Nature

A WEEKLY

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"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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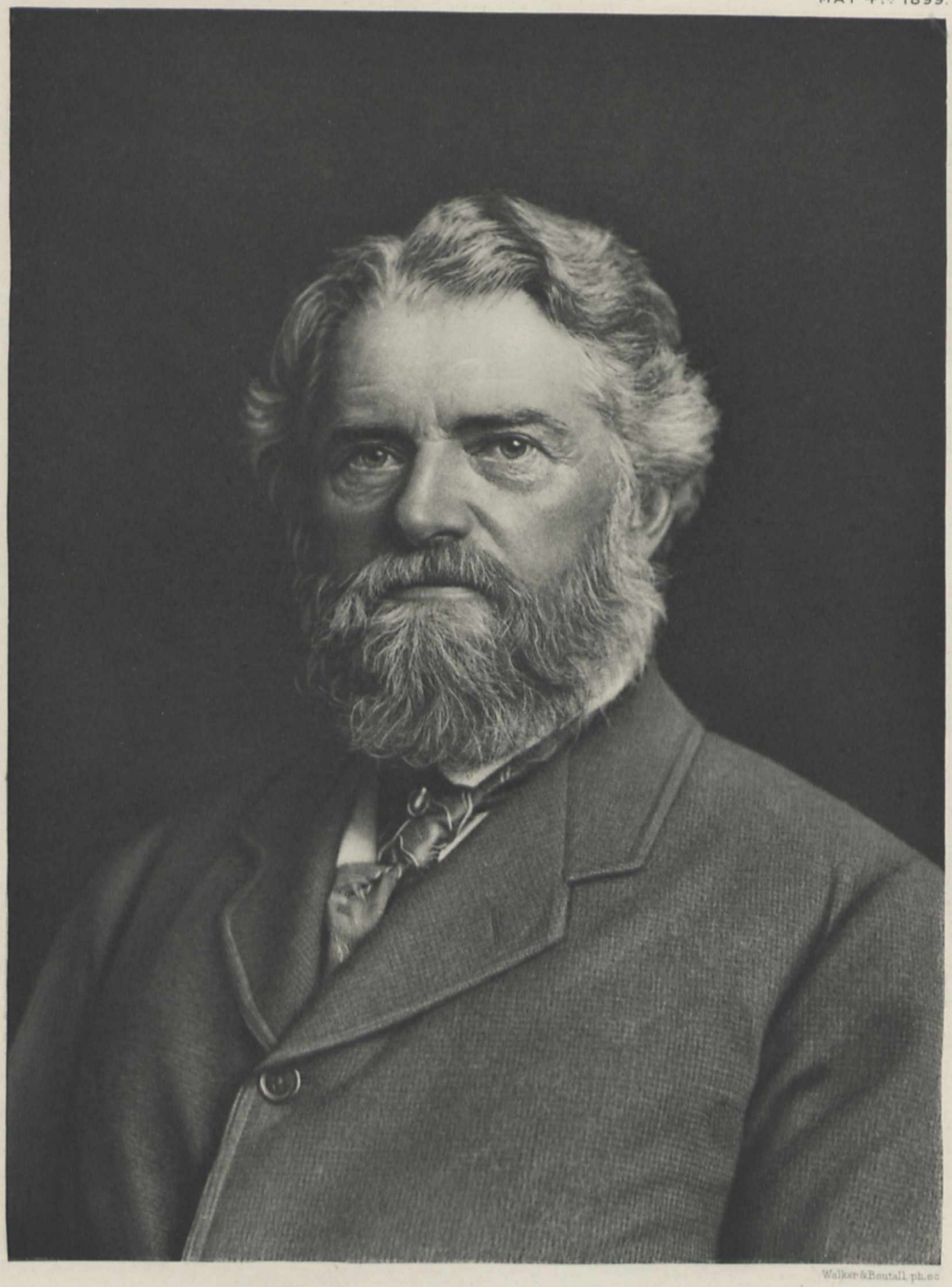


Walker & Boutall, ph. sc

Simon Newcomb

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

THURSDAY, MAY 4, 1899.

SCIENTIFIC WORTHIES.

XXXII.—SIMON NEWCOMB.

NEWCOMB must be considered, without contradiction, as one of the most celebrated astronomers of our time, both on account of the immensity of his work and the unity of view which marks the choice of the subjects treated by him.

All is linked together in our solar system: the study of the motion of each one of the celestial bodies forming part of it is based upon the knowledge of a great number of numerical data, and there exists no fundamental element whose influence is not repercussed on the entire theory of these bodies. To endeavour to build up the theory of our whole planetary world on an absolutely homogeneous basis of constants was an almost superhuman task.

The evaluation of each one of these data demands, indeed, that one should attentively go over most of the previous researches, and continue them by more thorough methods. All Newcomb's work, followed up with rare perseverance, has constantly tended to this ideal end: first to arrive at a more exact knowledge of the magnitudes serving as points of reference, and then to establish the theory, not only of all the planets, but also of their satellites on a system of constants as precise as modern observations permit. Wishing to realise in a complete manner this vast programme, Newcomb has recognised that the published observations do not always furnish the necessary information for obtaining with exactness all the looked-for elements. Abandoning, therefore, the domain of pure speculation, he has given himself up to researches which proclaim him possessed of a talent of observation of the highest order. By personal studies he has succeeded in filling many of the gaps which seriously impeded the progress of theory. Thus, in order to determine the masses of Neptune and Uranus and the elements of their satellites, he made a series of observations of great value, on which are partially founded the ephemerides inserted in all nautical almanacs.

I shall simply mention here in a few words some of the preparatory work preceding the construction of the magnificent edifice of which I have indicated the plan, on the happy completion of which the scientific world is to be congratulated. Throughout its execution one recognises the sign of a master-mind whose conclusions assume a definite character and remain acquired to science.

The solar parallax is one of the most essential data which intervene in all researches concerning the planetary system. Newcomb undertook to fix its value by the discussion of all the transits of Venus observed previously to 1882. In a very detailed memoir, he calls astronomers' attention to the danger to which they are exposed by giving an exaggerated confidence to certain modern methods. The systematic exclusion of the ancient observations cannot sufficiently be justified by discordances which exist between their results and those obtained more recently. By a minute and impartial discussion of all existing documents, Newcomb arrived at a value almost identical with the one adopted in 1896 by the International Conference of Paris.

Again, in order to obtain by an altogether independent means the value of this same constant, Newcomb undertook a determination of the velocity of light, based on the ingenious method suggested by Léon Foucault. These researches of a physical nature opened the way to an important advance in our knowledge of the heavens. In fact, we had all reason to hope that the value obtained for the velocity of light, combined with the constant of aberration, would allow us to determine the solar parallax more accurately than by the usual astronomical methods. Newcomb holds that multiplicity of methods is an essential condition of success; this motive led him to choose Foucault's method, which he applied with rare sagacity. The agreement between the different results obtained in this way by Cornu, Michelson and Newcomb is an admirable one, and testifies to the knowledge and skill of the experimenters. With the help of the values found for the velocity of light, it would have been possible to deduce the parallax, if recent observations had not revealed the uncertainty which still hovers over the real value of the aberration constants.

I cannot close the list of these preparatory studies without referring to a subject which interests the highest problems of astronomy of precision.

The observations of the planets and of the moon depend on the coordinates of the fundamental stars, of which unfortunately we possess as yet no catalogue absolutely free from systematic errors. One of Newcomb's constant preoccupations was to try to constitute a uniform system of points of reference, at least in right ascension, this coordinate having we ghty importance in the case of observations of moving bodies. The catalogues drawn up by him, and by Auwers, for the fundamental and bright stars of the ecliptic, have shared in equal measure up to a very recent date the favour of astronomers. But the use, in the same scientific research, of elements derived from different sources, presents inconveniences acknowledged for a long time. A reform in this direction had become very desirable. This circumstance has again afforded Newcomb the opportunity of manifesting the inexhaustible resources of his activity and talent. An international conference, held in Paris in 1896, under the auspices of the Bureau des Longitudes, had as its object to elaborate a common system of constants and fundamental stars to be employed in the astronomical ephemerides. Newcomb took one of the most important parts in the discussions and resolutions of this conference. At its suggestion he has undertaken, not only the research of the definitive values to adopt for the lunar-solar precession and the planetary precession, but also the construction of a new catalogue of fundamental stars in accordance with the system of elements chosen by the Paris meeting of astronomers. Newcomb has consecrated these two later years to the accomplishing of this arduous task. The catalogue of fundamental stars, which he has just finished, will come into use in the beginning of 1901, and will realise in the work of astronomers that unity and simplification so long desired.

I now come to the labours which have absorbed the greatest part of Newcomb's scientific activity: they refer to the domain of celestial mechanics.

At the time when the great work of Le Verrier had only reached the tables of Jupiter, Newcomb published an excellent theory of the two planets furthest from us, Uranus and Neptune. These tables, from the moment of their appearance, have been used by astronomers of every country.

Among the greatest triumphs of Newcomb's career must be counted his many and fruitful researches on the motion of the moon The theory of the moon bristles with difficulties. No one has yet succeeded in establishing a complete harmony between theory and observation. In his lunar tables, Hansen, in order to obtain this accordance for a limited interval of time, was obliged to attribute to an inequality arising from the action of Venus an empirical coefficient of an excessive amount, and to adopt besides an acceleration of the secular movement twice as great as that which results from the law of universal gravitation according to the calculations of two illustrious geometricians, Adams and Delaunay. Should we, as a great number of *savants* think, attribute to Hansen's number, so far from the theoretical value, an indisputable reality, and try to discover the physical causes of the anomaly; or should we see the origin of the disagreement in an erroneous interpretation of historical documents? Newcomb did not recoil before the difficulties which the solution of this problem entailed. He discussed all the occultations observed since the invention of the telescope up to a recent time; he himself examined forgotten observations, buried for one hundred and fifty years in the registers of the Paris Observatory. These neglected documents have thrown a vivid light on the question. In thus utilising an abundant harvest of new information, and correcting Hansen's theory by the exclusion of every empirical coefficient, Newcomb arrived at results of fundamental importance. He proved, agreeing in this with Tisserand's researches, that the eclipses of the Almagest, and those of the Arabs, as well as the ancient occultations, agree very well with the theoretical value of the secular acceleration; and further, as a corollary, that the most ancient solar eclipses, the representation of which would seem to demand an increase of the secular acceleration, can without scruple be left out of consideration, either because the reality of the phenomenon remains doubtful, or because there exists too great an uncertainty in the hour and place of observation.

One might without inconvenience, therefore, adopt the theoretical acceleration of 6″, correcting the mean motion and the longitude of the epoch. But whatever value is chosen, and this was not anticipated, one must, after having suppressed Hansen's erroneous inequality, resign oneself to introduce another notable empiric term of a period of about two hundred and seventy years, and of an unexplained origin; one simply notes that this amplitude is nearly that of an inequality due to Venus, the existence of which is not doubtful.

Besides this empiric inequality, Newcomb has discovered another, less pronounced, with a coefficient superior to 1″, with an amplitude of about twenty-seven days, and appearing to be associated with a long period perturbation of the excentricity and perigee. These delicate deductions have since been confirmed by the theoretical researches of Messrs. Neison and Hill, which show that the terms in question are due to the action of Jupiter. By all these investigations, Newcomb has elucidated, in a masterly way, the actual state of the theory of the motion of our satellite.

The two theories of the moon which must be considered the best are those of the two celebrated geometricians, Delaunay and Hansen; they are founded on totally different methods. By the help of a long, minute and tedious transformation, because it is a question of formulæ occupying several quarto volumes, Newcomb has rendered their expressions immediately comparable, bringing them moreover to a system of precise and uniform constants.

Further, by this comparison, he has shown that, in spite of the difference of method, the two theories lead to identical results for solar perturbations, which form the essential part of them and are indeed the only ones which were calculated by Delaunay.

I must now pass very briefly to some of Newcomb's other memoirs. One of his most original researches is relative to Hyperion, Saturn's seventh satellite, discovered almost simultaneously by Bond and Lassell.

The movement observed was in disaccord with the prediction of theory. In fact the major axis of Hyperion's orbit, instead of moving, directly, round Saturn in a century, accomplished a revolution in the opposite direction in the short period of eighteen years.

Newcomb has proved that this rapid retrograde revolution is caused by the perturbing action of the next satellite Titan.

In the various volumes of "The Astronomical Papers for the use of the American Nautical Almanac," Newcomb has published a great number of memoirs. One can follow step by step the immense progress achieved in the execution of the vast project which he had taken upon himself to accomplish.

It is difficult to convey an idea of the considerable efforts, the sagacity which must be displayed, the numerous investigations which must be accomplished, in order to make known to a sufficient degree of approximation the motion during a century of a body of our planetary system. Only those scientific men who have given themselves up to analogous studies can appreciate the enormous expenditure of physical and intellectual energy which must have been necessary to Newcomb in order to bring to a happy end the researches on the four planets nearest the sun. Newcomb has based his work on more than 60,000 observations, which he has compared with Le Verrier's tables; the perturbations have been calculated with great precision. While Newcomb has thus founded theories of these planets on a more precise basis, his celebrated collaborator, Mr. Hill, has obtained the same results for the two planets Jupiter and Saturn.

Henceforth, science will profit by the fruits of this immense labour, consisting of the tables of the planets Mercury, Venus, Mars and the Earth. In a special volume there are to be found various researches on the fundamental constants of astronomy.

We have only been able to give a short sketch of Newcomb's achievements; he is gifted with a prodigious power of work, which is testified by the extraordinarily long list of his researches.

The reception which has been accorded to them by all competent men points to their author as one of the most illustrious representatives of celestial mechanics.

This activity has embraced the most diverse branches of astronomy. Not only has he given a great scope to the intellectual movement of his country, but he has also contributed in a very successful manner to elevate the level of the civilisation of our age, enriching the domain of science with beautiful and durable conquests.

LOEWY.

THE TEMPERATURE-ENTROPY DIAGRAM.

The Entropy Diagram and its Applications. By J. Boulvin, Professor at the University of Gand, Belgium. Translated by Bryan Donkin. Pp. xii + 70. (London: E. and F. N. Spon, Ltd., 1898.)

RANKINE'S "Thermodynamic Function ϕ" (defined by $t.d\phi = d\mathrm{H}$) is now called "Entropy ϕ." The state of a pound of stuff which has only fluid stress and strain is completely defined when we know the values of any two of p, v, t, E or ϕ [during change of state the two must not be merely p and t] where E is the intrinsic energy and ϕ is the entropy. When we say that E returns to its old value if we bring the stuff to the same state again, we state the first law of thermodynamics in its most general form. When we say that ϕ returns to its old value, we state the second law of thermodynamics in its most general form.

A curve connecting the values of any two of the above coordinates will, therefore, completely define the changing state of a pound of stuff. Rankine does not seem to have used the t,ϕ coordinates graphically, but he used them very much indeed in the algebraic form; and the idea that a t,ϕ diagram might be constructed was published by several mathematicians more than a quarter of a century ago. In truth, the idea was familiar to all students of Rankine, but until Mr. Macfarlane Gray began his crusade in favour of the use of the t,ϕ diagram in practical steam engine calculation, no other person had any idea of the changes that its use would effect.

When a pound of water-stuff alters in pressure and volume in any assigned way, at what rate does it receive or give out heat? This is the problem that we used to solve in the most laborious way; and so troublesome was it that I question if anybody, not a lecturer, ever worked out more than one example completely. The problem was never put before any but the most advanced students.

Now, thanks to Macfarlane Gray, this sort of problem is not only taken up and solved by the average student in the most elementary classes, but it is of all problems the one whose solution is most easily understood; and it is through such work that we now most easily introduce the average student to the laws of thermodynamics and the properties of steam and water. For twelve years it has been one of the commonest of class problems to take an indicator (or p,v) diagram, and assuming a certain wetness of the steam at the beginning of the expansion, to convert it into a $t\phi$ diagram.

Prof. Boulvin has not added to our knowledge of theory or the practical application of the $t\phi$ diagram, but in his well-known "Cours de Mécanique appliquée aux Machines," in 1893, he made the method known to continental students, and exhibited the conversion of pv to $t\phi$ coordinates in a fourfold diagram; whereas in England such a conversion has always been on one diagram. Our method has possibly been such that the result is confusing to all but the man who carries it out; but this is the fault of all graphical methods of working problems. It has the merit of utilising the whole of a sheet of paper instead of one quarter of a sheet. The English method may be recommended to a student who wants an accurate answer. Prof. Boulvin's method may be recommended to a lecturer who wishes merely to *illustrate* the connection between the p,v and the $t\phi$ diagrams.

The solution of the problem is really very misleading, for, invariably, the assumption is made that there is no moisture in the cylinder at the end of the exhaust. This assumption is the basis of the method used by Hirn and his numerous followers in that kind of study of the steam engine which is usually supposed to be complete. It does not seem to be understood that if there is any moisture in the cylinder at the end of the exhaust, Hirn's

elaborate analysis is utterly wrong; and yet there is every ground for believing that even when steam is somewhat superheated when leaving the boiler, even well-jacketed cylinders are never free from moisture. I am sorry to say that the Hirn analysis is often employed for cylinders with no jackets when the steam supplied is known to be quite moist. As an academic exercise, no one would object to the method of study if students were informed of its uselessness in most practical cases, but, unfortunately, this information is never given in treatises which advocate the method.

If there is no leakage past the piston, we are sure that, from the beginning of the expansion to the release, we are dealing with the volume and pressure of a quantity of stuff which does not alter in amount. This is only a portion of an indicator diagram; and, as I have already pointed out, our usual study of it is based upon an unwarrantable assumption. But what are we to say of men like Prof. Boulvin, who pile upon this Pelion, Ossas of further assumption for the sake of making pretty academic problems, and then publish the solutions of these problems as if they were of practical importance?

Of course we may, if we please, say that when steam is released to the condenser, we can imagine the whole change as occurring in the cylinder itself; only we ought to remember that we are substituting a very simple hypothetical process for a very complicated reality, which has almost nothing in common with it. We ought to remember that the very pretty, beautifully complete, cyclic $t\phi$ diagrams, which we obtain from childish assumptions, may get to be looked upon by students, and even by ourselves, as having a real meaning.

The engineering teacher is much too apt to fill up the time of students with an elaborate and systematic course of instruction on a subject in which only a few lessons are essential, and, indeed, in which only a few lessons ought to be admissible. In some German schools we have systematic courses on graphical statics lasting whole terms or years. Courses on practical geometry are never supposed to be of use unless the student draws every imaginable kind of curve, draws every imaginable kind of intersection of surfaces. When some man who really thinks for himself has, after endless opposition and worry, convinced teachers that a certain kind of exercise is of value, his converts make his modest proposals into an elaborate academic system. There is no imaginable problem which does not become part of an elaborate course of exercise work. A student becomes wonderfully learned, but he loses the power to think things out for himself. Macfarlane Gray's method of study may be made part of a student's mental machinery in a few lessons, and in these few lessons it enables an elementary student to do easily what Hirn did with so much trouble; but, in truth, its great value lies rather in its enabling students to work out for themselves the well-known results of Rankine and Clausius. They see at a glance that liquefaction accompanies adiabatic expansion. They very quickly find the p,v law of adiabatic expansion of steam of any wetness. They can calculate easily the work that would be done by a perfect steam engine using the Rankine cycle, and many other important things which the average student used to take on trust. Not only does the $t\phi$ diagram enable one to see at a glance the reasonableness of much that used to be very obscure, but it clears the ideas of men who still prefer to work algebraically.

It is quite usual now in classes for students to prepare for themselves $t\phi$ sheets on which not only are the $t\phi$ lines for a pound of water and a pound of steam laid down, but also lines of constant p and constant v and constant E for wet, and also for superheated steam; and with these sheets many interesting problems may be worked.

The $t\phi$ sheets for a perfect gas, with lines of constant p, v and E, are even more valuable than such sheets for steam when one desires to convert an indicator diagram of a gas or oil engine into a $t\phi$ diagram. But, indeed, the $t\phi$ diagram is nothing like so valuable in gas engine work as in steam engine work, for rate of heat reception is quite easily obtainable from the p,v curve of a perfect gas. When we also remember that all idea of time is absent from a $t\phi$ curve, it will be seen that practical gas engine people are not likely to make much use of it.

Prof. Boulvin introduces his subject by a chapter on the laws of thermodynamics. He begins with—"The study of the changes produced in bodies by heat is based upon certain *fundamental laws* as the laws of Mariotte (or Boyle) and of Gay-Lussac (or Charles)." He defines absolute temperature as what is shown by an air thermometer, the zero of which is 273° C. below the ordinary zero. If adequate explanation were given, there might be no objection to these and other statements; but I am inclined to think that the ordinary reader will find such an introduction misleading. I think that some difficulty would be cleared up if the author proved the truth of the fundamental equations for perfect gases, instead of merely assuming their truth; it would lead to a much simpler treatment of the next two chapters. Parenthetically, I would observe that he is quite mistaken in thinking that a *small* error in measuring clearance in a gas engine cylinder will lead to very wrong values of k in the expansion curve, pv^k constant.

It would be interesting to know what the author means when, after speaking of Regnault's value 0·48 for the specific heat of steam, he says, "and this is about the same value as it would have if treated as a permanent gas, and its density calculated from its molecular weight." I think that there is almost no point of view from which this statement must not be regarded as absurd.

On the whole, the author may be said to have given an account of the subject which it is worth while for a beginner to study, should he not be able to lay his hands on the several better accounts which have already been published in England. It is a pity that the translator did not think it worth while to alter Prof. Boulvin's illustrations, for these have compelled him to use letters which will give trouble to the English student. Rankine's letter ϕ is universally used in England and America for entropy; here we have S used instead. I am wrong in assuming that the use of the foreign illustrations compelled the translator to employ these letters; for I see that he follows Prof. Boulvin in using r for latent heat, λ for Regnault's total heat; and, of course, he uses A for Joule's equivalent. In a book intended for English engineers, I think that either C.G.S. units or English engineers' units ought to be used. In this translation we find the hybrid units of French engineers.

Many of the names mentioned in connection with the history of thermodynamics are quite unknown to me; I nowhere find any mention of the names of Lord Kelvin or of his brother the late Prof. James Thomson, who first demonstrated the connection between pressure, temperature and change of specific volume on change of state. Rankine's name is not mentioned either, although to the English engineer this seems like leaving out the name of Columbus in a history of the discovery of America.

In the section referring to "diagrams of CO_2 marking the critical point," of course the name of Dr. Andrews is not mentioned, but those of Regnault and Zeuner, Cailletet and Mathias are. Of course, A is used instead of J for Joule's equivalent throughout this book.

The translator says that Prof. Unwin has read over the proofs. I wonder whether he looked over the translator's preface, in which he states, among other curious things, that "entropy in its strict sense has no meaning if employed to represent the changes of state of a fluid flowing through a vessel, and more or less throttled in its passage." If he means that a foolish man may make mistakes in using a $t\phi$ diagram, he is right enough. But if he means that a certain quantity of stuff in a certain state has not just as definite a quantity of entropy as it has of pressure or temperature, he makes a mistake which is by no means an unusual one.

Perhaps, on the whole, it is well not to extend to the translator much of the credit which one may give to the author of the book. The author may never have heard of Rankine or the Thomsons or Andrews or Maxwell, but it is really unpardonable that in the translator's list of the works dealing with "the subject of entropy" there should be no reference to anything written by Rankine.

JOHN PERRY.

UNSCIENTIFIC NOTES.

Haunts and Hobbies of an Indian Official. By Mark Thornhill, author of "Adventures of a Magistrate in the Indian Mutiny." Pp. xii + 346. (London: John Murray, 1899.)

THIS is a collection of notes on various subjects jotted down by an Indian civilian, who, during part of his Indian career, kept a diary which was, he says,

"chiefly devoted to observations on the birds, insects and animals whose acquaintance I made in my garden, or which I beheld on the bed of the river beyond."

Like many writers in the earlier half of the passing century, Mr. Thornhill uses the word animals in the restricted meaning of mammals. Occasional notes on the weather, on some of the natives of India, and on their habits, institutions and superstitions, and an account of a tour in the Deyra Dun at the base of the Himalaya, are added, and make a thoroughly readable and even an interesting book, though not one to which those desirous of information as to the "birds, insects and animals" of Northern India can be recommended to turn. The best portions of the work are those descriptive of the people of India and of the scenery; the changes of the seasons, and their effects, especially on insect-life, are also well described, but similar accounts have been given by other writers. The observations recorded were evidently made in parts of the North-western Provinces of India.

It is chiefly as a contribution to the zoology of Northern India that Mr. Thornhill's book demands notice here; and in this respect it would be difficult to find a more unscientific work. For science is essentially the accumulated experience of many men, and they who trust entirely to their own observations and neglect to make themselves acquainted with facts recorded by others, must not be surprised if the majority of their accounts are superfluous, and some of them erroneous. In the present work we have description after description of certain habits of the animal world well known to every Anglo-Indian, and useless to those unacquainted with India, because the author is unable to identify the animals observed. For instance, on p. 192 he describes in considerable detail a remarkable bird's nest. But although he must have devoted time and labour to obtaining and describing the nest, it does not appear to have occurred to him to inquire what bird built it, or whether any other observer had investigated this interesting form of bird-architecture. Yet from the description of the nest, and from the manner in which the structure was suspended from high grass, it is easy to recognise the nest of a weaver bird, and even to identify the species as probably the striated weaver bird *Ploceus manyar*. Any one who compares Mr. Thornhill's notes with those in Jerdon's "Birds of India," or better still with the elaborate account given in Hume's "Nests and Eggs of Indian Birds," must appreciate how useless the first-named are.

In the case just quoted, Mr. Thornhill, though his observations add nothing to what was well known before, does not mislead; so another instance may be taken, when his information is not only imperfect but incorrect. The following are extracts from his account (p. 118) of the animal well known in India under the name of the "musk-rat."

"This rat, fortunately, does not make its residence in the houses, and indeed it only occasionally enters them, and then as a rule by night. I do not know whether after all it is a true rat. In appearance it more resembles a very small, nearly hairless, ferret. It is of a drab colour, and has that half-transparent look noticeable in young mice and unfledged chickens. Its presence is manifested by a squeaking cry, accompanied by an intolerably sickly odour, something resembling musk. The odour is so penetrating that, according to the European popular belief, it will pass through the glass of a bottle and flavour the liquor within. The fact is correct, but not the explanation. Beer and wine are certainly occasionally flavoured by these rats running among the bottles that contain them, but the odour penetrates not through the bottle, but through the cork."

The so-called musk-rat of India is, of course, a large shrew, and resembles a ferret about as much or as little as the common English shrew does. It varies in colour, but is generally slatey-grey to bluish-grey. If it does not spend the day actually in houses, it haunts their immediate neighbourhood, merely hiding in holes. Its presence is not necessarily manifested by any odour, as Sterndale has shown. Lastly, the absurd old story that liquors in bottles become impregnated with the peculiar odour of the secretion from the lateral glands of the musk shrew, whether the scent was supposed to pass

through the bottle or through the cork (the corks, it should be remembered, were almost always covered with resin outside), was disposed of, as most of us believed for ever, by Jerdon thirty-two years ago, when he pointed out that liquors bottled in England were never impregnated. This view has been confirmed by later observers, amongst others by McMaster and Sterndale. When Indian-bottled beer or wine was tainted, the mischief was doubtless due to the use of dirty bottles or contaminated corks.

But even on subjects apart from zoology, Mr. Thornhill's information cannot always be trusted. Thus, on p. 213, he discusses the signification of the names Siwalik (or as he writes the word Shewalic) and Himalaya. Incidentally (p. 212) he states that the Siwaliks are of a different geological formation from the Himalayas, which is correct, and that they are considered to be of far greater antiquity, which is the reverse of the fact. Then he proceeds to remark that the name Siwalik is properly the designation of the entire Himalaya west of the Ganges, and as such is used invariably by the native historians; he quotes the story from one of the latter, that the term is derived from two Hindi words *sewa* and *lac* (thrice misprinted *lae*), meaning one and a quarter lakhs or 125,000, and that this denotes the number of peaks, and he states that Himalaya signifies the "Necklace of Snow." On questions of this kind Yule and Burnell's Glossary or "Hobson-Jobson" is a generally admitted authority, and a reference to it shows how incorrect Mr. Thornhill's account is. The origin of the term Siwalik is doubtful, but by the earlier native historians of India the name was not applied to the Himalayas at all, but to a tract of country much further to the southward; the story about 125,000 peaks is absurd, and the name Himalaya is derived, according to Sanscrit scholars, from *hima* snow and *alaya* an abode, and not from *hima* and *mala* a necklace.

One extract more must be given. Some of the subjects above mentioned may be regarded as matters of opinion, but the last quotation to be made betrays a want of acquaintance with elementary astronomy surprising in a man of good education. No comment is necessary except that all India is in the northern hemisphere, and that in the countries referred to in the work before us the pole star is from twenty-five to about thirty degrees above the horizon. At p. 100 there is the following paragraph; the italics are, of course, not in the original.

"The constellations are not quite the same as those we see in England: *those that in England lie far to the north are here invisible*, while we look on many that in England never rise above the southern horizon."

W. T. B.

ALPINE GARDENING.

Die Alpen Pflanzen in der Gartenkultur der Tiefländer. Ein Leitfaden für Gärtner und Gartenfreunde. Von Erich Wocke. Pp. xi + 257. (Berlin: Gustav Schmidt, 1898.)

THIS work is apparently written with a view to do for German gardeners and lovers of alpine flowers what Mr. William Robinson's "Alpine Flowers for English Gardens" (published in 1870, but long since out of print) has accomplished for their British *confrères*. Indeed, the author has treated his subject on somewhat similar lines. He is head gardener at the Zürich Botanic Gardens, and enjoys the great advantage of being able to study alpine plants in their natural conditions.

Nowadays every one is more or less interested in the cultivation of alpine plants, but comparatively few know how to grow them successfully, or to make suitable miniature Alps—popularly known as "Rock Gardens"—so as to resemble natural conditions at low elevations. Time was when heaps of clinkers and boulders of bricks thrown together anyhow were proudly designated as "rockeries." People know more about these things now, and those who do not, but would like to, may peruse with advantage the treatise under notice.

Mr. Wocke has dealt with the cultivation, propagation, and most suitable treatment for Alpine plants in a thoroughly practical manner, and German gardeners at least can no longer complain of the want of a good book on this subject. The reader is made acquainted with the conditions under which the various plants thrive naturally, so that he may know precisely how to treat a plant coming from a certain region or elevation. Plants that love the glare of the sun, or the shadow of a rock, or the moist, mossy bank of the mountain torrent, obviously require somewhat different cultural treatment; and the most successful gardener is he who endeavours to imitate nature as closely as possible.

The construction of the rockery is a most important matter, and the author rightly deals with it at some length. As a rule, horizontal fissures for the roots of plants should be avoided, being contrary to the natural downward direction taken by these organs. The reader may obtain a good idea of what a rockery should be like from the one in the Royal Gardens, Kew, although here, curiously enough, the natural state of things has been cleverly turned upside down, without however, producing unpleasant effects. Thus on the summit of the rocks—or miniature Alps—the tallest plants are placed, while at the base the dwarf and stunted forms luxuriate. As Mr. Wocke points out, plants have a tendency to become dwarfer and more stunted in growth the higher they ascend the mountain side.

A valuable list of the best Alpine and sub-Alpine plants is given, with indications as to their native habitats, and the conditions most suitable for them under cultivation. In addition, special lists of plants adapted for particular situations are given, so that the reader may see at a glance which kinds will thrive in, say, moist or dry, warm or cool, sunny or shady positions.

The last chapter in the book is devoted to rectifying the nomenclature of certain more or less well-known plants, but that is a matter which concerns the botanist more than the gardener.

On the whole, Mr. Wocke's book, which is illustrated by twenty-two explanatory woodcuts and four photographs of rock gardens (at Newton Abbot, by the way), is a welcome addition to the literature on Alpine gardening. With one or two trifling printer's errors in the botanical names, the work bears traces of having been carefully edited.

JOHN WEATHERS.

OUR BOOK SHELF.

Commercial Cuba. A Book for Business Men. By William J. Clark. With an Introduction by E. Sherman Gould. Illustrated. Pp. xviii + 514. (London: Chapman and Hall, Ltd., 1899.)

A THOROUGHLY practical book written from the standpoint of the American trader, "Commercial Cuba" lays no claim to either literary or scientific merits. From its own point of view it would be difficult to find anything more exactly adapted to the needs of the moment. From personal experience in Cuba, Mr. Clark is able to advise his countrymen as to the necessity for adapting their ways of living and of dealing to the peculiarities of a tropical West Indian climate and a Spanish-American population of conservative habits.

In speaking of the population, the author points out that there is no danger of Cuba becoming a second Haiti, as statistics show a tendency for the negro element to increase very slowly, if not actually to die out. Practical hints as to the preservation of health in the tropics occupy one chapter, in which the hygienic virtues of coco-nut milk are strongly insisted on. Every aspect of the economic life of Cuba is touched upon in turn, and lists are given of the more important products, with hints as to those which deserve more attention than they have yet received. A detailed account of each province, with a condensed gazetteer giving information as to every town and village, conclude the work.

The report, taken as a whole, amply confirms the general belief as to the extraordinary riches of Cuba, which has continued to flourish under difficulties imposed by population and government which no less favoured land could have endured. When the oppressive laws have been repealed, the way to the waiting markets of the United States thrown open, and a flood of American capital and American enterprise directed to its ports, Cuba promises to become all that its discoverers dared to dream. Hitherto the wealth of the island has lain in the plantation products, and mainly in two crops—tobacco and sugar; but the mineral resources appear to be enormous, and are practically untouched. There exists no adequate survey of the island, either topographical or geological, and the knowledge of the native flora and fauna is still very incomplete.

Mr. Clark, in discussing the labour problem, hazards the opinion that the future working population of Cuba will be largely composed of Italian immigrants, to whom the climate, prevailing religion, and mode of life in the island will prove particularly congenial, while the language will present little difficulty. All these conditions will militate against the immigration of negroes from the Southern States, while the coloured people of the overcrowded islands of the British West Indies are considered by the author to be too poor in physique to be desirable in Cuba.

The Free Expansion of Gases: Memoirs by Gay-Lussac, Joule, and Joule and Thomson. Translated and edited by J. S. Ames, Ph.D., Professor of Physics in Johns Hopkins University. Pp. 106. (New York and London: Harper and Brothers, 1898.)

THIS forms the first of a series of handy small volumes containing reprints and translations of classical papers, relating to various branches of physics, which are to be issued under the title of "Harper's Scientific Memoirs." Messrs. Harper are to be congratulated on their enterprise in launching a venture which should at least prove of great service to students, especially to students of the comparatively advanced type. They are also to be congratulated on having secured so well qualified a general editor as Prof. Ames, who is personally responsible for the contents of this first volume. That such a series should be issued at all is a remarkable evidence of the development of physical study and research in America, for it presupposes a considerable public to whom such papers are matters of sufficient interest to induce a purchase. Each paper is accompanied by a few lines of biography, and is printed in a practically complete form, with the omission only of tabular or illustrative matter which could be spared without serious loss. A few notes, giving corrections or explanations, are added, and the volume is completed by a list of books and articles of reference. In a short preface Prof. Ames draws attention to Gay-Lussac's experiments—the account of which forms the first paper in the volume—as affording a justification of Robert Mayer's assumption that the heat developed in compressing a gas is the equivalent of the work spent, the assumption, namely, on which Mayer's estimate of the mechanical equivalent of heat was founded. But it does not appear that Gay-Lussac's work, even if Mayer was acquainted with it, supplied the *lacuna* in his reasoning, or in any way detracted from the credit due to Joule for his later settlement of the matter.

The bibliography might with advantage have included a reference to the remarkable application, which in recent years has been made by Linde, of the slight cooling effect which a gas suffers in free expansion. The small cooling effect which was discovered by Thomson and Joule, the investigation of which is described in the papers reprinted here, has sufficed in Linde's hands to enable temperatures to be reached which are only a little short of the absolute zero. Incidentally, the work of Linde and Dewar has shown that the effect in hydrogen is a cooling effect, as it is in other gases, and it is to this that the liquefaction of hydrogen by Dewar is due. J. A. E.

The New Science and Art of Arithmetic for the Use of Schools. By A Sonnenschein and H. A. Nesbitt, M.A. Pp. x + 501. (London: Swan Sonnenschein and Co., Ltd., 1899.)

A School Arithmetic. By R. F. Macdonald. Pp. viii + 264. (London: Macmillan and Co., Ltd., 1899.)

MESSRS. Sonnenschein and Nesbitt's volume is a modification of one which appeared in 1870, and has for some years occupied a foremost place among school arithmetics. A number of text-books, in which the principles as well as the practice of arithmetic are treated, are now available; but the changes made by Messrs. Sonnenschein and Nesbitt should enable their work to hold its own among them. Several chapters have been remodelled in order to render the demonstrations easier; a new chapter on the properties of fractions has been introduced; least common multiple is now connected with the Euclid, Book V., and various other additions and alterations have been made to bring the volume up to date in the methods of work described.

A knowledge of the theory of arithmetical operations is essential to the student of mathematics; but ability to accurately work examples is more valuable in ordinary life than a comprehension of the principles involved in the processes employed. The only way to acquire facility in solving problems, or quickness and accuracy in arithmetic, is by steady practice; and abundant material for exercise with these objects in view is provided in Mr. Macdonald's volume. Sufficient information as to methods of working is given to enable the pupils to understand how to apply the various rules, but no attempt has been made to explain the reasons of the processes described, the purpose of the author being to establish and extend the knowledge of pupils who have already had a training in the principles of arithmetic. The volume practically consists of exercises, most of which are in problem form, and many are of the kind met with in everyday life. For students in Schools of Science, and pupils whose arithmetical faculties have become rusty, the book should be found especially suitable.

LETTERS TO THE EDITOR.

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

The Chief of the American Nautical Almanac.

PAGE 542 of the issue of NATURE for April 6 contains an announcement that Dr. T. J. J. See has been nominated as Chief of the American Nautical Almanac Office; but as this is entirely erroneous, I venture to hope you will correct it. Prof. See has been assigned to a subordinate position in the Naval Observatory, and has nothing whatever to do with the Nautical Almanac Office. WM. HARKNESS.

Nautical Almanac Office,
U.S. Naval Observatory, Washington, April 18.

[The announcement referred to by Prof. Harkness was based upon information given in *Science*, and was corrected in the following number (p. 562) upon the authority of the same journal. —ED.].

Wehnelt Interrupter.

IN a previous communication to this journal (p. 438), I pointed out various methods of controlling the Wehnelt interrupter with a view to preventing the destruction of Crookes' tubes. Since then I have made a series of observations which confirm what was previously stated. The principle upon which the experiments were conducted was to keep all the factors constant with one exception, the amperage, voltage, results upon the fluorescent screen and photographic plate being carefully noted and registered by means of an X-ray meter. In one set of experiments the voltage was varied, in another the density of the solution, in the third the size of the platinum, in the fourth the self-induction of the primary coil. By varying any of these, or by a combination specially suited for different purposes, complete control of the Wehnelt was obtained in the way of greater or less fluorescence, actinic power, and steadiness of the screen. Briefly stated, it was found that all these effects decreased as we lowered the voltage, the self-induction of the primary, the density of the electrolyte, and the size of the platinum.

Early in these investigations, great differences between the readings across the Wehnelt and those across the terminals of the primary were observed, for the most part indicating increase in the former. An extended series of observations was made by means of Lord Kelvin's electrostatic voltmeters and ampere gauge, and a relationship between all the different factors was clearly demonstrated. Different induction coils were used, in one of which the self-induction could be altered by withdrawing the soft iron core. Briefly put, it may be said: (*a*) that there was a corresponding decrease in the readings across the Wehnelt as the voltage in the primary decreased; (*b*) different conditions, such as length of spark gap, or different vacuum in the Crookes' tube placed in the secondary circuit, affected the readings considerably; (*c*) the increased voltage across the Wehnelt seemed to depend upon the amount of self-induction in the primary. In this group of experiments, it was noted that, as the self-induction increased, the voltage increased, the amperage decreased, and the number of interruptions also decreased. A non-inductive resistance was made with a view of confirming the results, and it was used instead of the primary of the ordinary coil. In this there was, however, sufficient self-induction to work the Wehnelt under certain conditions. With this arrangement, not a single reading across the Wehnelt was higher than that of the voltage across the primary. J. MACINTYRE.

Glasgow, April 28.

Polarisation Experiment.

BY the following simple arrangement a single pile of glass plates may serve at once as polariser and analyser, and be used to study or to exhibit on a screen the interference colours with mica or crystal sections. It may not be new, but I have not seen it given anywhere. A beam of light is reflected down from a pile, polarised in the plane of reflection. Passing through a double-refracting crystal, it is resolved and then reflected by a common mirror under the crystal. On passing through the pile, which polarises by refraction in a plane at right angles to the plane of first polarisation, it shows the interference colours. Using sunlight and interposing a convex lens, we may by this simple means project the interference rings of crystal sections.

Central College, Bangalore, India. J. COOK.

Gecko Cannibalism.

A FEW days ago, on opening the stomach of a young female gecko (*Gecko monarchus*, a species which occurs fairly commonly in the compound outside our bungalow here), it was found to contain, in addition to a caterpillar and some other remains which I could not identify, a smaller gecko of the same species; this, judging from its position in the stomach, had evidently been eaten head foremost, and was quite entire.

The lengths of the two individuals were:

Larger individual	Tip of snout to cloaca, 57 mm. (tail broken off).
Smaller ditto	Tip of snout to cloaca, 32 mm.
	Tip of snout to tip of tail, 74 mm.

Günther, in his "Reptiles of British India," alludes to geckos as being known to destroy "the younger and weaker members of their own species," and he describes the individuals of *Gecko monarchus* as "pugnacious among themselves"; but the fact that an animal will prey upon another of its own species while living under completely natural conditions and with an abundant supply of its normal insect food seems worth recording. F. P. BEDFORD.

Singapore, March 23.

"Asia, the Land of Rice."

THROUGH the medium of your pages I would ask, Can any of the numerous readers of NATURE give information as to how or from what origin the name Asia came to be applied to a large portion of the earth's surface? Did it in olden times belong more especially to that district which we now term India? Was the name Asia used by any race of people to denote the land of spices and other valuables, whose products were brought by caravan across Persia and onward by way of the Red Sea?

In the last number of the *Journal* of the Polynesian Society (vol. vii. 185) an interesting paper, by Mr. S. Percy Smith, the Surveyor General for New Zealand, is published, "Hawa-iki: the whence of the Maori," in which he shows that Polynesian traditions tell that the Maori people of New Zealand originally started on their migrations through the isles of the Pacific from a large country which they name "Atia-te-varinga."

"In Madagascar, the name for rice is *vari* or *vare*; in Sunda (Java), Macassar, Kolo, Ende, rice is *pare*; in the Bima tongue it is *fare*; in Malay it is *padi* and *pari*. It is stated that the Arabs changed the original Malay *f* into *p*, so that originally the Malay name was *fari*."—"It is sufficiently clear from the above that *vari* means rice, and the Rarotongan tradition is correct, though not now understood by the people themselves."—"It would seem from this that Atia was a country in which the rice grew, and the name Atia-te-varinga may be translated Atia-the-be-riced, or where plenty of it grew."

In the word *varinga* the suffix *nga* is significant of the plural, and so we get "Atia the rice-growing land."

TAYLOR WHITE.

Wimbledon, Hawkes Bay, N.Z., February 9.

RECENT SCIENCE IN ITALY.

A BRIEF survey of recent numbers of the *Transactions* published by the Reale Accademia dei Lincei, or by the various other Italian Royal scientific academies, will amply show that the country to which we are indebted in the past for the telescope, the mariner's compass, the voltaic cell and other equally valuable inventions, is keeping well to the fore in all advancements of modern science.

In mathematics there have appeared, during the year 1898, papers by A. Brambilla on Steiner's surfaces, and on the surfaces of Veronese, also on the principal polygons of a gibbous quartic with a double point; while G. Gallucci has dealt with tetrahedra inscribed in a gibbous

cubic. Capelli has continued his researches on the reducibility of algebraic equations. Papers dealing with kinematical considerations have been published by E. Cavalli and C. Pietracola. The theory of groups forms the subject of papers by G. Bagnera and G. Fano; while the geometry of hyper-space and non-Euclidian geometry have received contributions from R. Banal, E. Bertini, L. Berzolari, L. Bianchi—Berzolari's paper being on an extension of Meunier's and Euler's theorems to hyper-spaces.

Of papers on higher geometry, we may note those of F. Enriques on the double planes of linear order $p^{(1)} = 1$, and on surfaces which possess a sheaf of rational curves; besides other papers by F. Amodeo, E. Ciani, B. Levi, M. Pieri, P. Pizzetti, and E. Veneroni. The Wronskian determinant has been treated by E. Bortolotti and P. Vivanti. A number of papers dealing with questions chiefly of analysis have appeared by U. Amaldi, P. Burgatti, E. Bortolotti, T. Cazzaniga, S. Pincherle, U. Scarpis, C. Severini, and others. A review of Italian mathematical work would not be complete without some reference to G. Vailati's historical papers, dealing chiefly with the early theories of mechanics.

Passing to astronomy, we find that P. Tacchini has continued his observations on the sunspots, protuberances and faculæ at the Roman College during the year. Observations have been contributed by E. Millosevich on the comet Perrine, on the planet DQ, 1898 (433), and on the last intrajovial planets. Contrary to the common opinion that the astronomy of the ancients was based exclusively on the geocentric hypothesis, Schiaparelli has shown that Heraclitus Ponticus, a disciple of Plato, had already adopted the theory that the sun was the centre of the orbits of the planets, while the earth remained the centre of the universe, and of the lunar and solar rotations—a system substantially that of Tycho.

A considerable number of additions to our knowledge of terrestrial physics have appeared during the year. Seismology has been well represented by G. Agamennone, who has occupied himself with determining the velocities of propagation of the earthquakes of Aidin and of Pergamos (Asia Minor) of 1895, and the earthquakes of India, of Labuan, and of Hayti of 1897; while P. Tacchini has considered the Emilia earthquake of 1898. Volcanic phenomena have been closely observed on Vesuvius by R. V. Matteucci. The year 1898 witnessed the rare appearance of flames on the volcano, which have been attributed by Semmola to jets of incandescent gas at a high temperature, unaccompanied by combustion; while Matteucci differs in thinking that these flames are due to the imprisonment of inflammable substances. The formation of a cupola of lava on Vesuvius forms the subject of another note by Matteucci. A highly promising field of research has been opened up in a paper, by the same writer, on the physics of flowing lava, dealing with the effect of artificial refrigeration on the crystallisation of the magma. The probable presence of coronium in the gases of the Solfatara and of Vesuvius is dealt with by F. Anderlini, R. Nasini and R. Salvadori. Bassani describes the formation of a small vent in the Solfatara.

F. Morano, in his experiments on the thermal conductivity of the rocks of the Campagna, has added fresh links of evidence on that debatable point, the age of the earth; while the second bone of contention betwixt mathematicians and geologists—the glacial period—forms the subject of a note by L. De Marchi, in reply to objections of Arrhenius.

G. Folgheraiter has recently continued his investigations on the secular variations of magnetic dip as revealed by the magnetisation of ancient vases. At the observatory of Capodimonte, the variations of the magnetic elements have been closely studied by F. Contarino and V. Tedeschi, the latter concluding that at the present rate of decrease, the magnetic declination would vanish in 113 years.

F. Angeletti has devoted his attention to the rectification of the terrestrial meridian, and has found for the earth's quadrant the value 10,000,855·76477 metres. On Mount Etna and its neighbourhood an important series of meteorological and gravitational observations have been carried out by A. Riccò. E. Oddone, working in the neighbourhood of Pavia, has investigated local variations of gravity, and the distribution and circulation of underground waters. Finally, a series of observations has been carried out on the steamer *Aspromonte* on the temperature and colour of the waters of the Adriatic and Ionian seas, of which A. Riccò and G. Saija have published a general *résumé*.

Passing from the physics of the earth to physics proper, a prominent place must be given to E. Villari's investigations on the Röntgen rays, referring more especially to their action in promoting the discharge of electrified bodies. Various experiments made by screening these rays off partially by the aid of tubes, all tend to the conclusion that the rays do not themselves promote the discharge, but cause it by means of the air on which they act. The diffusion of Röntgen rays and the influence of secondary rays emitted by bodies on which they fall have been considered at some length by R. Malagoli and C. Bonacini, whose views have been criticised by Murani. A. Battelli has continued his investigations on the nature of Röntgen rays by examining the analogy between these and kathodic rays. Other properties of Röntgen rays are dealt with by G. Guglielmo, A. Ròiti, A. Sandrucci and others. Several papers have appeared from the pen of that fertile physicist A. Righi, dealing, among other points, with the kinematic interpretation of Zeeman's phenomenon, and with the absorption of light in a magnetic field. The former of these subjects is also dealt with by O. M. Corbino. The properties of caoutchouc have been investigated by O. M. Corbino and F. Canizzaro, with regard to the variations of its dielectric constants due to traction; while M. Cantone has studied the traction and the accompanying phenomena of hysteresis from a mechanical point of view, applying his results to the determination of "Poisson's ratio." The velocity of Hertzian waves forms the subject of a paper by V. Boccara and A. Gandolfi, while Murani proves, contrary to the assertion of Le Royer and Van Berchem, that a coherer is not adapted to exhibit the maximum and minimum points of stationary Hertzian waves. In thermo-electricity, we have P. Straneo's papers on the temperature of a bimetallic conductor, and on the simultaneous determination of thermal and electric conductivities of metals. In electricity proper, we may refer to Grassi's calculation of the dimensions of induction in a continuous current dynamo, and his note on the work of magnetisation in an open cycle; A. Dina's application of aluminium to transform alternating into continuous currents; F. Lori's studies on the capacity of condensers; and A. Ròiti's paper on the two discharges obtainable from one condenser. Of thermodynamical interest are G. Bruni's series of papers on certain solid solutions, and on the equilibrium of amorphous mixtures, and of systems of two and three components with a liquid phase. C. Del Lungo deals with the density of liquids and saturated vapours considered as a function of the temperature.

In chemistry, a long series of quantitative and qualitative analyses have been conducted by Oglialoro, in conjunction with O. Forte and G. Cabella, on the waters of the baths of Belliazzi in the island of Ischia.

Menozzi, experimenting on the behaviour of certain organic nitrates in contact with the earth, has shown that hippuric acid is not absorbed or decomposed by the constituents of ordinary earth, though certain salts of this acid, similarly treated, undergo transformation. A.

Piutti has discovered a new test for the presence of wood in paper, namely chlorohydrate of *o*-Br-phenetidin, which tinges the woody fibres a bright yellow, while cellulose, ordinary fibres of cotton, wool, silk and linen are unaffected. A large number of other papers on certain new organic derivatives have been published in the *Rendiconto* of the Naples Academy, partly under the authorship of Piutti, working in conjunction with Piccoli, partly as the result of work done in Piutti's laboratory; while a detailed study of the crystallography of certain other new organic compounds, illustrated by diagrams, is contributed to the *Rendiconti* del Reale Istituto Lombardo by Boerio. Papers dealing with the methylation of the indols, and the bases derived from them, have been contributed to the *Atti dei Lincei* by A. Piccinini, G. Plancher and Bettinelli.

A geographical congress was held last April, in connection with the centenary celebrations of Paolo Toscanelli and Amerigo Vespucci.

In geology, mineralogy, and palæontology, a number of papers have appeared, but these are chiefly of local interest. We may, however, mention G. Gemmellaro's description of a new genus of brachiopods from the Sicilian *Fusulina* limestone; Artini's account of a meteorite which fell in the Somali peninsula; Bassani's work on the ichthyofauna of the eocene limestones of Gassino in Piedmont; and Taramelli's exposition of Schardt's theory, according to which a large extension of the Swiss pre-Alpine rocks is to be regarded as a limb of the secondary formation which at one time covered the Alps much further to the south.

Botany is represented by Delpino's description of several new instances of myrmecophilous plants furnished with extra-nuptial glands; A. de Gaspari's contribution to the biology of ferns dealing with spore dissemination, acarophily and myrmecophily; L. Buscalioni's work on the origin of vascular elements in the growing point of monocotyledonous roots, and his joint paper with R. Pirotta on plurinucleate vascular elements in Dioscoreaceæ; and B. Longo's researches on chromatolysis in vegetable nuclei, and on the affinities between the Rosaceæ and Calycanthaceæ.

A prominent place in the zoological literature furnished by Italy must be accorded to B. Grassi's researches on the relations between mosquitos and malaria, which have formed the subject of several notes in NATURE. Suffice it here to say that these researches have led Grassi, with the co-operation of G. Bastianelli, A. Bignami, and A. Dionisi to trace the further stages of the development of the malarial parasite within the body of the gnat *Anopheles claviger*, a work which must certainly result in facilitating the prevention of this dangerous disease in Italy. A series of papers on the morphology of Diplopods have been presented by F. Silvestri. The late A. Costa commenced an investigation on the reciprocal actions of certain animal toxins, based on the fact that the sting of certain Hymenoptera (*Scolia*) has the remarkable property of allaying the irritation due to a scorpion's sting. P. Pavesi chronicles the capture of a fish (*Coregonus Schinzii Helveticus*) near the mouth of the Ticino, probably carried down from Lago Maggiore. L. Maggi has made an extended study of the comparative anatomy of the skull, tracing the homology and homotopy of certain bones from the ichthyosaurus up to man.

Among physiological and histological papers, interest attaches to Albini's considerations on the nutritive value of whole-meal bread, which seem to demonstrate that this bread is inferior in nutritive matter to ordinary bread, besides having the disadvantage of containing an excessive quantity of indigestible matter formed of the harder parts of the pericarp of the grains. A. Montuori has investigated the formation of hæmobilin. Golgi has noted two remarkable peculiarities of the nerve-cell. Monti deals with the preservation of museum specimens, and with the pathology of nerve-fibres in anæmia, in embolism, in congestion, in hydræmia, in malaria, in poisoning, and in inflammation. The conversion of starch into sugar during digestion in the stomach is dealt with at some length by E. Oehl. Marenghi has studied the regeneration of nervous fibres in cut nerves; M. Jatta, the genesis of fibrin in pleural inflammation; and D. Baldi has applied the Baubigny process to discover the presence of bromine in thyroids.

Italian science has lost the following workers during the year 1898: Pacifico Barilari, engineer, for many years president of the Council of Public Works in Rome; Giuseppe Gibelli, professor of botany in the Royal University of Turin; A. Costa, the author of numerous papers on entomology dealing with Amphipoda, Hymenoptera, and especially with Italian saw-flies; Teodoro Carnel, botanist, of Florence; and Dr. Eugenio Bettoni, director of the Royal Piscicultural Station in Brescia.

A condensed review, such as the present, would not be complete without some reference to the long array of papers—many of them of the greatest interest to specialists—which want of space prevents us from enumerating individually, but which are none the less worthy of consideration.

G. H. BRYAN.

HIGHER EDUCATION IN PARIS.[1]

THE report of the Senate of the University of Paris, drawn up by Prof. Moissan, and presented to the Minister of Public Instruction in December last, gives abundant evidence of the excellent provision for higher education in Paris. It is gratifying to observe the importance attached, by State authorities in France, to the opinions held by eminent men of science on the subject of education. The record of a splendid year's work which is here brought together is proof enough, were any needed, that nothing but good can result when men distinguished in science exert their influence on Councils responsible for the administration of education.

On July 10, 1896, the new University of Paris was endowed by law with a large measure of autonomy. After the period of transition, which naturally followed the inauguration of the new University, the results of self-government have proved completely satisfactory, as the work accomplished during the school-year 1897-8 amply demonstrates. Since 1896 new chairs have been established, new courses of instruction have been formulated, new laboratories have been furnished, and the provisions for practical work have been extended in several directions. The Senate has considered many questions directly affecting their relations with the students, and has endeavoured to interest the general public in the work and development of the University. It is recognised that the University should be a national institution, and that substantial progress can only be assured by an association of effort on the part of the whole body of professors and the public.

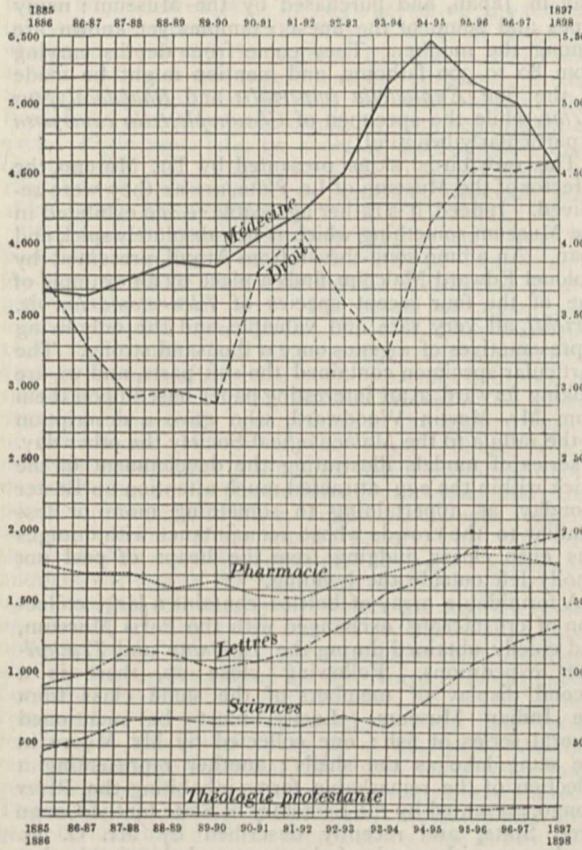
Number of Students, &c.—The following table shows the number of students in the various faculties for two years, that especially dealt with in the present report and the year immediately preceding:—

	1897-8.	1896-7.
Faculty of Protestant Theology	95	77
Faculty of Law	4607	4549
Faculty of Medicine	4495	5015
Faculty of Science	1370	1243
Faculty of Letters	1989	1904
Higher School of Pharmacy ...	1790	1845
	14,346	14,633

[1] Rapport du Conseil de l'Université de Paris. (Année Scolaire 1897-1898.)

The decrease in the number of students studying medicine is more apparent than real, the method of classifying and certain natural fluctuations being sufficient to explain it. The increase in the numbers taking law, science and literature has been steadily maintained for some years, though, as the accompanying curves show, there have been temporary unimportant diminutions.

The number of foreign students at the University during 1897–8 was 1258, of whom 110, representing eighteen nationalities, were studying science. There were 250 women students, of whom 187 were foreigners. The numbers of bachelor's diplomas awarded in the faculty of Science for the two years referred to above



Number of students in the various Faculties of the Paris University since 1885.

were 947 and 795 respectively. These included several branches, as follows :—

		1897–8.	1896–7.
Faculty of Science.	Classical (Literature—Mathematics) ...	585	444
	Modern (Literature—Sciences)	197	203
	Modern (Literature—Mathematics) ...	165	148
		947	795

It is interesting to note that fifty scholarships are offered by the State in science, out of a total number of 146 in all faculties. No science scholarships are provided either by the city authorities or by private individuals, though fifty-six, spread over the other faculties, are available from these sources.

The Doctorate of the University of Paris.—Recognising that the systems of secondary education in other countries differ from those of France, and that in consequence foreigners are not able to rapidly pass the examinations necessary for the diploma of bachelor, which have hitherto been compulsory before proceeding to the doctorate, the Council of the University of Paris has modified the regulations governing the bestowal of its doctorate as far as foreigners are concerned. As the report makes clear, the imperfect knowledge of French and French literature possessed by most of these foreign students has also been taken into account, and for the future the bachelorship will not be considered indispensable. A foreigner may, without having taken the degree of bachelor at the University of Paris, be very strong in some subject or other. Why, asks Prof. Moissan, should he be prevented from taking the doctorate? The Council wish, as they say, to open their University to every type of mind; two things only are demanded of the aspirant to the doctorate—intelligence and work. No kind of official stamp will be insisted upon. This will lead the way, the Council very properly think, to what they regard as their chief duty—the encouragement of scientific investigation. There is a large number of students at present in the science laboratories of the University itself, as well as those of the Pharmaceutical School, who are preparing theses for the new doctorate.

New Gifts to the University.—Many important gifts and bequests have been made to the University during the year.

(1) *Charles Legroux Prize.*—A donation of 10,000 francs, made by Madame Legroux, for the establishment of a quinquennial prize, to be awarded to the best work on the treatment and causes of diabetes.

(2) *Marjolin Legacy.*—The proceeds from property to be applied to paying the fees, for further terms, of French students of medicine who have been characterised for their zeal and exactness.

(3) *Mercet Donation.*—M. Émile Louis Mercet has given an annual amount of 3000 francs for six years, to be applied towards the salary of a secretary for a department of the Sorbonne.

(4) *Countess Chambrun Foundation.*—An annual gift of 5000 francs for thirty years towards the foundation of a course of study in social economics.

(5) *Anonymous Gift of* 50,000 *francs.*—This bequest was remitted to the Council by M. Lavisse. It brings an annual revenue of 2000 francs, which is to be devoted towards alleviating the needs of deserving French or foreign students.

(6) *Anonymous Gift of* 75,000 *francs for Travelling Scholarships.*—The anonymous donor proposes, if necessary, to renew this gift annually for three or four years. It is to be devoted to founding five travelling scholarships, each of the value of 15,000 francs. Two are to go to old students of the École normale supérieure, three to old students of the University. The choice of suitable students will be in the hands of the Council of the University on the report of a commission appointed by the Rector. The scholarship holders will employ some fifteen months in travelling round the world with the object of studying the social conditions, forms of government, &c., of different countries.

Of other important questions, such, for example, as an account of the work carried on in the laboratories and hospitals, the researches which have been made, and the technical applications arising therefrom, the errors rectified during the year, M. Moissan says space will permit him to say nothing. But there is more than enough in this interesting report to show that the University of Paris, with its 116 professors, to say nothing of lecturers, laboratory directors, and experimentalists, is doing a good work, and that its constitution in 1896, out of the older University of France, was fully justified. When it is borne in mind, moreover, that side by side with the instruction in science which is going on in the University, Paris possesses such large schools as the College of France, the Natural History Museum, the School of

Mines, the Normal School, the Polytechnic, the School of Fine Arts, the Pasteur Institute, the Central School and others, all engaged in a greater or less degree in imparting and advancing scientific knowledge, it will be seen that the provision for higher technical instruction in Paris is of the most satisfactory kind.

A. T. SIMMONS.

THE EXHIBITION OF RECENT ACQUISITIONS AT THE NATURAL HISTORY MUSEUM.

IT has already become recognised that collections of objects intended to be exhibited to the general public should be presented in such a way as to enable the visitor to obtain some systematised information. This one takes to be the so-called educational side of the question. Museum curators, however, although by necessity extremely conservative, are beginning to find themselves in a position not very different from that of the popular lecturer or writer of the day. Unless these have something new to offer, be it only the method, so to speak, of marketing their wares, they will fail to arrest the attention which, when once directed in the sought-for way, may never again be lost.

The curator, it must be pointed out, is in a worse plight than the others, for the lecturer's audience is a varying one, and the writer can change his public; while the museum, as one is accustomed to it, is a fixture. Again, whereas the hearing of a lecture or enjoyment of an article usually presupposes some amount of expenditure upon the part of the hearer or reader, on the other hand most museums are free; and there is a good deal of truth in the saying that what is paid for is appreciated more than that which is had for nothing.

A little living interest must always be an advantage to a museum, and there seems some likelihood that Prof. Ray Lankester's infusing of some into the natural history side of the British Museum may mark the beginning of a new era there.

Possibly the new departure may be of more direct value to the general public, who only pays for the Museum, than to the specialists who use the building; but let us consider the matter in detail.

The arched recesses opening out of the entrance hall have hitherto been assigned to the index collections. These were intended as a biological introduction to the main groups represented in detail in the galleries, but they have never been absolutely completed. Recently, indeed, some of the specimens have been taken away, possibly to reappear in a more suitable position at the head of the series they elucidate. More to the point is the fact, that their place in the last alcove but one on the right-hand side is now taken by "specimens recently acquired."

The collection which first arrests attention illustrates the remarkable molluscan fauna of Lake Tanganyika. There are three series of shells, two of which show the freshwater molluscs of the general type which inhabit the African lakes, as illustrated by representatives from Lakes Nyassa and Tanganyika. The third consists of shells from the latter piece of water, which belong to the series called halolimnic, by Mr. J. E. S. Moore, who has done so much to add to our knowledge of the Tanganyikan fauna, and who has started this month upon a second expedition to the Great Lakes of Africa. This naturalist has shown that the shells in question are almost identical with well-known Jurassic forms, and the chief interest surrounding this exhibit is that in many cases, side by side with the examples collected by Mr. Moore, are their fossil representatives. This reminds one forcibly of the arbitrary line drawn in the arrangement of the Museum between fossil and recent genera; but this by the way. As instances of the pairs of similar species might be quoted:

Tanganyika.	Jurassic.
Chytra kirkii.	*Onustus ornatissimus*, Burton Bradstock.
Bathanalia irridescens.	*Amberleya orbignyana*, near Yeovil.
Pseudomelania damoni.	*Purpurina bellona*, Bradford Abbas.
Limnotrochus thomsoni.	*Littorina dorsetensis*, near Yeovil.
Melania admirabilis.	*Cerithium subscalariforme*, Bradford Abbas.

Possibly the most striking exhibit is the collection of siliceous hexactinellid sponges dredged from Saguma Bay in Japan, and purchased by the Museum: many types and some of the finest examples yet known are among the number. They come from depths varying from 80 to 300 fathoms, and mention might be made of the fine *Euplectella imperialis* and *Rhabdocalyptus victor*, while the specimen of *Chaunoplectella cavernosa* is particularly beautiful.

The rare birds' skins presented by Dr. Moreno, the director of the Museum of La Plata, are as they were received. Indeed, it is rather agreeable to see exhibited in the Museum something which is not absolutely spick and span. An albino song-thrush from Argyll, presented by Colonel Edward Malcolm, finds a place by an example of one of the four recent species of *Pleurotomaria*, viz. *berichii*, all very rare and valuable, and the only living representatives of a genus once a thousand strong. The particular specimen contained the soft parts, and we are looking forward to an interesting paper based upon them from Mr. Martin Woodward, who gave a description of the radula to the Malacological Society the other day. A series of models illustrating the development of the chick within the egg attracted much attention on Easter Monday, as appertaining to something more or less familiar to the crowds whose acquaintance with oranges was even closer, judging from the heaps of peel not wholly left outside the building.

A formidable array of bottles contains a large collection of crustaceans exchanged with the Paris Museum, and chiefly obtained during the *Talisman* and *Travailleur* expeditions. Following close up, there is a second display of members of the same class from the Indian Museum. Lastly, must be mentioned several series of fish: one collected by Mr. Moore in the same lake as the shells; another representing a selection of the remarkable forms inhabiting the River Congo, presented by the Secretary of State for the Congo Free State, and recently described by Mr. G. A. Boulenger, with annals of the museum belonging to that republic. Many peculiarities of structure are to be met with; for instance, the curved snouts of the species belonging to the genus *Gnathonemus*, from which they take such names as *curvirostratus elephas* and *rhyncophorus*. The large teeth, too, of *Hydrocyon goliath* are most striking, fitting as they do between a pair of those in the opposite jaw, and coming to lie in deep grooves beyond their bases.

Two specimens of *Lepidosiren paradoxa*, sent by Mr. Graham Kerr from Paraguayan Chaco, complete the present list of the new exhibits.

Neglecting the actualities and possibilities of the Museum as a centre for research, it is primarily a storehouse in which everything, so far as space allows, is exhibited; a fact that enables the collector to name his specimens without unduly taking up the time of the staff. Secondly, the educational idea has been added to, but not combined with, this; while the popular interest will bear development, and it remains for the new director to work the various lines of usefulness into a well-balanced and harmonious whole.

WILFRED MARK WEBB.

SURGEON-MAJOR G. C. WALLICH, M.D.

THERE passed away in his eighty-fourth year, at Nottingham Place, Marylebone, on March 31, George Charles Wallich, L.R.C.S. Ed., Surgeon-Major on the Retired List of Her Majesty's Indian Army; and in his decease zoology has lost an honest devotee whose work has left its impress on the progress of the science. He was the eldest son of Nathaniel Wallich, F.R.S., Knight of the Royal Danish Order of Dannebrog, distinguished during the early half of the century for his work on Indian botany, he being superintendent of the Botanic Gardens, Calcutta, where G. C. Wallich was born in November 1815. He was educated at Beverley in Yorkshire, at Reading Grammar School, and at King's College, Aberdeen, and the Edinburgh University, where he graduated M.D. in 1836, becoming the following year a Licentiate of the Royal College of Surgeons of that city. In 1838 he entered the Indian Army, and served as assistant-superintending surgeon in the Sutlej Campaign, and in 1847 he went through the Punjab wars, receiving the medal in commemoration of each. Eight years later he acted as field-surgeon during the Sonthal Campaign; and, invalided home in 1857, he two years afterwards settled at Guernsey, and afterwards at Kensington.

His scientific career dates from 1844, in which year he produced a paper dealing with "Some experiments tending to prove that the venous circulation is dependent on a vital act." His period of active and most continuous investigation, however, dates from the years 1858 to 1883, and his forty-eight papers produced during that time mostly deal with important questions of structure and distribution of the Protozoa, and allied organisms especially conspicuous in the leading topics in the marine biology of the time. Those which remain were devoted to the allied consideration of questions bearing on the formation of the sedimentary deposits formed by the lower organisms in both passing and past periods of the world's history, with here and there an occasional departure into the higher groups of animals. It was in the year 1860 that Wallich started upon the line of inquiry by which his authority was established. Being recommended by Sir R. Murchison and Huxley for the post of naturalist to H.M. *Bulldog*, about to survey the ground for the North Atlantic cable between Great Britain and America, he sailed under command of Sir F. L. McClintock, R.N., in June 1860, returning to London in November of that year. As the result of this voyage, he was the first to demonstrate that ocean depths below 1000 fathoms were actually inhabited. The facts concerning temperature, pressure, and the general conditions at these depths at the time known and surmised had led to the belief that animal life was thereat impossible, and Wallich, in proving the contrary, laid the foundations of our modern deep-sea research. Working out the soundings obtained during this memorable voyage, he later published the first part of a projected book, entitled "The North Atlantic Sea Bed," by which he became famous. Although never completed, this will remain a standard work in the literature of deep-sea investigation, and a lasting testimony to its author's acumen and powers of observation. While most fascinated by the geographical and lithological aspects of his task, Wallich was by no means neglectful of the more purely biological, and of the structure and physiological manifestations of the individual organism. Contemporary of the elder Carpenter, of Allman, and others who early in the latter half of the present century essayed the pioneer's task of unravelling the mysteries of life as revealed in their essence by the unicellular organism, his contributions towards the determination of the excretory nature of the contractile vacuole, and his attempt, at a period at which our micro-chemical methods were in their infancy, to differentiate the nucleus by means of an electric discharge, will always be interesting chapters in the history of physiological inquiry. Trenchant in his literary style, prone to discussion, we find him in controversy with his contemporary workers—conspicuously as concerning his views upon the "Bathybius," which Huxley, in later years, admitted his "bogey," and the Coccospheres, upon which recent investigation has proved his views to have been largely sound. He did well in his time, and his work will endure.

While neither distinction nor special recognition were meted out to him during the active years of his life, he was in 1898 awarded the Gold Medal of the Linnean Society of London, "in recognition of his researches into the problems connected with bathybial and pelagic life." He was an Hon. Fellow of the Microscopical Society, and a Corresponding Member of the Royal Society of Liége.

NOTES.

IT is announced that, in accordance with the amended Standard Time Act, Adelaide time was advanced half an hour at midnight on Sunday.

WE learn from the *Astronomische Nachrichten* that the Fürstlich Jablonowskisebe Gesellschaft offers for 1902 a prize of 1000 marks for an essay bearing on Poincaré's investigations of Neumann's method of the arithmetic mean. The scope of the essays is defined by the society as follows:—That the investigations contained in Poincaré's work of 1896, entitled "La méthode de Neumann et le problème de Dirichlet," might be materially developed in some direction or other.

PARTICULARS concerning the work of the Belgian Antarctic Expedition have been given to the Brussels Geographical Society by Lieut. Gerlache, commander of the expedition. The *Times* gives the following summary of Lieut. Gerlache's report: The expedition left St. John's Bay on January 14, 1898, and on the 21st explored the South Shetland Islands. On January 15, in 55° 5′ south latitude and 65° 19′ west longitude, soundings to the depth of 4040 metres were taken. The *Belgica* left on the 23rd for Hughes Bay, discovering a strait separating the lands of the east from an unknown archipelago. The land to the east was named Danco Land. Magnetic observations were made and interesting botanical, geological, and photographic results were obtained. On February 13 the *Belgica* went in the direction of Alexander I. Land, exploring the belt of bank ice towards the west. On March 10 the ship became fast in the ice in latitude 71° 34′, longitude 89° 10′. The sun disappeared on May 17, and there was continual night until July 21. M. Danco died on June 5, and his remains were deposited in a tomb of ice. The *Belgica*, after leaving her winter quarters, again became fast in the ice in 103° west longitude. She reached open water on March 14. The expedition made successful magnetic and meteorological observations, and obtained collections of pelagic and deep-sea fauna and samples of submarine sediments. On February 26 Black Island was explored, and on the following day the *Belgica* entered the Cockburn Channel, arriving at Punta Arenas, in Patagonia, on March 28.

AT the annual meeting of the members of the Royal Institution held on Monday, the Duke of Northumberland, President, presiding, it was announced that next month the Institution will complete one hundred years of its existence, the first meeting of its members in the building in Albemarle Street having been held on June 5, 1799. The managers have decided that this event, so interesting and memorable in the life of the Institution and in the history of science in this country, shall be duly celebrated.

They have, therefore, arranged for the delivery of two Commemoration Lectures. The first of these lectures will be delivered at three o'clock on Tuesday, June 6, by Lord Rayleigh, when His Royal Highness the Prince of Wales, Vice-Patron of the Institution, will preside and receive the honorary members; the second of these lectures will be delivered at nine o'clock on Wednesday evening, June 7, by Prof. Dewar, when His Grace the Duke of Northumberland, President of the Institution, will preside. It was further announced that the Lord Mayor has consented to give a reception to the members, foreign guests, and representative men, at the Mansion House, on the evening of Tuesday, June 6.

IN a brief reference to the recent scientific work of the Royal Institution, Prof. Dewar announced on Monday that having obtained liquid hydrogen in considerable quantity, he has directly determined its temperature and other physical constants, finding its boiling point to be much lower than was previously supposed, namely 20° above the zero of absolute temperature, and attaining by exhaustion a temperature of only 15° absolute. Pending the discovery in quantity of some yet lighter gas, there are no means within sight of bridging this gap and reaching the zero point. Prof. Dewar also took occasion to give a warning against the exaggerated accounts of the properties of liquid air, which, originating in America, have found their way into popular magazines in this country.

THE Trustees of the National Portrait Gallery have received, under the will of the late Colonel John Barrow, F.R.S., formerly of the Admiralty, a bequest of a series of portraits, painted for Colonel Barrow by Mr. Stephen Pearce, relating to the various expeditions in search of Sir John Franklin. The portraits comprise a large portrait-group representing "The Arctic Council" "discussing a plan of search for Sir John Franklin"; four large half-length portraits, representing Sir Robert McClure, Sir Leopold McClintock, Captain Penny, and Sir George Nares, each in the dress worn by him in the Arctic regions; fifteen small portraits of Sir Richard Collinson, Sir Henry Kellett, Sir Edward Belcher, Sir Edward Inglefield, Dr. John Rae, Captain Rochfort-Maguire, Captain J. E. Moore, Dr. Robert McCormick, Lieut. J. Stewart, Lieut. Bellot, Sir Horatio T. Austin, Admiral Sherard Osborn, Dr. William Kennedy, Sir Leopold McClintock, and Sir Erasmus Ommanney.

THE Report of the Council of the Zoological Society, read at the seventieth anniversary meeting held on Friday last, stated that the number of Fellows on December 31, 1898, was 3185, showing an increase of twenty-seven during the past year, and that the number of Fellows on the roll of the Society was in excess of what it had been in any year since 1885. The principal new buildings erected in the Society's Gardens in 1898 were the Fellows' tea pavilion, the new llama-house, and the new zebra-house, all of which are well adapted to the purpose for which they were intended. The number of visitors to the Gardens was 710,948. The number of animals living in the Gardens at the end of the year was 2656, of which 818 were mammals, 1363 birds, and 475 reptiles and batrachians. Dr. John Anderson, F.R.S., Mr. W. E. de Winton, Dr. Charles H. Gatty, Sir Hugh Low, G.C.M.G., and Dr. Henry Woodward, F.R.S., were elected into the Council in the place of the retiring members, and his Grace the Duke of Bedford and Mr. Edward N. Buxton, elected into the Council since the last anniversary, were re-elected; also Sir William H. Flower, K.C.B., F.R.S., was re-elected President, Mr. Charles Drummond, Treasurer, and Dr. P. L. Sclater, F.R.S., as Secretary.

AT the annual general meeting of the Institution of Civil Engineers, held on April 26, Mr. W. H. Preece, C.B., President, in the chair, the result of the ballot for the election of officers was declared as follows:—President, Sir Douglas Fox; vice-presidents, Mr. James Mansergh, Sir William White, K.C.B., Mr. Charles Hawksley, and Mr. John Clarke Hawkshaw; other members of Council, Mr. James Barton (Dundalk), Mr. Horace Bell, Sir Alexander Binnie, Dr. Henry Taylor Bovey, Mr. T. Forster Brown, Mr. W. R. Galbraith, Mr. George Graham, Mr. G. H. Hill, Mr. J. C. Inglis, Mr. Alexander Izat, Dr. Alex. B. W. Kennedy, F.R.S., Sir James Kitson, Bart., Mr. Anthony George Lyster, Mr. John Allen McDonald, Mr. E. Pritchard Martin, Mr. William Matthews, Sir Guilford Molesworth, K.C.I.E., Sir Andrew Noble, K.C.B., Mr. Alexander Siemens, Mr. Thomas Stewart, Mr. John I. Thornycroft, F.R.S., Mr. William Thwaites, Mr. F. W. Webb, and Sir E. Leader Williams.

THE Royal College of Surgeons of England has unsuccessfully appealed against the decision of the Court of Queen's Bench upon the subject of its liability to property duty in respect of part of the property held by it for the public objects of the institution. A strong protest is made against this result in the *Lancet*. It is pointed out that the College is a body incorporated by Royal Charter, the object being the "benefit of the common weal of this kingdom by the promotion of the art and science of surgery and the due promotion and encouragement of the study and practice of the said art and science of surgery." To the attainment of this object all its funds are legally appropriated and actually applied; nevertheless, the courts have decided to exclude the College from the benefits of an exception created by the Act of Parliament in favour of "any property legally appropriated and applied for . . . the promotion of science." The decision distinguishes between the museum and the library in Lincoln's Inn, and while it protects the museum as being devoted to the promotion of the science of surgery, the library is regarded as for the private convenience or advantage of the members of the College. The *Lancet* points out that eight or nine years ago the question arose as to whether the Institution of Civil Engineers was, in circumstances almost precisely parallel to those of the Royal College of Surgeons at the present day, liable to the same duty. Fortunately for that institution, the House of Lords held that applied science, no less than the pure sciences, fell within the meaning of the Act, and sustained the claim to exemption in spite of the professional eminence and social success of its members. The Royal College of Surgeons is less fortunate in its present situation.

THE death is announced of Dr. C. Brongniart, Paris, distinguished by his entomological works, and more especially by his memoir on fossil insects of the Primary period.

ACCORDING to a despatch from St. Louis a very destructive cyclone swept over Kirksville, Missouri, on Thursday last. The storm broke about 6.30 p.m. with great fury, sweeping a path a quarter of a mile broad through the eastern portion of the town, four hundred buildings being demolished. Heavy rain followed, accompanied by intense darkness.

DR. LUDWIG BÜCHNER, of Darmstadt, the author of "Kraft und Stoff" (1855), a work which did much to popularise scientific materialism in Germany, died on Monday, at seventy-five years of age. Dr. Büchner was one of the most meritorious popularisers of natural science in Germany, and greatly assisted in diffusing a knowledge of the Darwinian theories in the Fatherland.

THE death is announced of Mr. Charles Leeson Prince, of Crowborough, Sussex, whose meteorological work has on several occasions been referred to in these columns. Mr. Prince was a member of the Royal College of Surgeons, and a licentiate of the Society of Apothecaries. For many years

he had taken great interest in all questions relating to meteorology. He was a Fellow of the Royal Astronomical and of the Meteorological Societies, and a member of the Scottish Meteorological Society, and the author of several papers on the meteorology of Uckfield and Crowborough Hill.

MR. AKERS-DOUGLAS, M.P., the First Commissioner of Works, speaking at Whitstable-on-Sea on Thursday last, referred to the favourable reports by the medical inspectors on the Whitstable oyster beds, and said that the promised legislation has not been forgotten. The President of the Local Government Board, with a desire to set at rest the fears regarding the eating of oysters, and to protect a *bona-fide* industry, is about to introduce a measure providing for the inspection of oyster layings, prohibiting removal from insanitary grounds, and regulating the importation of foreign oysters from suspected districts.

REUTER reports that the President of the Geographical Society at Christiania has received a letter from M. Borchgrevink, dated Cape Adair, Victoria Land, February 28, in which he says:—"I have now landed on the great Australian continent with staff, instruments, and seventy-five dogs. The greatest discipline has prevailed throughout."

FROM the current number of the U.S. *Monthly Weather Review* (for December last) we learn that the important decision has been taken of correcting all the published barometrical values for gravity from January 1, 1899. This change has been found necessary owing to the recent extensions of the Weather Bureau in the West Indies and along the South American coast. The reduction to standard temperature has been practised for the last sixty years, but the reduction to standard gravity has been applied only in special cases; and although the amount of the correction is now usually stated at the head of meteorological tables in the same way as the latitude and longitude and height above sea-level, the general application of the correction to the individual readings has been delayed until a concert of action among all nations could be arrived at. Its importance, however, has been recognised by various meteorological conferences. In the latitude of London the correction to standard gravity of latitude 45° amounts to about +·02 inch.

THE Report of the Kew Observatory Committee of the Royal Society has been published for the year 1898. In the section referring to terrestrial magnetism, it is stated that two magnetic storms, or periods of considerable disturbance of the needles were registered, viz. on March 14-15 and on September 9-10. The first storm was the largest recorded since August 1894, and both were presumably associated with the aurora simultaneously seen in the British Isles. One of Prof. J. Milne's seismographs, intended to measure the tilting of the ground along an east-west line, was erected in the early part of the year. The largest tremors were recorded on June 29, August 31, and November 17. Among the experimental work carried on during the year may be specially mentioned that relating to atmospheric electricity, aneroid barometers, and platinum and mercurial thermometry. The verification of instruments of various kinds has steadily increased, the number tested during the year exceeding 24,000. Although the number of watches sent for trial was less than in the previous year, the high standard referred to in previous reports has been maintained. During the year, various schemes have been promoted in connection with electric tramways in the neighbourhood of the observatory. The Committee state that whilst everything has been done, as far as can be foreseen, to protect the magnetographs, it is impossible to contemplate the future without some misgivings. The proposed establishment of a National Physical Laboratory will, in all probability, greatly extend the usefulness of the Kew Observatory; the arrangements were not completed before the close of the year 1898.

THE members of the German Deep Sea Expedition arrived in Hamburg on Saturday, on board the *Valdivia*, after nine months' absence. They were welcomed (the *Times* reports) by the Imperial Secretary of State for the Interior, Count von Posadowsky, the Saxon Minister of Education, Baron von Seydewitz, Prof. Drygalski, who will be the leader of the German Antarctic expedition, and a large number of the representatives of the scientific world. At a banquet given in the dining-hall of the offices of the Hamburg-American Line, Count Posadowsky welcomed the members of the expedition in a speech in which he referred to the interest manifested by the Emperor in the expedition and in all seafaring projects. This was not due solely to his Majesty's personal inclinations, but resulted from his profound recognition of the importance of these subjects for the future of Germany. A telegram was read in which the Emperor expressed his satisfaction at the success of the expedition.

DR. R. H. SCOTT, F.R.S., gives in the *Quarterly Journal of the Royal Meteorological Society*, dated January 1899 and just issued, a translation of the important paper on the diurnal oscillation of the barometer, contributed by Dr. Julius Hann to the *Meteorologische Zeitschrift* for October 1898. Meteorologists unfamiliar with the German language will be glad to have this English version of Dr. Hann's contribution to the theory of the daily barometric oscillations.

AS an indication of the character of the season, Mr. W. Baylor Hartland, writing from Cork, says his son saw swallows on Wednesday last, April 26, at Ard-Cairn. On Thursday he himself saw a pair of corncrakes nestling among some daffodil beds. Mr. Hartland adds: "If this had occurred in a field of rye, wheat, rye-grass, or vetches, I should not have noticed it. But for the birds to nestle within the foliage of broad plantations of daffodils, planted for commercial purposes in Ireland, never before happened in the Green Isle. I have grown them for eighteen years, but the foliage this year is so luxuriant, I suppose the birds were attracted by its shelter."

A PARLIAMENTARY Return just issued shows that between the date of the passing of the Vaccination Act on August 12 and December 31, 1898, the number of certificates of conscientious objection received by the vaccination officers was 203,413, and that the number of children to whom such certificates related was 230,147.

IT is stated by the *Allgemeine Militär-Zeitung* that the aluminium steerable balloon invented by Count Zeppelin will very probably make its first ascent at the beginning of July. The ascent will take place above Lake Constance. In order that the balloon may rise clear of trees and buildings, a platform has been built in the lake on pontoons, at about 700 metres from the shore, where the apparatus for raising the balloon will be placed.

IN a paper on the treatment of refractory silver ores by lixiviation, read by Mr. Breakell at a recent meeting of the Institution of Mining Engineers, some results are given which bear strong testimony to the value of Russell's modification of the hyposulphite process. Experiments are described proving that the presence of only 0·2 per cent. of copper increases the volatilisation loss of silver in chloridising roasting. In one case the loss was raised from 0·5 to 3·6 ounces of silver per ton by the addition of this amount of copper. On the other hand, metallic silver and sulphide of silver, which are always present, especially in badly roasted charges, are readily dissolved

by hyposulphite solutions containing copper, though not rapidly acted on in its absence. It follows that the presence of copper should be avoided in the furnace charge, and that it may be added with advantage in the later stages of the process.

THE old view that insects, with all the lower animals, were created for man's benefit cannot reasonably be held at the present time, but it must, nevertheless, not be forgotten that there are very many beneficial as well as injurious insects. Dr. L. O. Howard has recently summed up the good and bad qualities of insects so far as it is possible to do, and he finds that the insects of 116 families are beneficial, and the insects of 113 families are injurious, while those of 71 families are both beneficial and harmful or their functions have not been determined. The injurious insects are made up of 112 families which feed upon cultivated or useful plants, and one family the members of which are parasitic upon warm-blooded animals. Of the beneficial insects, those of 79 families are valuable as preying upon other insects, 32 families are of service as scavengers, two families as pollenisers, and three families as forming food for food fishes.

PROF. F. E. SCHULZE, of Berlin, the general editor of the important new German work, "Das Tierreich," which is in course of publication by Messrs. R. Friedländer and Son, has obtained the services of Prof. Kretschmer, of Marburg, for the preparation of a series of rules for the formation and pronunciation of zoological and botanical names upon classical and orthodox principles. These rules seem to be excellent in every way, and will, we trust, be strictly followed by the numerous contributors to "Das Tierreich." In America, we regret to say, a small school of zoologists has arisen who prefer to spell and pronounce names *in*correctly, following literally the mistakes often made by their original propounders. This pestilent heresy has, we are glad to say, not met with much support in Europe, and we hope that Prof. Kretschmer's rules will assist in suppressing it.

IN the "Report of the Entomological Department of the New Jersey Agricultural College Experiment Station for the year 1898," Dr. John B. Smith calls attention to the interesting and perhaps important fact that the San José scale now begins breeding later than when it first came under his observation, and that the rate of increase before midsummer is materially less than in the past, the period of greatest increase being now in September. It is evident that the introduced pest is endeavouring to accommodate itself to its new surroundings, and it will be interesting to see whether it succeeds or fails. If it fails, its automatic extinction will be a mere matter of time, though it is quite possible that it may be capable of producing a great amount of harm before that time arrives.

A RECENT number of the *Cape Agricultural Journal* contains a report of an address given by Dr. Edington on the artificial use of a particular fungus, said to be parasitic to locusts, for the destruction of the latter. The results so far obtained with the fungus in question appear to be at considerable variance, some farmers stating that they have derived great benefit from its application, whilst others assert as positively that it has been of no use whatever. A great deal must of necessity depend upon the circumstances in which this, together with other such similar living-destroying agencies, are employed, and Dr. Edington, in the course of his lecture, pointed out what he considered the best methods for promoting the successful use of this fungus. If locusts can be destroyed in so simple a manner as this is described to be, the gain to the Cape farmers will be enormous, and at any rate means should be adopted so that its use may become more widely known, and more extensive trials given to it. The use of fungi for the destruction of pests is being tried in America, where the white muscardine fungus, *Sporotrichum globuliferum*, has been largely employed during the last few years to check the injurious over-production of the chinch-bug. Mr. Benjamin Duggar, of the Cornell Agricultural Experiment Station, has, however, been recently making a careful study of this organism in relation to the insect in question, and has come to the conclusion that, although it is undoubtedly parasitic at times, it is not sufficiently efficient to enable it to be artificially employed with economic success. It is obvious that to obtain trustworthy data on this subject, many and very carefully conducted investigations must be carried out. It is to be hoped that Dr. Edington will be able to give the locust-problem the time and attention which it requires to enable scientific conclusions to be drawn as to the economic value of the fungus he recommends in destroying locusts.

THE current number of the *Journal of the Sanitary Institute* continues the reports of papers read at the congress held in Birmingham last year. Amongst them we note a useful little address given by Dr. Mary D. Sturge in the Section devoted to domestic hygiene, entitled "The Claims of Childhood." Whilst emphasising the responsibilities of parents towards their offspring, the writer also points out the necessity of our following the example of France in getting legislative measures directed towards checking the growing use of tobacco amongst young boys. In Norway only last year, it appears, stringent laws were passed forbidding the sale of tobacco to lads under sixteen, and prohibiting their smoking in the streets. Although the municipal authorities in most of our large crowded cities are alive to the duty of modifying as far as possible the unfavourable conditions under which children are of necessity reared, yet much remains still to be done. Dr. Sturge, amongst other matters, calls attention to the smoke-nuisance, and indulges in the hope that some day legislative steps will be taken whereby it will be controlled, and incidentally tells us that in the Tudor period a law existed ordering Londoners to burn nothing but wood during the time that Parliament was sitting, in order that the health of the country squires who came to town might not be impaired!

MR. WILLIAM H. DALL has prepared a useful table of the North American Tertiary horizons, correlated with one another and with those of Western Europe (Eighteenth Annual Report of the U.S. Geological Survey, 1898).

THE geology of the eastern part of Texas, with reference to the artesian wells, forms the subject of an essay by Mr. Robert T. Hill and Mr. T. Wayland Vaughan (Eighteenth Annual Report of the U.S. Geological Survey).

MM. E. PIETTE and J. de la Porterie describe some prehistoric remains from excavations at Brassempouy, south-east of Dax, Department of Landes. Drawings on bones and various finely-worked implements are figured (*L'Anthropologie*, Paris, tome ix.).

THE Triassic formation of Connecticut is very fully discussed by Prof. William M. Davis (Eighteenth Annual Report of the U.S. Geological Survey). He treats the subject from three points of view—deposition, deformation, and denudation. The formation comprises a great series of sandstones and shales, with local conglomerates; and it includes in the central division great sheets and dykes of volcanic rock. In mass the formation is of "continental" as opposed to marine origin.

THE origin of peneplains is discussed by Prof. W. M. Davis in an article in the *American Geologist* for April. The article is in the main a reply to criticisms by Prof. Tarr. It is maintained that the prolonged results of both marine abrasion and subaërial denudation tend to reduce the land to a base-level (or peneplain)—a nearly featureless plain, a little below or a little above sea-level. It is admitted, with regard to ancient plains of

denudation, that in many instances there seems to be no way of determining how much work was done by the sea, and how much had been previously done by rivers, rain, and similar agencies.

"THE Alkali Soils of the Yellowstone Valley" forms the subject of an essay by Messrs. M. Whitney and T. H. Means (U.S. Department of Agriculture, *Bulletin* No. 14, 1898). In the Western States of America, any excessive accumulation of soluble mineral salts in the soil is popularly spoken of as "alkali." These salts include sodium carbonate, sulphate and chloride, magnesium sulphate and chloride, and occasionally some of the borates. They may be traced to the sandstones, shales, and slaty rocks from which the soils have been derived. Before irrigation was introduced, the salts were present in rather large amounts, but they were well distributed throughout the soil, and not in such large quantities as to be injurious to crops. The injury is due entirely to over-irrigation, and may, in the authors' opinion, be easily remedied.

WE learn from the *Botanical Gazette* that the University of Texas has established a distinct department of botany, which will begin its separate existence with the next college year. The new department will be placed under the charge of Dr. W. L. Bray.

MR. F. J. HANBURY and Rev. E. S. Marshall announce for early publication their long-promised "Flora of Kent," which has been twenty years in preparation. From its variety of soil, its geographical position, and its extended sea and river coast, this will be one of the most interesting and richest county floras of England. There will be two maps, one showing the divisions of the county, and the other coloured geologically; and in the introduction, devoted to the topography of the county, there will be sections assigned to geology and meteorology.

THE study of natural history has been greatly stimulated in this country by the meetings, the excursions, and the publications of local societies. We have before us the *Irish Naturalist* for April, with a paper on the botany of the Great Central Plain of Ireland, by Mr. R. Ll. Praeger, and the conclusion of one on the Brachiopoda and Mollusca of the carboniferous rocks of Ireland, by Dr. A. H. Foord; also the *Halifax Naturalist* for April, containing a paper on the crocus leaf, by Mr. C. E. Mass, and one on the Halifax fish fauna, by Mr. E. D. Wellburn, as well as an instalment of Mr. W. B. Crump's flora of Halifax.

AMONG the more interesting articles in the *Journal of the Royal Horticultural Society* for April is an account of a visit to Naina Tal, Kumaon, the summer residence of the Lieut.-Governor of the North-West Provinces of India; and one on the Botanical Garden at Padua, founded in 1545, and said to be the oldest in the world. It contains some trees of remarkable antiquity, one of *Vitex agnus-castus*, 349, one of *Chamaerops humilis*, 314, and one of *Platanus orientalis*, 219 years old; besides a number that have more than completed the century. Several of these are figured. There is a specimen of *Salisburia adiantifolia*, 148 years old, in which grafts from the female have been inserted on the original male plant, so that it produces both male and female flowers.

MR. BERNARD QUARITCH has published a catalogue containing descriptions of 1781 works of geography, voyages, travels, history of America, Africa, Australasia and Asia, and of books on the languages of America, Africa, and Oceanica, offered for sale by him.

THE fourteenth part of Mr. Oswin A. J. Lee's "Among British Birds in their Nesting Haunts" (Edinburgh: David Douglas) contains ten magnificent plates illustrating the nests of the turtle-dove, barn owl, reed warbler, tree sparrow, stone curlew, partridge, tufted duck, jay, and kingfisher.

FOUR different kinds of species are considered by Mr. O. F. Cook in the *American Naturalist*; they are enumerated as follows: (1) The phylogenetic species, a division or section of a line of biological succession; (2) the insular or segregated species, the living end of a line of the preceding category; (3) the incipient species, preferably known as a sub-species; (4) the artificial species, the result of man's interference in nature. Mr. Cook considers that the designation "species" should be reserved for its original use with the second of these categories, and the use of the popular designation "variety" should be restricted to the fourth. He criticises classification according to "amount of difference," and points out that with this as the only criterion, "fossils, geographic races, and artificially produced varieties are being catalogued miscellaneously and indiscriminately as species."

IN a note communicated to the *Atti dei Lincei*, viii. 5, Dr. A. Pochettino describes the results of certain observations made with acoustic resonators with a view of determining in what manner the modulus of decay is affected: (1) by varying the shape of the aperture, keeping its area constant; (2) by furnishing the aperture with flanges of various sizes; (3) by varying the distance between the resonator and the excitor. Dr. Pochettino finds that by increasing the diameter of the flange the modulus of decay diminishes; or, in the first place, the resonator becomes more capable of reinforcing vibrations of its own period, and at the same time becomes less sensitive to vibrations slightly differing in period, in the second place, the vibrations, when once excited, last longer. The modulus of decay also decreases when the distance between the excitor and resonator is increased. In experimenting with elliptic and circular apertures, the moduli of decay were found to be very nearly equal.

THE second volume of the second edition of Prof. H. Weber's masterly "Lehrbuch der Algebra" has just been published by Messrs. F. Vieweg and Son, Brunswick. The two original volumes have already been reviewed in detail in NATURE (vol. lv. pp. 25 and 481, 1897), so it is unnecessary to do more than announce the completion of the second edition of this standard treatise.—The third edition of "Premiers principes d'Electricité industrielle," by M. Paul Janet, has been published by Messrs. Gauthier-Villars, Paris. The original work contained the substance of lectures delivered in Grenoble in 1892, under the auspices of the municipality of that city. So many advances have taken place in applied electricity since the lectures were given that a number of alterations and additions have been necessary in order to bring the volume up to date.—Mr. William Schooling has revised and extended "Inwood's Tables of Interest and Mortality, for the Purchasing of Estates and Valuation of Properties," and Messrs. Crosby Lockwood and Son have just published the new edition (the twenty-fifth) containing extensive additions made by him. The whole work appears to have been very carefully revised, and it now forms an instructive as well as serviceable collection of tables. A table of logarithms of natural numbers has been introduced, and also M. Fédor Thoman's logarithmic tables of compound interest and annuities. From the point of view of practical mathematics, the new edition of "Inwood" is distinctly in advance of the former issues.

THE additions to the Zoological Society's Gardens during the past week include a Feline Dourocouli (*Nyctipithecus vociferans*) from South Brazil, presented by Mrs. Firman; a Common Raccoon (*Procyon lotor*) from North America, a Pine Marten (*Mustela martes*), British, presented by Master Eric Mellin; an Indian Pigmy Goose (*Nettopus coromandelianus*, ♂) from India, presented by H.G. the Duke of Bedford; three Ostriches (*Struthio camelus*, 3 ♀) from Lagos, presented by Mr. G. F. Abadie; a Macqueen's Bustard (*Houbara macqueeni*) from

Western Asia, presented by Mr. B. T. Ffinch; two Double-banded Sand-Grouse (*Pterocles bicinctus*) from Senegal, a Lesser Pin-tailed Sand-Grouse (*Pterocles exustus*) from North Africa, presented by Mr. W. H. St. Quintin; a King Parrakeet (*Aprosmictus cyanopygius*) from Australia, presented by Mr. C. D. Chambers; a Delalande's Gecko (*Tarentola delalandii*) from West Africa, presented by Miss Shenton; a Rhesus Monkey (*Macacus rhesus*, ♂) from India, a Great Kangaroo (*Macropus giganteus*, ♂) from Australia, a Salvadori's Cassowary (*Casuarius salvadorii*), a Blue-necked Cassowary (*Casuarius intensus*) from New Guinea, a Beccari's Cassowary (*Casuarius beccarii*) from South-eastern New Guinea, five Oblong Chelodines (*Chelodina oblonga*) from Australia, a Derbian Sternothere (*Sternothaerus derbianus*) from West Africa, a Blackish Sternothere (*Sternothaerus nigricans*) from Madagascar, two Black-necked Swans (*Cygnus nigricollis*) from Antarctic America, deposited.

OUR ASTRONOMICAL COLUMN.

COMET 1899*a* (SWIFT).—This comet having now passed considerably to the west of the sun, it is possible that it may be observed in the eastern sky before sunrise. The following ephemeris is given by Herr H. Kreutz in *Astr. Nach.* (Bd. 149, No. 3556):—

Ephemeris for 12*h. Berlin Mean Time.*

1899.	R.A. h. m. s.	Decl. ° ′	Br.
May 4 ...	23 57 45 ...	+25 17·9 ...	1·74
5 ...	53 54 ...	26 17·3	1·69
6 ...	49 53 ...	27 19·3	
7 ...	45 41 ...	28 24·0 ...	1·67
8 ...	41 17 ...	29 31·5	
9 ...	36 40 ...	30 42·0 ...	1·66
10 ...	31 45 ...	31 55·7	
11 ...	26 28 ...	+33 12·7 ...	1·66

During the week it moves in a north-westerly direction from between Ψ Pegasi and α Andromeda, and is now rapidly decreasing in brightness as it recedes from the sun.

TEMPEL'S COMET (1873 II.).—The following ephemeris is given by M. L. Schulhof in *Ast. Nach.* (Bd. 149, No. 3554):—

Ephemeris for 12*h. Paris Mean Time.*

1899.	R.A. h. m. s.	Decl. ° ′ ″	Br.
May 4 ...	18 48 57·0 ...	− 4 42 8 ...	0·460
5 ...	50 39·5 ...	4 37 57	
6 ...	52 21·5 ...	4 33 51	
7 ...	54 3·2 ...	4 29 51	
8 ...	55 44·5 ...	4 25 58 ...	0·521
9 ...	57 25·5 ...	4 22 13	
10 ...	18 59 6·0 ...	4 18 33	
11 ...	19 0 46·1 ...	− 4 15 3	

During the week the comet moves slowly north-eastwards through the northern portions of Scutum Sobieski, and should be looked for in the early morning.

SECOND WASHINGTON STAR CATALOGUE.—Appendix I. to the Washington Observations of 1892 has recently been issued, and is devoted to the publication of the catalogue of standard stars which has been compiled from the work done with the transit circle of the U.S. Naval Observatory during the last thirty years. The instrument was made by Pistor and Martins, of Berlin, and was used almost continually from January 1866 to June 1891, being successively under the charge of Profs. Newcomb, Hall, Harkness, and Eastman. Prof. J. R. Eastman, who had the direction of it from 1874 to 1891, has had almost entire charge of the catalogue, and it is therefore issued in his name. Of the 72,914 observations embodied in the book, 17,334 were made by him personally and 39,867 under his immediate supervision.

The first half of the volume is occupied by descriptions of the apparatus and methods of reduction of the observations. Next come the tables of annual results; then a catalogue of stars employed in the American Ephemeris. The general catalogue, with which the book concludes, gives data for 5151 stars, all for the epoch 1875·0.

SPECTRA OF STARS OF CLASS III. *b*.—Prof. W. C. Dunér, of the Upsala Observatory, has been revising his survey of the red stars by means of the new Steinheil refractor, erected there in 1893. This has a visual objective of 36 cm. aperture, and a photographic objective of 33 cm. aperture. All the spectroscopic observations have been made with ocular spectroscopes of the Zöllner type, with dispersions varying from 3°·5 to 10° from C to G (*Astrophysical Journal*, vol. ix. p. 119, 1899).

In most cases, the previous results were confirmed, but in several of the brighter stars of this class he has found additional features. In all the brighter stars the band 5 (λ 576) is seen to be double, while near to the less refrangible edge of band 6 (λ 5636) a bright band is seen. Additional confirmation of the reality of these details is provided by the photograph of the spectrum of 132 Schjellerup in the *Astrophysical Journal*, vol. viii., which clearly shows a bright line at λ 5595. Variations in the relative intensities of the bands are common, notably in the case of bands 6 (λ 5636) and 4 (λ 586). In 152 Schj., the brightest of this class of stars, band 6 and 9 are very bright, while band 4 is quite faint. In 280 Schj. band 4 is the strongest in the spectrum, while band 6 is scarcely visible. Prof. Dunér thinks that, by a closer attention to these variations, a classification of these red stars would be rendered possible.

LEAD COMPOUNDS IN POTTERY GLAZES.[1]

IT has been known for some months that Prof. T. E. Thorpe, F.R.S., and Prof. T. Oliver, had been commissioned by the Home Secretary to investigate the use of lead compounds in the production of pottery glazes and colours, and to suggest means which might be adopted to counteract the evils admitted, on all hands, to follow from their use. It had been found considerably easier by those who had drawn public attention to these evils even to exaggerate them, grave as they were, than to devise remedies which had any chance of practical adoption at the hands of the trade. The scientific eminence of Profs. Thorpe and Oliver, and their practical acquaintance with the details of many manufacturing processes, warranted the opinion that the choice of the Home Office was a wise one. The appearance of their report marks a very welcome stage in the treatment of this troublesome and intricate question. There exists in this country a pottery industry of considerable dimensions, producing pottery wares of infinite variety, and supplying, not merely the demands of our own country, but possessing, probably, a larger export trade than that of any similar industry in the world. This industry has been built up on the practical experience of generations of workers in the same business. The methods in use may appear, in many cases, to be the reverse of scientific; but, at all events, they have sufficed for the production of pottery of excellent make and finish, at a price which enables our potters still to hold their own, in spite of the efforts of their foreign rivals to copy their methods, their shapes, and their designs. It is idle for any one to deny the fact that, for pottery such as forms the bulk of our productions, glazes containing lead compounds are the simplest and the most trustworthy, and best fulfil all the requirements of a difficult and complicated manufacture. It is admitted, however, that lead compounds, used in the form and proportions common in English practice, may, and often do, cause serious illness and suffering—amounting in extreme cases to blindness, paralysis, and death—to those employed in certain of the processes of pottery production. Regulations have been framed from time to time by the Home Office, designed to minimise these evils. The latest proposals of this kind, which came into force only at the end of last year, deal with the removal of dust from work-rooms; the provision of means by which dust containing lead compounds shall be kept from the face of the worker; the provision of overalls and head coverings, as well as adequate and convenient washing accommodation for all workers who come in contact with lead compounds; and last, but by no means least, provide for a compulsory monthly medical examination of all women and young persons employed in certain specified occupations. These regulations, which are set out in full on pp. 43–45 of the report, are in startling contrast with the official regulations in force in foreign countries. While foreign Governments have for the most part either made

[1] Report to Her Majesty's principal Secretary of State for the Home Department on the employment of Compounds of Lead in the Manufacture of Pottery. By Prof. T. E. Thorpe, LL.D., F.R.S., and Prof. Thomas Oliver, M.D., F.R.C.P.

no regulations at all, or have confined themselves to benevolent advice (see report, pp. 46–50), we have in this country adopted, on the initiative of the Home Office, and with the assent of manufacturers, regulations on the points named above, which cannot fail to diminish the more serious evils complained of. Doubtless the pottery manufacturers will be grateful to Profs. Thorpe and Oliver for establishing this point.

It was felt, however, that important and valuable as such regulations may be, they leave untouched the kernel of the whole question. The terms of reference contained in the letter from the Home Secretary inviting the co-operation of Prof. Thorpe put the matter very clearly: The Secretary of State desires to ascertain (1) how far the dangers may be diminished or removed by substituting for the carbonate of lead, ordinarily used, either (*a*) one or other less soluble compounds of lead, *e.g.* a silicate; (*b*) "leadless" glaze; (2) how far any substitutes found to be harmless or less dangerous than the carbonate, lend themselves to the varied practical requirements of the manufacturer; (3) what other preventive measures can be adopted.

The report sets forth in a clear, simple, and decided form the conclusions arrived at on these points. It furnishes an account of visits paid to various pottery works on the continent. Results are given of the analytical determination of the proportion of lead compounds in glazes collected from a number of potteries in this country. Valuable tables are also given as to the solubility of various lead compounds, and of certain pottery "fritts" and glazes containing lead, in dilute, hydrochloric, and acetic acids; and, *inter alia*, we find that Prof. Thorpe has discovered in the course of his investigations a compound silicate containing 22 per cent. of lead oxide, which, he says, is insoluble in dilute acids. We are also furnished with the considerations and arguments on which the Professors have based their recommendations.

The recommendations themselves are four in number, and may be summarised as follows:—

(1) The prohibition of lead compounds entirely in the glazes used on seven-tenths of the wares produced in the potteries.

(2) That in all other branches of the pottery industry lead shall only be used in the form of a fritted compound silicate.

(3) That the use of raw lead—*i.e.* white lead—in glazes or colours should be absolutely prohibited.

(4) That the employment of women and young persons as dippers, dippers' assistants, ware cleaners after dippers, and glost placers should be prohibited in all factories where glazes containing lead continue to be used.

That these conclusions, if carried into effect, would do away with lead-poisoning in the pottery industry, there can be no two opinions. That the first and fourth of them, if insisted on in the present state of our knowledge, would cause, not only a serious dislocation of the pottery industry, but the transference of some of it to our foreign rivals (who are, for the most part, under no restrictions whatever as to their use of lead compounds or female labour), there can also be little doubt. Even in view of such circumstances, the adoption of these conclusions might be considered advisable, if an impartial consideration of the facts stated in the report showed that no other conclusions would meet the case. It is necessary, therefore, to consider whether the conclusions arrived at by Profs. Thorpe and Oliver are justified by the information given in the report. It may be said at once that a careful consideration of the report leads one to the conclusion that they are not.

The facts contained in the report may be summed up as follows:—

(1) English potters, generally speaking, use glazes containing "raw," *i.e.* "unfritted" white lead. This compound finds its way into the system, and being readily soluble in the gastric juice produces an excessive amount of lead-poisoning.

(2) Women and young persons are stated to be more susceptible to lead-poisoning in this way than adult males. The figures quoted are open to other interpretations.

(3) Leadless glazes are being tried by several manufacturers in this country on a limited scale. The results obtained so far may be described as satisfactory; but that they have been tried on an adequate scale, and under widely varying conditions, there is not sufficient evidence to prove.

(4) Certain foreign manufacturers, producing pottery similar to that produced in this country, have abandoned the use of "raw" white lead in their glazes.

(5) The glazes stated in the report to be used by these manufacturers contain as large a percentage of lead monoxide as is contained in the glazes used for similar purposes in this country.

(Compare table 1 on page 38 of the report, giving the percentages of lead monoxide found in certain earthenware glazes used in Staffordshire, with the percentages of lead oxide found in the foreign glazes, mentioned on pp. 16–25 of the report.)

(6) The lead compound used in these foreign glazes is either a bisilicate of lead ($PbO2SiO_2$), or a compound silicate containing as bases oxide of lead, alumina, lime, and alkalies (report, pp. 16–25).

(7) Wherever these compounds have been introduced in place of white lead, lead-poisoning has disappeared (report, see pp. 17, 18, 20, 25).

(8) The foreign manufacturers above mentioned use "leadless" glazes no more than English potters do.

(9) Women and young persons are employed at these factories as dippers, dippers' assistants, ware cleaners after dippers or glost placers, and yet there are no cases of lead-poisoning.

The statements thus briefly presented are an accurate summary of the information contained, on these points, in the report, and it is evident that they furnish no warrant for the first and fourth conclusions arrived at by Profs. Thorpe and Oliver. No one doubts that it would make assurance doubly sure to prohibit the use of lead in the glazes used on seven-tenths of the pottery produced in the "potteries" district of Staffordshire. The report contains very little evidence to show that such a cutting of the Gordonian knot is practicable, while it furnishes ample evidence that so drastic a regulation is not required to abolish "plumbism." English potters, from the time of Josiah Wedgwood down to the present, have made numberless experiments to produce leadless glazes. In a paper by Mr. W. P. Rix, published in the *Journal* of the Society of Arts of March 3, 1899, an account is given of the best known of these, and it is shown clearly that in almost every case their use has been abandoned, in some cases after a very lengthy trial, because of practical difficulties connected with their production, which made them too uncertain for general use. The experiments to which Profs. Thorpe and Oliver refer on p. 9 of their report are too recent and too incomplete to afford any justification for the sweeping statement made on that page in the following words, the italics being mine:—

"We have no doubt whatever that leadless glazes, of sufficient brilliancy, *covering power*, and durability, and adapted to all kinds of table, domestic, and sanitary ware, are now within the reach of the manufacturer."

As a matter of fact, it is known to every practical potter who has experimented with leadless glazes, and to none better than those who are working with them at the present time, that leadless glazes of sufficient stability—*i.e.* containing a sufficiently high percentage of alumina to bring them into agreement with the ware—do not become fluid (or "flow," as the potter calls it) in the firing to the same extent that lead glazes do. They are, consequently, deficient in that "covering power," as a potter understands the term, that Profs. Thorpe and Oliver claim for them.

At the general firing temperature of English earthenware glazes, a leadless glaze, even of the very latest type, becomes clear and glossy, but it does not become fluid. It follows from this, that the slightest inequality of thickness produced in the dipping remains after firing; that any small bit knocked or chipped out of the glaze coating before it is fired—an accident of the most ordinary occurrence—leaves a bare spot, for the glaze cannot flow over the space as a lead glaze would; moreover, the mending of imperfectly glazed pieces before firing is rendered almost impossible for the same reason. These points are of the utmost importance in practice, for, while greater care must be taken in sorting the bisque ware before dipping, as well as in the operations of dipping and placing, the proportion of defective pieces may still be too great to be borne. That, at all events, is the past experience of the potters who have worked with leadless glazes; and I feel assured that no firm of pottery manufacturers in this country is prepared to abandon leaded glazes for all their ordinary earthenware at the present time, and face the consequences. I cannot but consider that in this matter Profs. Thorpe and Oliver have been misled by the natural enthusiasm of those who have recently produced leadless glazes, and in their desire to put an end to the evils of lead-poisoning they have over-stated the

present value of leadless glazes to the trade at large. The time is not yet ripe for the drastic change proposed in their first recommendation.

Their third conclusion, "that the use of 'raw' lead, *i.e.* 'unfritted' lead, as an ingredient of potters' glazes or colours, should be absolutely prohibited," is not one whit too strong. The experience of pottery manufacturers in this country and on the continent proves that such a course is possible in every section of the trade. Between the bisilicate of lead containing 65 per cent. of lead monoxide, used at Rörstrand (report, p. 20) and at Dresden (report, p. 25), and proved in the experience of those works to have abolished lead-poisoning, and the compound silicate discovered by Prof. Thorpe (see report, p. 32) containing 22 per cent. of lead-oxide, and stated to be insoluble in dilute acids, and therefore non-injurious, there would seem to be ample margin for all the potter's requirements. According to the evidence contained in the report, such compounds have been used for years, or might be used, without producing lead poisoning in those who work with them. Were the use of such of these compounds as are found to best answer the practical requirements of the various trades, made compulsory on every potter in this country, and the Factory Inspectors empowered to take samples from the dipping-tubs for examination in the Government Laboratory, the axe would indeed be laid to the root of this evil.

The report is to be commended to the careful consideration of every one interested in a great industry. The facts stated in it, speaking generally, admit of little or no dispute. From a careful consideration of its pages, one gathers the encouraging conviction that it contains information which will enable the question to be fairly and satisfactorily dealt with from the point of view of workman, manufacturer, and Home Office alike. Its second and third recommendations, worked in conjunction with the monthly medical examination of *all* workers, of whatever sex or age, who come in contact with any form of lead compound, and with the adequate protective provisions as regards ventilation, clothing, and cleanliness, now in force at all pottery works in this country, would put an end, within a reasonable time, to the gross evils of plumbism. It is to be hoped that the pottery manufacturers will rise to the situation, and show their willingness to adopt such of the recommendations contained in the report as are of practical value.[1] The existing state of things, at all events, cannot be allowed to continue.

W. BURTON.

MECHANICAL ENGINEERING IN WAR-SHIPS.

THE address delivered at the Institution of Mechanical Engineers on Thursday last, by the President, Sir William H. White, K.C.B., F.R.S., was a valuable statement of the part which mechanical engineering has played in the growth of our shipbuilding industry and the development of our mercantile marine during the past forty years. Mechanical engineering has intimate relations with all other branches of engineering, but with none has it been more closely associated than with shipbuilding in recent times; and in his address Sir William White indicated the directions in which the construction and working of ships have been influenced by it. He showed how the development of mechanical appliances for the equipment and working of ships during the last forty years is no less remarkable than the advance in the machinery used for shipbuilding. Nearly all steamships are now fitted with mechanical steering gear, mostly steam, in some instances hydraulic, and in a few recent ships electrical. The same motive powers are now used for working anchors and cables in steamships. Artificial ventilation is now very largely employed in many classes of ships, and especially in warships; electric lighting is becoming the rule; mechanical power is universally employed for pumping purposes in steamships; remarkable progress has been made in appliances for lifting coal and cargoes; and refrigerating machinery has led to the development of a new branch of the shipping industry, as well as added to the health and comfort of all who travel by sea. The advances in these and other directions were sketched by Sir William White, but the limitations of space prevent the publication of his address in full. The last section dealt with mechanical engineering in warships, and is here reprinted.

[1] The pottery manufacturers have already taken action in the direction indicated.

Mechanical Engineering in Warships.

The auxiliary machinery of warships necessarily has much in common with the corresponding machinery in merchant ships. There are, however, many special requirements arising from their armament and equipment as fighting machines, and hence it happens that in warships the applications of mechanical power reach their fullest development. Modern warships are sometimes styled "boxes of machinery," and the description is not inapt. The tendency is, in fact, to multiply machines, and to minimise manual labour to an extent which is not universally approved. On the other hand, with modern armaments and equipment, an extensive use of mechanical power is inevitable, and the expenditure of fuel on auxiliary services grows greater in proportion to that devoted to propulsion.

Ten years ago in a first-class battleship of 12,000 h.p. (maximum) for the propelling machinery, there were fifty auxiliary engines capable of indicating in the aggregate about 5000 h.p. if they all worked simultaneously—which they did not, of course. To-day, a similar statement would show a growth in the auxiliary power as compared with the propelling.

The multiplication of auxiliary services makes very serious demands upon the coal-supply of warships. Even in harbour the expenditure of coal is large on lighting, distilling, ventilation, air-compression, drilling with the heavy guns, and other services. From 10 to 25 tons a day may thus be expended in a large battleship or cruiser of high speed. As warships cruise at low speeds and spend much time in harbour, it results that, taking the year through, fully as much coal is burnt for auxiliary services as for propulsion. Coal endurance being one of the most important factors in warship efficiency, facts such as these have tended to cause a doubt as to the wisdom of more widely extending mechanical appliances. It is pointed out that manual power with simple fittings, such as can be readily replaced if damaged in action, can compete with mechanical appliances in many directions; and that it is better to have larger crews in fighting ships, so as to provide a margin for inevitable casualties, than to use the alternative of labour-saving machines liable to derangement or injury and not easily repaired in action. The practical solution of the problem clearly lies in the due proportion being found between manual and mechanical appliances.

Gun construction in its modern form is largely dependent upon mechanical engineering. Your past-Presidents, Lord Armstrong and the late Sir Joseph Whitworth, were famous as mechanical engineers before they undertook the design and manufacture of guns. In this Address, however, the story of progress from the smooth-bore cast-iron 68-pr., weighing 95 cwts., to the 110-ton breech-loading rifled gun, firing 1800-lb. projectiles, can find no place. Nor can more than a brief glance be taken at the interesting work done by the mechanical engineer in regard to appliances for mounting, working, and loading modern guns, supplying the ammunition, and securing rapidity and accuracy of fire with a minimum of labour.

Anyone who will study the breech mechanism and mounting of a hand-worked quick-firing gun will discover a triumph of mechanical engineering over a very special and difficult problem. Take, for example, a 6-inch quick-firing gun of the latest naval pattern. The gun weighs about 7 tons, fires 100-lb. projectiles, with a muzzle velocity of nearly 2800 feet per second, and an energy of 5370 foot-tons, corresponding to a penetration of 22 inches of wrought iron. Its breech mechanism is so devised that four or five aimed shots can be fired per minute. Its mounting is so arranged that the gun can be easily trained, elevated or depressed by one man. The great energy of recoil is perfectly controlled, and the crew numbers only four or five men. If such a gun is compared with the 68-pr. smooth-bore muzzle loader, mounted on a wood truck carriage with rude arrangements for elevating, and still ruder for training and controlling recoil, one has a striking illustration of the progress made in forty years with hand-worked guns.

When one passes to heavier guns worked by mechanical power, a still greater contrast appears. The 110-ton gun of 16¼ inches calibre has charges of 960 lbs. of powder and 1800-lb. projectiles. Fired with a velocity of 2100 feet per second, three projectiles have an energy of 54,000 foot-tons with an estimated penetration of 37 inches of wrought iron. Obviously, manual power alone was unequal to working such guns. The mechanical engineer has devised suitable machinery which enables pairs of guns, mounted in a thickly armoured turret, to be

loaded, trained, elevated, and depressed with ease and comparative rapidity under the guidance of a few men. Mr. George Rendel was one of the first, as well as one of the most successful, workers in the design of mechanical appliances for working heavy guns by hydraulic power. Messrs. Armstrong have from the first taken a leading position in this class of work. Messrs. Whitworth, and, in more recent times, Messrs. Vickers, have also undertaken it on a large scale. Hydraulic power finds most favour in the Royal Navy. Abroad, electrical power is now extensively used. Pneumatic power has been employed in a few cases.

Improvements in gun-design and in explosives have resulted in an increased ratio of power to weight in the latest types of guns. As a result, in the latest completed battleships, guns of 12-inch calibre, weighing 46 tons, firing 850-lb. projectiles, with muzzle velocities of about 2400 feet per second, and energies of 33,000 foot-tons have been used instead of the 67-ton and 110-ton guns of early date. These reduced weights of charges and projectiles are more easily handled; and this fact, together with certain changes in the system of mounting, have enabled many of the operations of loading and working the guns to be performed by manual power as well as by hydraulic power. This duplication is obviously advantageous, and reduces greatly the risk of heavy guns being put out of action. There was a time when a return to guns of still smaller dimensions, capable of being worked exclusively by hand-power, was strongly advocated. It was urged that it was unwise to depend at all on mechanical power, because it might fail at a critical moment. Such arguments are now but little heard. Experience does not demonstrate that any serious risk of "breakdown" need be feared in mechanical appliances. Moreover, the advocates of manual power overlooked the fact that, supposing that system had been adopted, there must still remain in all modern mountings and breech mechanisms many comparatively delicate parts, perhaps more liable to injury or derangement than the appliances which were condemned.

Steady improvement has been made in heavy gun mountings and in rapidity of fire. For example, with 12-inch guns from two and a half to three minutes were formerly considered to be a reasonable interval between successive rounds; now that interval has been brought below one minute, when pairs of guns are loaded and fired. Loading has also been made possible with the guns in any position, whereas formerly the guns were brought to fixed hoists, and to a definite angle of elevation for loading. It is most interesting to watch the working of these heavy guns, by means of mechanisms controlled by a few men. All the operations are performed with rapidity and precision, from the moment projectiles and charges are moved from their stowing positions in shell rooms and magazines situated deep down in the holds, up to the time when they are rammed home in the gun, the breech closed and the gun made ready for firing. Then one sees the captain of the barbette or turret training or changing the elevation of the gun up to the instant when he fires by electricity, and the huge projectile is discharged.

Passing from guns to torpedoes, one finds a fresh example of the important work done by mechanical engineers. The inventor of the automobile torpedo, Mr. Whitehead, is an eminent member of the profession. The torpedo itself is a beautiful example of mechanical engineering. All the machinery connected with air compression and storage, all the arrangements for ejecting above or below water, involve skilful mechanical design. Nor is this all. From the introduction of the torpedo has sprung the necessity for special structural and defensive arrangements in warships, as well as the construction of the swift torpedo flotilla-boats, destroyers, gunboats and depot ships, whose performances are not merely remarkable, but suggestive of possibilities in regard to steam navigation at high speeds.

The smaller classes of boats using the locomotive torpedo have to be carried by warships. They weigh, fully equipped, 18 to 20 tons, or about three times as much as the heaviest load ordinarily dealt with in merchant ships by their own lifting gear. This has involved the design of special lifting appliances for warships. After long experience in the Royal Navy, the most suitable arrangement has been found to be a strong steel derrick carried by the mast, with powerful steam or hydraulic hoists working tackles which lift the boats and top the derrick. Winches or capstans are also used in some instances for swinging the derricks. Admiralty specifications require that the lifting gear shall be capable of dealing with a load of about 18 tons lifted by a single wire rope, as well as with a load of 9 tons raised 30 feet per minute. In one ship, the *Vulcan*, built as a torpedo depot ship and boat carrier, instead of derricks two powerful hydraulic cranes are fitted. She carries six steel torpedo boats, 60 feet long and of 16 knots speed, besides sixteen other boats, some of large size. The total weight of these boats is 150 tons, and they are placed 27 feet above water. The two cranes and their gear weigh 140 tons; the tops of the cranes are 55 feet above water. It required careful designing to meet such exceptional conditions satisfactorily and to produce a stable and seaworthy ship. She has now been many years on service and has a good reputation.

Besides these special boat-lifting appliances, warships commonly have special coal-hoists, transporters and other gear for the purpose of accelerating the taking of coal on board. Rapidity in coaling must be of great importance in time of war, and keen competition between ships in the various squadrons as to the rates attained have led to great improvements in details of gear, as well as to remarkably rapid coaling becoming the rule in the Royal Navy. Recently, at Gibraltar, the *Majestic* took on board 1070 tons of coal in 6 hours and 10 minutes—a very fine performance.

All the larger ships in the Royal Navy have engineers' workshops fitted with a considerable number of machine-tools, driven by power, and of sufficient size to deal with ordinary repairs. The *Vulcan* is a special vessel in this sense also, as she has an exceptionally well-equipped workshop, a small foundry and a hydraulic press for forgings. For repairs of the boats she carries, or for those of torpedo boats and destroyers in company, or for certain repairs to ships of the fleet to which she is attached, the *Vulcan* has been found most useful. Besides being a floating factory and a boat carrier, she has a large torpedo and mining equipment, an electrical laboratory, and serves as a school of instruction for mining and torpedo work. In addition, she is a swift cruiser, with a fair armament and well protected. As an armed ship, she represents the fullest application of mechanical appliances afloat. Her construction was commenced in 1887. Other navies have since imitated her.

Another *Vulcan* was fitted up as a floating factory to serve with the American fleet during the recent war. She was originally a merchant steamer, but is said to have proved of great service. Naval opinion seems to favour the use of vessels of this class with fleets. It is held, moreover, that no modern fleet can be considered to be complete unless the fighting ships are supplemented by ships specially equipped for distilling and storing fresh water, or carrying coals, ammunition and reserve stores.

SATURN'S NEW SATELLITE.

IN *Harvard College Observatory Circular*, No. 43, just received, Prof. E. C. Pickering gives the following detailed account of the discovery and observations of the new satellite of Saturn:—

Nearly all of the astronomical discoveries made by the aid of photography have related to the fixed stars. In the study of the members of the solar system, the results obtained by the eye are generally better than those derived from a photograph. For many years it has been supposed that photography might be used for the discovery of new satellites, and in April 1888 a careful study of the vicinity of the outer planets was made by Prof. William H. Pickering. Photographs were taken with the 13-inch Boyden telescope, with exposures of about one hour, and images were obtained of all the satellites of Saturn then known except Mimas, whose light is obscured by that of its primary. It was then shown that Saturn probably had no satellite, as yet undiscovered, revolving in an orbit outside of that of Enceledus, unless it was more than a magnitude fainter than Hyperion (Forty-third Report Harv. Coll. Obs., p. 8).

In planning the Bruce photographic telescope, a search for distant and faint satellites was regarded as an important part of its work, and accordingly plates for this purpose were taken at Arequipa by Dr. Stewart. A careful examination of these plates has been made by Prof. William H. Pickering, and by superposing two of them, A 3228 and A 3233, taken August 16 and 18, 1898, with exposures of 120 m., a faint object was found which appeared in different positions on the two plates. The same object is shown on two other plates A 3227 and A 3230, taken

on August 16 and 17, 1898, with exposures of 60m. and 122m. respectively.

The position is nearly the same on the two plates taken on August 16, but on August 17 it followed this position 33″, and was south 19″, while on August 18 it followed 72″, south 43″. Its motion was direct, and less than that of Saturn, though nearly in the same direction. It cannot, therefore, be an asteroid, but must either be a satellite of Saturn or a more distant outside planet. The proximity of Saturn renders the first supposition much more probable. On August 17 the position angle from Saturn was 106°, and the distance 1480″. Assuming that it was at elongation, and that its orbit is circular, its period would be 400 days, or five times that of Japetus. It was at first identified with a very faint object found on plates taken in 1897, and the period of seventeen months was derived from them. This supposition has not been confirmed.

Measurements of the positions of the images give additional material for determining the form of the orbit. The method of measurement is that described in the *Annals*, vol. xxvi. p. 236. The uncorrected positions of the four images referred to the first plate of August 16 as an origin, are for x, 0″·0, +1″·2, +33″·6, and +71″·8; for y, 0″·0, −1″·7, −19″·8, and −42″·1; the corresponding Greenwich mean times are 12h. 16m., 14h. 18m., 12h. 56m., and 13h. 12m. Correcting for the motion of Saturn, the relative motion with reference to that body is in x, 0″·0, −2″·4, −10″·7, and −22″·0; in y, 0″·0, +0″·1, +2″·4, and +2″·9. It appears from this that the apparent motion is about 10″·4 a day, at a distance of 1480″. A computation shows that if the orbit is circular, the period must be either 4200 or 490 days, according as the satellite is near conjunction or elongation. These values may be greatly altered if the orbit is elliptical. Since the interval of time between the first and last photographs on which the satellite appears is only two days, it is impossible to predict its position with accuracy. It is probable that its position angle from Saturn now lies between 280° and 290°, and its distance between 20′ and 30′. These uncertainties will probably be greatly diminished from measures of plates of Saturn taken in Arequipa on September 15, 16, and 17, 1898, which for some unexplained reason have not yet been received in Cambridge.

The direction of the motion, which is nearly towards Saturn, shows that the apparent orbit is a very elongated ellipse, and that it lies nearly in the plane of the ecliptic. Prof. Asaph Hall has pointed out that this is to be expected in a body so distant from Saturn. The attraction of the latter only slightly exceeds that of the sun. Hyperion appears as a conspicuous object on all four of the plates, and the new satellite appears about a magnitude and a half fainter on each. The approximate magnitude is therefore about 15·5. As seen from Saturn, it would appear as a faint star of about the sixth magnitude. Assuming that its reflecting power is the same as that of Titan, its diameter would be about two hundred miles. It will, therefore, be noticed that while it is probably the faintest body yet found in the solar system, it is also the largest discovered since the inner satellites of Uranus in 1851. The last discovery of a satellite of Saturn was made in September 1848 by Prof. William C. Bond, then director of this Observatory, and his son, Prof. George P. Bond. The satellite Hyperion was seen by the son on September 16 and 18, but its true character was first recognised on September 19, when its position was measured by both father and son (see *Annals*, ii. p. 12). Soon afterwards it was discovered independently by Lassell, at Liverpool.

Prof. William H. Pickering, as the discoverer, suggests that the name Phœbe, a sister of Saturn, be given to the new satellite. Three of the satellites—Tethys, Dione, and Rhea—have already been named for Saturn's sisters, and two, Hyperion and Japetus, for his brothers.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The following are the speeches delivered on April 27 by the Public Orator, Dr. Sandys, in presenting (1) Prof. Sir William Turner and (2) the Rev. Prof. Wiltshire, for the honorary degree of Doctor in Science:—

(1) Virum regni totius medicorum concilio praepositum, virum honoribus academicis plurimis cumulatum, etiam noster Senatus titulo suo decorare anno proximo decrevit. Inter Lancastrienses natus, inter Londinienses educatus, inter Edinenses, medicinae in schola celeberrima, quam tot coloniae Britannicae studiorum medicorum quasi μητρόπολιν venerantur, anatomiae scientiam per annos plus quam triginta praeclare professus, non modo Universitati suae aedificiis novis instruendae operam insignem dedit, sed etiam studiorum suorum actis per seriem edendis iamdudum maxima cum laude praefuit. Idem, rerum naturae spoliis olim in Britanniam feliciter reportatis, Australasiae praesertim anthropologiam opere in magno accuratissime expositam luculenter illustravit. Nuper societatis Britannicae scientiarum finibus proferendis praeses in annum proximum designatus, ab eadem disputationibus de anthropologiae scientia etiam inter Canadenses habendis haud ita pridem praepositus, hominum omnium plausus propterea praesertim meritus est, quod simiarum superbiam recentem repressit et generis humani dignitatem veterem denuo vindicavit.

Duco ad vos generis humani vindicem, equitem insignem, anatomiae professorem illustrem, WILLELMUM TURNER.

(2) Unus ex alumnis nostris, societatis geologicae, astronomicae, Linnaeanae socius, idcirco praesertim inter peritos laudatur, quod palaeontographicae societatis in usum, palaeontologiae studiosorum ad fructum, aevi prioris monumenta a rerum natura in saxis impressa, non sine summo ingenio et labore illustrata, per annos plurimos litterarum monumentis mandaverit. Idem Universitatem nostram beneficio singulari ad sese devinxit, quod non modo bibliothecam suam, sed etiam vitae antiquae relliquias veteres in saxis conservatas et saxorum inter se diversorum exempla quam plurima, nuper nobis in perpetuum donavit. Illa vero exempla omnia, olim inter Londinienses in Collegio Regali professor, docendi praesertim in commodum collegerat, cum Horatio (ut videtur) arbitratus "demissa per aurem quam quae sunt oculis subiecta" animum segnius excitare. Etiam ipsa fama liberalitatis tantae nuper inter nosmet ipsos inter rerum naturae praesertim studiosos animum gratum excitavit. Quanto magis iuvat Universitatem totam liberalitatis tantae auctorem ipsum hodie oculis suis redditum et auspiciis optimis praesentem contemplari. Qui prioris aevi tot exempla nobis donavit, ipse nostro in saeculo munificentiae in Universitatem nostram ab aliis imitandum praebuit exemplum.

Praesento vobis geologiae professorem emeritum, virum de rerum naturae studiis praeclare meritum, THOMAM WILTSHIRE.

Prof. A. Cornu, of the École Polytechnique of Paris, has been appointed Rede Lecturer for the present year. The lecture will be delivered in the Senate House on June 1, as a part of the proceedings relating to the jubilee of Sir G. G. Stokes. On the same evening, a conversazione will be held in the Fitzwilliam Museum. Next day an address from the University and a commemorative gold medal will be presented to the veteran Lucasian professor. The guests of the University will be received by the Chancellor, and certain honorary degrees will be conferred. A garden-party at Pembroke College, and a State dinner in the evening, will close the festivities.

Prof. Macalister announces three lectures of an historical character, on eponymous structures in human anatomy, on May 9, 13, and 16.

University tables are vacant at the Naples and the Plymouth Zoological Stations. Applications are to be sent to Prof. Newton by June 1.

THE *Times* makes the following announcement:—"We understand that Mr. Passmore Edwards has intimated his intention of giving 10,000*l.* upon trust to equip a school and building for the teaching of economics and commercial science in the New London University. The Trustees, who are to carry out the trust and offer the building when ready to the new University Senate, are the Bishop of London, Mr. Sidney Webb, and Mr. Haldane, Q.C., M.P. The work of the London School of Economics will probably be continued there. Further endowments will, of course, be wanted for chairs of banking, commercial history and geography, commercial law, insurance and other special subjects, and this munificent gift by Mr. Passmore Edwards should encourage other wealthy Londoners to imitate his generosity."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 20.—"On Intestinal Absorption, especially on the Absorption of Serum, Peptone, and Glucose." By E. Waymouth Reid, F.R.S., Professor of Physiology in University College, Dundee, St. Andrews University, N.B.

The experiments detailed in the full paper deal with the absorption from the intestine, of the animal's own serum, and of solutions of glucose and peptone. The method employed has been that introduced by Leubuscher, in which two loops of intestine are simultaneously employed, the one the experimental, and the other the control, loop.

The conclusions arrived at are as follows:—

(1) A physiological activity of the intestinal epithelium in the act of absorption is demonstrated by—

(*a*) The absorption by an animal of its own serum (or even plasma) under conditions in which filtration into blood capillaries or lacteals, osmosis and adsorption are excluded.

(*b*) By the cessation or diminution of the absorption of serum when the epithelium is removed, injured or poisoned, in spite of the fact that removal, at any rate, must increase the facilities for osmosis and filtration.

(2) The activity of the cells is characterised by a slower uptake of the organic solids of the serum than of the water, and a rather quicker uptake of the salts than of the water. The relations to one another of the absorptions of these various constituents is variable in different regions of the intestinal canal (upper ileum, lower ileum, and colon).

(3) No evidence can be obtained of specific absorptive fibres in the mesenteric nerves.

(4) The state of nutrition of the cells is the main factor in their activity, and this is intimately associated with the blood supply.

(5) In reduction of the rate of absorption, without detachment of epithelium, the absorption of the various constituents of serum is reduced in the proportion in which they exist in the original fluid.

(6) The activity of the cells may be raised by stimulation with weak alcohol, without evidence of concomitant increase of blood supply.

(7) The bile has no stimulant action on the cells.

(8) The cells exhibit an orienting action upon salts in solution (sodic chloride especially). In a loop of gut with injured cells, sodic chloride enters the lumen from the blood at a time when it is being actively absorbed from a normal control loop in the same animal. (This fact was first noted by O. Cohnheim.)

(9) The absorption of water from solutions introduced into the gut is dependent upon two factors:—

(*a*) The physical relation of the osmotic pressure of the solution in the gut to the osmotic pressure of the blood plasma.

(*b*) The physiological regulation of the difference of osmotic pressure by the orienting mechanism of the cells.

(10) The chief factor in the absorption of peptone is an assimilation (or adsorption) by the cells, while in the absorption of glucose, diffusion, variable by the permeability of the cells (and so, probably, related to their physiological condition) is the main factor.

(11) By removal of the epithelium, the normal ratio of peptone to glucose absorption is upset, and the value tends to approach that of diffusion of these substances through parchment paper into serum.

(12) Absorption in the lower ileum is greater for the organic solids of serum, and less for peptone and glucose than in the upper ileum. The relative absorption of water in the upper and lower ileum is variable.

(13) The relative impermeability of the lower ileum to glucose disappears with removal of the epithelium.

(14) Absorption in the colon is for all constituents of serum, and for peptone and glucose far less per unit of measured surface than in the middle region of the ileum.

(15) The normal relative excess of salt absorption from serum over water absorption, observed throughout the intestine, is most marked in the colon, and more marked in the lower than in the upper ileum.

(16) Finally, it is suggested that the cell activity which causes serum to pass over to the blood is of the same nature as that involved in the orienting action of the cells upon salts in solution.

Zoological Society, April 18.—Prof. G. B. Howes, F.R.S., Vice-President, in the chair.—Mr. C. W. Andrews read a paper on the osteology of one of the great extinct birds of Patagonia, *Phororhacos inflatus*. He described in detail the structure of the skull and skeleton, and compared them with various recent forms of birds. The evidence as to the affinity of this type was somewhat conflicting, but on the whole pointed to a relationship with the *Gruiformes*, as had been previously suggested by the author. It seemed probable that the aberrent *Cariama* was the nearest living representative of *Phororhacos*, being related to it somewhat in the same fashion as the small modern Armadillos are to the great extinct forms such as *Glyptodon* and *Panochthus*.—A communication was read from Mr. P. W. Bassett-Smith, entitled "A systematic description of the parasitic Copepoda found on fishes." It contained a summary of the literature on the subject, and an enumeration of the known species of these parasites and lists of their synonyms. A new family (*Philichthydidae*) was introduced, to embrace the forms which are found in the mucous canals and sinuses of fishes, and a new genus (*Oralien*) was proposed for the reception of *Chondracanthus triglae* (Blainv.).—Mr. W. E. de Winton read a paper on the African species of *Canidae*. The author, from an examination of a series of specimens lately received from Africa, had come to the conclusion that the known species of *Canidae* of that continent were fourteen in number. He pointed out that the numerous supposed new species of jackals that had recently been described were mostly varieties of well-known forms, and that he was of opinion that only four species of jackals were found in Africa, viz. *Canis anthus*, *C. variegatus*, *C. mesomelas*, and *C. adustus*.—A communication from Dr. H. von Ihering, on the Ornis of the State of São Paulo, Brazil, was read. It embraced the conclusions arrived at, from observations made by the author during the last six years, regarding the distribution of birds in that State, in which he recognised elements of three different faunas—namely, the northern and southern divisions of the South-east Brazilian fauna, and the Central Brazilian or Pampas fauna of the interior.—A communication from Mr. G. A. Boulenger, F.R.S., contained the description of a new lizard from Ecuador under the name *Ameiva leucostigma*.—A communication was read from the Rev. O. Pickard-Cambridge containing descriptions of twelve new species of exotic Araneidea.

MANCHESTER.

Literary and Philosophical Society, April 11.—Mr. J. Cosmo Melvill, President, in the chair.—Mr. John Watson read a paper entitled "On *Calinaga*, the single genus of an aberrant sub-family of butterflies." He first referred to the species known to science, and to the uncertainty as to where this curious butterfly should be placed in the classification of insects. It was pointed out that, besides the evidence of its geographical distribution, the structure of the feet pointed to the probability of its being a very ancient form. The basal cell shows a close affinity to the *Glacialis* section of *Parnassius*, and the general tendency of the structure of *Calinaga* was towards its being an offshoot—an early offshoot—of the Lepidopterous phylum from which the Papilioni-Pieri-Nymphalid stock originated. A paper on a biological aspect of cancer was read by Mr. F. J. Faraday. Cancer has been defined as epithelial proliferation, with an invading tendency. The author suggested that it was a case of arrested development, at what might be termed the cryptogamic as distinct from the phanerogamic stage. He pointed out that changes in the environment, noticeably a deficient supply of free oxygen and sunlight, had a remarkable influence in arresting organised differentiation and favouring the development of cryptogamic parasitism; and cited the attenuation and fermentation experiments of Pasteur and his successors. The "travelling cell" in cancer could only be described as a pathogenic micro-coccus evolved from normal epithelial cells. From analogy, the author inferred that deficient oxygenation of the blood generally, or deficient local blood-irrigation through local causes or interruptious, might account for the cancerous proliferation.

PARIS.

Academy of Sciences, April 24.—M. van Tieghem in the chair.—The President announced to the Academy the death of M. Charles Friedel.—On surfaces of constant positive curvature, by M. Gaston Darboux.—Electrical registration of the valvular movements which determine the opening and closing of the orifices of the heart, by M. A. Chauveau. Diagrams obtained

by the apparatus are given, showing the curves of the tricuspid, mitral and aortic valves.—New observations of the planet EL (Coggia, March 31, 1899), made at the Observatory of Marseilles with the 26 cm. equatorial, by M. E. Stéphan.—Observations of the new Coggia planet (EL), made at the Observatory of Algiers with the 31·6 cm. equatorial, by M. Rambaud.—On the sterilisation of potable waters by ozone on the industrial scale, by MM. Marmier and Abraham. The apparatus was set up at Lille. After the water had passed through the ozonising column, all saprophytic and pathogenic organisms were destroyed with the exception of some spores of *Bacillus subtilis*; this organism also offering considerable resistance to all the usual methods of sterilisation.—On furfuryl alcohol, by M. G. André. Specimens of this alcohol prepared by different methods for calorimetric determinations differed considerably in purity, the method of Wissel and Tollens being the only one yielding a pure substance.—Osazones from oxycelluloses, by M. Léo Vignon. Cotton wool was oxidised in various ways to oxycelluloses, and these heated with phenylhydrazine in acetic acid solution. The osazones formed were not constant in composition.—On the sugar of maize stems, by MM. C. Istrati and G. Œttinger. Measurements of the reducing power before and after inversion of the juice from the stems of sixteen varieties of maize.—Remarks on a preceding communication "On the pathogenic agent of hydrophobia," by M. E. Puscariu. The amylaceous formations observed in the central nervous system of animals who died from hydrophobia have been found in cases of general paralysis, abscess of the brain and in diphtheric paralysis. Hence the view previously put forward, that these formations are of parasitic origin and peculiar to hydrophobia, is erroneous.—On the reducing power of the tissues: the blood, by M. Henri Hélier.—On a ratio existing between intraorganic oxidations and the production of kinetic energy in the organism, by M. Alexandre Poehl.—The microbes of flowers, by M. Domingos Freire. Numerous species of organisms have been found in flowers, including the pathogenic *Bacillus pyocyaneus*.—On the wines obtained by the preliminary heating of the vintage, by M. A. Rosenstiehl. The preliminary sterilisation of the must by heating and the subsequent introduction of suitable yeasts, in all the instances tried, gave a wine superior to that obtained by the traditional methods.—The specific characters of the fungus of *Pityriasis versicolor*, by M. Paul Vuillemin.—Researches on the mineral elements, especially iron, in the human fœtus, by M. L. Hugounenq.—The formation of the egg in *Myriothela* and *Tubularia*, by M. Alphonse Labbé.—Tangential increase of the pericycle, by M. Henri Devaux.—Discussion of barometric observations, by M. A. Poincaré.

DIARY OF SOCIETIES.

THURSDAY, MAY 4.

ROYAL SOCIETY, at 4.30.—On the Chemical Classification of the Stars: Sir Norman Lockyer, F.R.S.—Demonstration of Vermiform Nuclei in the Fertilised Embryo Sac of *Lilium martagon*: Miss E. Sargant.—*Onygena equina* (Willd.): a Horn-destroying Fungus: Prof. Marshall Ward, F.R.S.—Impact with a Liquid Surface studied by the Aid of Instantaneous Photography. Paper II.: Prof. Worthington, F.R.S., and R. C. Cole.—The External Features in the Development of *Lepidosiren paradoxa* (Fitz.): J. G. Kerr.—An Observation on Inheritance in Parthenogenesis: Dr. E. Warren.—The Thermal Expansion of Pure Nickel and Cobalt: A. E. Tutton.

LINNEAN SOCIETY, at 8.—The Position of Anomalurus as indicated by its Myology: F. G. Parsons.—On *Notheia anomala*, Harv. et Bail.: Miss Ethel S. Barton.—On Variation in the Desmidiæ: G. S. West.

CHEMICAL SOCIETY, at 8.—On the Combustion of Carbon Disulphide: H. B. Dixon and F. J. Russell.—The Action of Nitric Oxide on Nitrogen Peroxide: H. B. Dixon and J. D. Peterkin.—On the Mode of Burning of Carbon: H. B. Dixon.—Crystalline Glycollic Aldehyde: Henry J. Horstman Fenton and Henry Jackson.—On the Blue Salt of Fehling's Solution and other Cupro-tartrates: Orme Masson and B. D. Steele.—The Preparation of Acid Phenolic Salts of Dibasic Acids: Dr. S. B. Schryver.—The Maximum Pressure of Naphthalene Vapour: R. W. Allen.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Electric Locomotives in Practice and Tractive Resistance in Tunnels, with Notes on Electric Locomotive Design: G. V. McMahon.

FRIDAY, MAY 5.

ROYAL INSTITUTION, at 9.—Pictures produced on Photographic Plates in the Dark: Dr. W. J. Russell, F.R.S.

GEOLOGISTS' ASSOCIATION, at 8.—The Drainage of Cuestas: Prof. W. M. Davis.

SATURDAY, MAY 6.

GEOLOGISTS ASSOCIATION.—Excursion to the Thame District. Director: A. M. Davies. Leave Paddington at 9.50.

MONDAY, MAY 8.

SOCIETY OF ARTS, at 8.—Leather Manufacture: Prof. H. R. Proctor.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Explorations in the Bolivian Andes: Sir Martin Conway.

TUESDAY, MAY 9.

ROYAL INSTITUTION, at 3.—Electric Eddy-Currents: Prof. S. P. Thompson, F.R.S.

ANTHROPOLOGICAL INSTITUTE, at 8.30.—Ethnographical Notes on the Fang: Dr. Albert L. Bennett.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—The Photography of Colour: E. Sanger Shepherd.

WEDNESDAY, MAY 10.

SOCIETY OF ARTS, at 8.—Fruit-Growing in Kent: George Bunyard.

GEOLOGICAL SOCIETY, at 8.—The Geology of the Davos District: A. Vaughan Jennings.—Contributions to the Geological Study of County Waterford: the Lower Palæozoic Bedded Rocks of the Coast: F. R. Cowper Reed.

THURSDAY, MAY 11.

MATHEMATICAL SOCIETY, at 8.—The Zeroes of a Spherical Harmonic $P_n^m(\mu)$ considered as a Function of n: H. M. Macdonald.

FRIDAY, MAY 12.

ROYAL INSTITUTION, at 9.—Magnetic Perturbations of the Spectral Lines: Prof. Thomas Preston, F.R.S.

ROYAL ASTRONOMICAL SOCIETY, at 8.

MALACOLOGICAL SOCIETY, at 8.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—City and Guilds of London Institute, Report to the Governors, March 1899 (London).—Engine-Room Practice: J. G. Liversidge (Griffin).—Manual of Library Cataloguing: J. H. Quinn (Library Supply Company).—The Philosophy of Memory: Dr. A. T. Smith (Louisville, Morton).—The Flora of Cheshire. Lord de Tabley (Longmans).—Outlines of Zoology: Prof. J. A. Thomson, 3rd edition (Pentland).—The Phenomena of Nature: J. Walker, Part 2 (Sonnenschein).—Essai Critique sur l'Hypothèse des Atoms: Prof. A. Hannequin, deux édition (Paris, Alcan).—Graduated Test Papers in Elementary Mathematics: W. J. Wood (Macmillan).—Annual Report of the Smithsonian Institution, 1897 (Washington).—Milk: Dr. C. M. Aikman, 2nd edition (Black).

PAMPHLETS.—Some Insects Injurious to Garden and Orchard Crops (Washington).—Geological Society of Washington, Presidential Address: A. Hague (Washington).—Return, Local Authorities (England, Wales, and Ireland), Technical Education (London).

SERIALS.—Indian Museum Notes, Vol. iv. No. 3 (Calcutta).—Transactions of the Institution of Engineers and Shipbuilders in Scotland, April (Glasgow).—American Naturalist, April (Boston).—Bulletin of the American Mathematical Society, April (New York).—Bulletin de la Société Impériale des Naturalistes de Moscou, 1898, Nos. 2 and 3 (Moscou).

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