be retained indefinitely. Specimens of lime after exposure to the jar-spark have been found to give out light when heated after being four years in the dark. It seems not altogether improbable that the influence of impurities in promoting phosphorescence may often be attributed to their interfering with the freedom of movement, and so permitting the groupings of the substance to be sufficiently highly charged. The effect of heat in rendering a substance a better conductor can be well studied with pure substances in vacuo under the electric discharge.

Under the vigorous bombardment of radiant matter the temperature of the substance rises. In some substances this leads to an increase in the brilliancy of the glow maintained often even when the heating is very considerable; in others the hotter portions are marked out by a complete absence of phosphorescence. Observation seems to favour the conjecture that this absence is in many cases to be explained on the hypothesis that the heat endows the molecules with such freedom as to practically render them uninsulated. To pursue this part of the subject any further would lead to a discussion of a question that can only be referred to. It is the consideration of how far the change of glow in some specimens of lime from a red or orange colour in a low vacuum to a green or blue glow in a high vacuum is to be attributed to shorter oscillations in the exciting cause, and how far the change is connected with a dissociation of complex groupings into simpler ones; a dissociation which may be considered to be brought about by the rapid oscillations breaking up the lime groups into two or more smaller groups. Connected with this is also the question dealing with the possibility of phosphorescence being coincident with the recombination of the separated smaller grouping; but this part of the subject can only be illustrated by experiments of too minute a character to be suitable to a lecture, and involves besides the study of too many details. One other thing which must be taken into account in drawing any deductions from the change in the colour of the glow as the temperature rises is that in some cases the effect of heat is to discharge some colours in a complicated substance, and so leave visible others which were before masked.

The whole question of the inter-relations of the molecular weights of the phosphorescent substances, of the wave-lengths of the exciting undulations, and of the wave-lengths of the resulting glows is an important and interesting one; but it must be left alone in the present lecture with the statement, somewhat unsatisfactory it is feared, that, while there is no doubt that special undulations of measurable wave-length are most efficient in exciting phosphorescence in some substances, the same effects can be produced, though to a less degree, by vibrations which can perhaps be best described as undifferentiated and irregular pulses.

Returning to the sources of oscillations, there is one other source which has yet to be considered, and that is chemical combination. The fact that many substances will phosphoresce during and after exposure to the flame of hydrogen has already been alluded to. The flame of coal-gas burnt in a Bunsen burner will excite phosphorescence in many specimens of lime; but the effect is not strong enough to be shown to an audience.

Naturally this effect would be stronger the nearer the lime was placed to the source of light. Inside the flame itself would be the nearest attainable position, but then the heating effect practically masks or destroys all others. In phenomena such as the glow of phosphorus the temperature does not rise to any very marked extent. It is possible to obtain chemical combination in the presence of many bodies of a porous nature without, during the early stages of the action, getting very marked heating effects. The action of spongy platinum in inducing the oxidation of coal-gas or alcohol vapour may be taken as a familiar illustration of the use of a porous material for this purpose.

In the case of a conducting metal it could not be expected that the oscillations arising from the chemical combination would cause phosphorescence even in the early stages, when the temperature has not risen to any extent; but if such a body as lime could be obtained in a very porous condition it might, while acting as an inducer of chemical combination, itself respond to the oscillations arising out of that combination.

This is found to be the case. A jet of unlighted coal-gas allowed to play over warm porous lime produces a slight phosphorescence, very faint, but quite visible in a dark room.

By dusting easily volatile substances, such as finely powdered resin, over slightly heated lime, the oxidisable vapour is brought more closely into contact with the lime, and the phenomenon of phosphorescence is made more visible. So far, however, it has not been obtained with sufficient brilliancy to be shown to more than a few people at a time. When the different limes that have already been experimented with are subjected to oscillations from this chemical source, they yield their respective colours in the same way as before. The lime, which showed a green glow in the vacuum tube, or when dusted on to a hot plate after exposure to the jar-spark, gives a green glow with the powdered resin. So also in the cases of the orange and blue yielding limes. The possibility of the phosphorescence being due to the resin vapour itself is excluded by control experiments with other porous bodies which do not phosphoresce, but yet are equally active in bringing about oxidation.

This phosphorescence was often well seen when some of the limes were being prepared in a furnace. (It has been already mentioned that many substances retain the power of phosphorescing at a high temperature, especially if they are in a very fine state of division or not quite pure.) Most of the limes were made from organic salts of calcium, and as the organic matter burnt away, a thin and scarcely visible flame played over the surface of the lime at the top of the crucible in which the calcination was carried out. It was frequently quite possible to predict by watching the glow which was developed in the lime what colour would be given when the phosphorescence was brought about by oscillations from the other sources, such as the jar-spark or the discharge in vacuo.

No one who has spent much time in experimenting with various substitutes for lime in lantern work can have failed to be struck by the very different appearances of the light on the screen given by such bodies as magnesia and zirconia in comparison with lime; but, perhaps, the best examples are the two mantles in use at the present day for incandescent gas lights. One of them, the Welsbach mantle, gives a light of almost a white colour. The other, or Sunlight mantle, shows a much pinker colour to the eye.

Experiments with many substances used in a similar way to the mantles seem to indicate that, in addition to the ordinary heating effect of the gas flame, there is another and a phosphorescent effect which probably, so far as observation can tell, precedes the ordinary hot stage. It is not usual to find any pure substances capable of showing this phenomenon to any marked extent unless, as mentioned just now, they are in an extremely fine state of division; a condition which, like the presence of impurities, may be considered to be unfavourable to the too rapid discharge of the strained particles; thus giving them the opportunity of becoming fully enough charged to make their oscillations, when they are discharged, of sufficient vigour to be sensibly visible.

If either of the mantles mentioned be introduced into a tube and treated with an electric discharge in a high vacuum, the phosphorescent glow can be studied either with or without the heating effect. The glow of the Welsbach mantle is a greenish white, but not very marked. The Sunlight mantle gives a fine red glow. It is interesting to note that the glow shows great persistence even when the temperature of the substance has been raised very considerably by the vigour of the bombardment.

Having now dealt with the last source of oscillation which it was proposed to consider, it may be as well to summarise the conclusions which for the present seem to be the least open to objection so far as experimental evidence goes. The attempt has been made to connect together all the phenomena of phosphorescence with a view of showing between them a likeness in kind. Any theoretical suggestions should be taken only as hypotheses for assisting this attempt and for pointing the direction of further experiments. It is believed, then, that the following typical examples of the various phenomena which are described as phosphorescent phenomena are similar in kind and can be related to one another by the application of slight modifications of the same general principle—the glow of phosphorus, the fluorescence of quinine, the sparkling of heated chlorophane, the luminosity of Balmain's paint, the light from lime in a vacuum tube, and the glowing of barium platinocyanide under the influence of X-rays. To these it is proposed to add coloured flames and the spectral light of glowing gases. It is suggested that all these phenomena may be looked upon as outward evidences of response on the part of the substances to rapid oscillations, whether these oscillations have their origin in chemical combination in what is commonly spoken of as light, or in electrical discharge. The nature of that response may in some cases be of a direct character; but, when account is taken of the many degrees of persistence of phosphorescence and of potential phosphorescence, it seems in many cases first to assume the form of something which, to avoid circumlocution, may be called a statical charge. The release of this condition of strain is accompanied by oscillations which give rise to the visible undulations of the phosphorescent light.

One final suggestion may perhaps be made, though it is mentioned with diffidence, as many may consider it outside of the subject.

If it be accepted that the light of the sun has its immediate origin mainly in the masses of luminous clouds floating in the photosphere, and if these clouds be considered as condensations into material of greater molecular complexity than that from which they were condensed, then it may be not altogether out of place in the present lecture to speculate on the relation between the actual light from the glowing clouds and possible oscillations of the particles of the medium in which they exist. There is no need to emphasise the idea that the oscillations of very simple molecular systems give rise to undulations which can only be perceived when, by their action upon something more complex than themselves, they cause either a distinct chemical change or set up undulations within the range of the visible spectrum.

May it be that there are similar oscillations in the sun, that the simpler materials out of which the photospheric clouds are condensed vibrate too quickly to give out visible light, but that their oscillations are rendered visible when they are absorbed and responded to by the more complex groupings of the condensed masses? A sun-spot, looked upon as a partial absence of clouds, would mean that the conditions which serve to screen us to a great extent from the rapid undulations have been somewhat modified.

Is it too much to suppose, in view of the close resemblances between many of the actions of light and electricity, and of the well-known electrical effects of ultra-violet light and of X-rays, that the breaking down of a dielectric which they can accomplish may, on a vastly larger scale, accompany an unusual exposure of the earth to similarly rapid undulations? Should there be anything in this suggestion, it may help to remove a part of the difficulty in relating the presence of sun-spots to those casual electrical disturbances with which they undoubtedly coincide in point of time.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A NEW technical institute was opened at Wellingborough on Thursday last, by Sir Philip Magnus. The building has been erected by the Urban District Council at a cost of 3000*l.*, exclusive of the site, and it will be maintained out of the free library rate.

THE following donations are announced in *Science*:—Colonel Oliver W. Payne has given 1,500,000 dollars to the Cornell University Medical College; the late Mr. Rowland Hazard has bequeathed 100,000 dollars to Brown University; Mr. George A. Gardner has given 20,000 dollars to the Massachusetts Institute of Technology, to be added to the general endowment fund; Dr. D. K. Pearsons, of Chicago, has offered 50,000 dollars to Fairmount College, Wichita, Kans., on condition that 150,000 dollars can be raised; in connection with the Maryland Agricultural Experiment Station, the State Legislature has granted 14,000 dollars for the erection of a science hall, to be used jointly by the college and station. 10,000 dollars have also been granted for inaugurating State work in entomology and vegetable pathology, and an annual grant of 8000 dollars for maintenance has been made.

THE new Technical Institute and Public Library, erected by the West Ham Corporation, will be opened to-day by Mr. J. Passmore Edwards. The foundation-stone of a natural history museum, which will be built close by, will also be laid. The Technical Institute, the principal of which is Mr. A. E. Briscoe, will be wholly under the control of the municipality, and will be financed from municipal sources. Every department is well equipped, special attention being paid to the chemical laboratories and the engineering workshops. The buildings have cost 450,000*l.*, and a further 15,000*l.* has been spent on equipment and fittings. The money for the working has been created by the accumulation of the Excise duties grants, but the corporation have secured sanction to raise 35,000*l.*, and have power to levy a 1*d.* rate (which will produce about 3800*l.*) for technical instruction purposes. The new central library is wholly on the ground floor, and is fitted with all the modern appliances of such institutions. Towards the cost of the natural history museum Mr. Passmore Edwards has contributed 2500*l.* The Essex Field Club, who will have the scientific control of the museum, will house their large collection here.

IN the course of an address upon "Science and Education," delivered at Mason College on Tuesday, Sir Archibald Geikie remarked that there is no more pernicious doctrine than that which measures the commercial value of science by its immediate practical usefulness, and restricts its place in education to those only of its subdivisions which are of service to the industries of the present time. By all means let artisans know as much as could be taught them regarding the nature and laws of the scientific processes in which they are engaged. But it is not by mere technical instruction that the industrial and commercial greatness of the country will be maintained and extended. If we are not only to hold our own, but to widen the boundaries of applied science, to perfect our manufactures, and to bring new departments of nature into the service of man, it is by broad, thorough, untrammelled scientific research that the success must be achieved. The continued development of the faculty of prompt and accurate observation is a task on which students cannot bestow too much attention. Amongst the mental habits which education in science helps to foster are a few which specially deserve attention as worthy of most sedulous care all through life. In the first place should be put accuracy; in the next thoroughness, which is closely akin to accuracy; then breadth; then the habit of wide reading in scientific literature; and then patience. It is by failures as well as by successes that the true ideal of the man of science is reached.

THE following entrance and other scholarships have been awarded at London Medical Schools:—London Hospital Medical College: Price Scholarship, value 120*l.*, Mr. F. W. Jones; Epsom Scholarship, value 126*l.*, Mr. Colmer; Price University Scholarship, value 60*l.*, Mr. Bousfield; Science Scholarship, value 60*l.*, Mr. J. W. Fox; Science Scholarship, value 30*l.*, Mr. Rainforth.—Charing-cross Hospital Medical School: Livingstone Scholarship (100 guineas) to Mr. G. E. Bellamy; Huxley Scholarship (55 guineas) to Mr. B. R. Bickford; Universities Scholarships (each 60 guineas) to Mr. H. G. Gabb and Mr. B. G. Fiddian. Entrance scholarships have also been awarded to Mr. R. H. Cooper (60 guineas), Mr. D. M. Davies (40 guineas), and Mr. T. Law (30 guineas); and exhibitions of 30 guineas each to Mr. A. C. Ingram, Mr. G. O. Lambert, and Mr. B. R. Lloyd.—Guy's Hospital Medical School: Scholarships for University students: H. S. French, Christ Church, Oxford, 50*l.*; Open Science Scholarship, E. H. B. Milsom, Guy's Hospital Medical School, 150*l.*; F. Rogerson, Guy's Hospital Medical School, and N. J. Spriggs, private study (equal), 30*l.* each.—St. Thomas's Hospital Medical School: Entrance Scholarships in Natural Sciences: 150*l.*, Chas. Michael Roberts; 60*l.*, Harry Mellor Woodcock; 20*l.*, Charles Hugh Latham.—University College, London, Medical Entrance Scholarships: 131 guineas, Mr. H. A. Haig; 55 guineas, Mr. M. Stewart Smith; 55 guineas, Mr. W. M. Sadler.—The first and second entrance scholarships of the Middlesex Hospital Medical School have been awarded to Mr. W. Cameron Macaulay and Mr. William Gordon Taylor, respectively.

THE Secondary Education Bill introduced into the House of Commons by Colonel Lockwood, proposes to separate technical from secondary education. For this and other reasons the Council of the Association of Technical Institutions has entered a protest against the Bill. It is pointed out that the proposed separation of technical and secondary education is an entire reversal of previous educational policy, and if it were carried into effect it would be detrimental to the education of this country. The power which Colonel Lockwood's Bill gives for the creation of a new local authority to deal specially with secondary education is also objected to, the multiplication of local authorities for the purposes of education beyond the elementary stage being regarded as a retrograde step. Other defects which the Bill possesses are: (1) The proposal to provide for the financial needs of secondary education by taking away from technical education part of the money assigned for instruction in science and art, and of the money available under the Local Taxation Act. (2) The proposal that the limits of secondary and technical education shall be settled on the basis of the opinions expressed by an advisory Council on which secondary schools and teachers shall be very largely represented, but which shall not contain a single representative of technical institutions. (3) No provision is made for the registration of teachers in technical institutions. (4) The proposal that a local secondary education authority shall not provide or have the management of any secondary school. The Council desires that steps should speedily be taken to organise secondary education in this country, and is willing to aid any statesmanlike attempt to accomplish this, but Colonel Lockwood's Bill would, it is pointed out, do mischief by creating a distinction between technical and secondary education, and setting up a purely artificial barrier between the two. It is not expected that the Bill will pass, but as the manner in which it is received may influence the Government to incorporate the proposals contained in it in the Secondary Education Bill to be produced next session, it behoves those interested in technical education to show unmistakably that such provisions as those in Colonel Lockwood's Bill are not generally acceptable.

AT a Congregation of Cambridge University held on Saturday, Dr. Hill, the retiring Vice-Chancellor, delivered a valedictory address, in the course of which he made the following remarks:—"The admirable and central sites which have been purchased by the University during the last three years are still entirely unoccupied, although many departments of the University are either overcrowded or most inadequately housed; but, at the desire of our Chancellor, steps have been taken which may, it is hoped, bring in the funds necessary for the erection of the buildings which are so urgently required. A very influential committee of University men has been formed for the purpose of organising a 'Cambridge University Association,' the members of which will be kept informed of, and will be pledged to make known, the needs of the University. It is hoped that through the influence of this association the University may be placed in possession of the means of maintaining her position in the ever-widening and ever-changing educational life of the nation. The legal and medical schools, feeling that it is impossible to wait until the general resources of the University allow of the provision of new buildings, have opened subscription lists on their own account, and it is significant of their sense of the pressing need for such accommodation that of the 6000*l.* already subscribed a large proportion has been given by the teachers of law and medicine and other residents in the University. Among gifts to the University during the past year were a very valuable collection of minerals given by the Rev. T. Wiltshire, Professor of Geology and Mineralogy in King's College, London, a collection of polyzoa given by Miss E. C. Jelly, a skeleton of the elephant seal given by Sir W. L. Buller, K.C.M.G., a MS. of *de proprietatibus rerum* of Bartholomaeus Anglicus given by Lieut. Archibald Stirling, and a collection of Malay native objects given by W. W. Skeat. The University has also received a bequest of 10,000*l.* under the will of the late A. W. G. Allen for the establishment of a scholarship or prize in memory of the Right Rev. Joseph Allen, formerly Bishop of Ely, and grandfather of the donor. Not a few gifts for the foundation of scholarships and prizes have been received by the University during recent years. Such gifts are always acceptable; but at the present time there is a greater need for the endowment of teaching posts and the provision of buildings for University purposes than for the encouragement and stimulation of students." Dr. Hill was re-elected Vice-Chancellor for the ensuing year.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 26.—M. van Tieghem in the chair.—On the changes occurring in the large nebula in the belt of Andromeda, by M. G. Rayet. The brilliant point announced by M. Seraphimoff is probably the central point of the nebula, the brightness of which is variable, and is now temporarily increased. The position of the point does not coincide with that of the temporary star whose position was measured by M. Bigourdan in 1885.—On a geometrical theory of the marine compass, by M. S. L. Ravier.—On the convergence of some *réduites* of the exponential function, by M. H. Padé. The term *réduite* is applied to a function (regular in the neighbourhood of the origin) of the rational fractions which, near this point, represent this function with close approximation.—Action of lime and chalk upon certain natural humic materials, by M. G. André. The earths were heated at 100° for fifteen hours with lime, chalk, or water, and determinations made of the nitrogen volatilised as ammonia, the nitrogen rendered soluble, and the ammonia present in the filtrate.—On the composition of œolosomine, by M. A. B. Griffiths. Œolosomine is the name given to a colouring matter, green in acid, purple in alkaline solutions, found in *Œolosoma tenebrarum*.—Chlorophyll assimilation in plants growing by the sea-shore, by M. Ed. Griffon. The leaves of maritime plants under the influence of sea-salt undergo a reduction of chlorophyll, acquiring by way of compensation a greater thickness and a more marked development of the assimilating tissues. But this modification of structure, although having a tendency to compensate the injurious action of the salt, is insufficient, since the assimilation per unit of surface is always less for the leaves of a maritime species than for comparable leaves of the same species growing inland.—Observations of an aurora borealis at Göttingen (Hanover) on September 9, by M. B. Violle.—On an observation of the green ray at sunrise, by M. H. de Maubeuge: The phenomenon was noticed from the steamer *Ernest Simons*, by several people simultaneously, over Mt. Sinai.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Arithmetical Chemistry: C. J. Woodward, Part 1, new edition (Simpkin).—The Campaign in Tirah: Colonel H. D. Hutchinson (Macmillan).—The Telephone: Prof. W. J. Hopkins (Longmans).—An Introduction to Practical Quantitative Analysis: H. P. Highton (Rivingtons).—Diet and Food: Dr. A. Haig (Churchill).—Beiträge zur Physiologie des Centralnervensystems: Prof. Max Verworn, Erster Theil (Jena, Fischer).—The Living Organism: A. Earl (Macmillan).—Catalogue of Chemical and Physical Apparatus and Chemicals (Leeds, Reynolds and Branson).—Eclipses of the Moon in India: R. Sewell (Sonnenschein).—Cape of Good Hope: Report of the Marine Biologist, 1897 (Cape Town, Richards).—The Gold Coast, Past and Present: G. Macdonald (Longmans).—Psychology in the Schoolroom: T. F. G. Dexter and A. H. Garlick (Longmans).

PAMPHLETS.—The Witness of Science to Linguistic Anarchy: Lady Welby (Grantham, Clarke).—Glasgow and West of Scotland Technical College: Reports on Experiments on the Manuring of Oats, Hay, and Turnips and Potatoes (Glasgow).—The Wanton Mutilation of Animals: Dr. G. Fleming (Bell).

SERIALS.—Chambers's Journal, October (Chambers).—Good Words, October (Isbister).—Sunday Magazine, October (Isbister).—Longman's Magazine, October (Longmans).—Monthly Weather Review, June (Washington).—National Geographic Magazine, September (Washington).—Century Magazine, October (Macmillan).—Humanitarian, October (Duckworth).—Contemporary Review, October (Isbister).—Fortnightly Review, October (Chapman).—Reliquary, &c., October (Bemrose).—Himmel und Erde, September (Berlin, Paetel).—Janus, July-August (Williams).—Journal of the Royal Agricultural Society of England, Vol. 9, Part 3 (Murray).—Proceedings of the Geologists' Association, August (Stanford).—National Review, October (Arnold).—Knowledge, October (Holborn).—Observatory, October (Taylor).

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