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SHAKESPEARE AND PRECIOUS STONES.

Shakespeare and Precious Stones. By Dr. G. F. Kunz. Pp. 101. (Philadelphia and London: J. B. Lippincott Co., 1916.) Price 6s. net.

THE author of this contribution to the literature of the Shakespeare Tercentenary has long been known as the most prominent expert authority on gems and jewelry in the United States. He has acquired a wide knowledge of the various sources of origin of precious stones from the earliest times up to the present day, and is familiar with the pedigree of every jewel which has made itself famous among the generations of mankind. It was fitting, therefore, that, among the various essays in connection with the Shakespeare celebration last year, Dr. Kunz should discourse on the knowledge which the great dramatist possessed of precious stones. He has compiled a daintily printed volume in which he has collected all the poet's references on this subject, and he adds comments on the probable sources from which the gems of Elizabethan and earlier, as well as later, times have been obtained. His reverence for the memory of Shakespeare has led him to make all his quotations from the First Folio of 1623—an affectation which, with no compensating advantage, gives his readers a little additional trouble in finding the passages cited. The number of those who can refer to the First Folio must be extremely limited, even in New York.

It was inevitable that Shakespeare should be much less familiar with precious stones than with the living things of natural history of which he has made so much use. At Court functions and entertainments by the leaders of society he must have seen, at least from a distance, great ladies "walled about with diamonds," or "decked with diamonds and Indian stones." It is to the distant sheen and glitter of the gems that he usually alludes in his plays and poems, rather than to their individual character when seen close at hand. He refers, for instance, more than twenty times to the diamond, without much indication that he knew what was the special quality which has given that gem its deserved pre-eminence. Out of the seven references to the diamond in "Cymbeline," there is only one where this distinctive quality is recognised—"that diamond of yours outlustres many I have beheld."

The names of the gems are often used by the poet as adjectives of colour, and with no reference to the other qualities of the stones. Thus in the only mention of the emerald in the Plays the name is simply a synonym for green. Mrs. Quickly tells her fairies to

> write
> In emerald tufts, flowers purple, blue, and white.

The ruby also is chiefly used as a colour-epithet, applied more especially to lips and cheeks. This gem is introduced, however, with delicate effect into the fairy world, where around the queen

> The cowslips tall her pensioners be;
> In their gold coats spots you see:
> These be rubies, fairy favours.

The jewel most often alluded to by Shakespeare is the pearl, which he mentions upwards of thirty times. Yet in no single passage does he, by a descriptive epithet, indicate the peculiar kind of beauty which has made this gem to be so prized in every age. One of his favourite similes is to compare tears to pearls. When Proteus in "The Two Gentlemen of Verona" was banished, his Silvia was said to have poured forth on his behalf "a sea of melting pearl, which some call tears." Again, when Cordelia in "King Lear" heard of the indignities put on her father, her eyes filled with tears,

> which parted thence
> As pearls from diamonds dropp'd.

Another comparison of which the poet makes effective use is to liken dewdrops to pearls, and nowhere with more exquisite delicacy than in his fairy world, where it is one of the functions of the fays to

> seek some dewdrops here,
> And hang a pearl in every cowslip's ear.

Further, when Oberon saw the garlands with which Titania had bedecked the hairy scalp of the transformed Bottom, he could not but exclaim:

> That same dew, which sometime on the buds
> Was wont to swell, like round and orient pearls,
> Stood now within the pretty flowerets' eyes,
> Like tears, that did their own disgrace bewail.

There is an allusion to the origin of the pearl in "As You Like It," where, among his sententious remarks, Touchstone tells the Duke that "rich honesty dwells like a miser, sir, in a poor house; as your pearl in your foul oyster." Dr. Kunz, on rather slender grounds, is inclined to believe from this passage that the poet may have been acquainted with some of the repulsive details of the pearl fishery.

Shakespeare could sometimes put the names of precious stones to a contemptuous purpose. In "The Comedy of Errors" we hear of a kitchen-wench who had a "nose, all o'er embellished with rubies, carbuncles, sapphires"—a portraiture which in later days was imitated by a Scots ballad-monger, who wrote that

> many a Cairngorm pimple
> Blazed upon the face of Kate Dalrymple.

It is seldom that Shakespeare's references to gems indicate that he was probably making use of his own personal acquaintance with them. Perhaps the best example of this knowledge occurs in "Twelfth Night," where the Clown, in taking leave of the Duke, exclaims: "Now the melancholy god protect thee; and the tailor make thy doublet of changeable taffeta, for thy mind is a very opal." The singular variability of colours in this stone as it is turned round in the light makes it a good illustration of mental vacillation.

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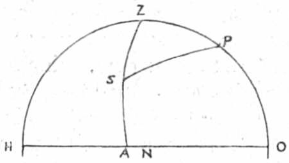
Dr. Kunz cites, among the precious stones mentioned by Shakespeare, a number of substances which, though they can scarcely be reckoned precious, have long been employed in jewelry, such as agate, amber, coral, jet, and rock-crystal. His little volume, though without literary distinction, contains much information on the subject of which it treats, and will be welcomed by lovers of the great dramatist.

IDENTIFICATION OF STARS.

Star Identifier and Diagrams for the Graphical Solution of Problems in Nautical Astronomy. By J. E. McGegan. (London: The London Name Plate Manufacturing Co., and J. D. Potter, 1916.) Price 10s. 6d. net.

BY the pamphlet and diagrams prepared by Mr. McGegan he suggests a method by which, when an observer has taken an altitude of a star the identity of which is doubtful, he can, if he also observes the compass bearing of the object at the same time, ascertain its declination and right ascension, and thus identify it in the Nautical Almanac.

The problem is very simple, provided the data can be accurately observed, as the annexed diagram will show: where P is the pole, Z the zenith, N the place of the observer, H O the horizon, while S is the star observed which requires to be identified. The arc S A will be its altitude, the arc P O the latitude of the observer. Consequently, the arc Z S will be its zenith distance, and the arc P Z the colatitude, whilst the angle P Z S will be its azimuth, which can be obtained by correcting the compass bearing observed to the true bearing, and then deducting the result from 180° to find the azimuth. There is consequently a spherical triangle P Z S, with two sides and the included angle known, to find the third side P S (the polar distance) and the angle Z P S (the hour angle). By applying the hour angle to the right ascension of the meridian of the place, readily ascertained from the Nautical Almanac, the right ascension of the star is obtained and its declination from its polar distance.



To solve the problem without much calculation Mr. McGegan has ingeniously constructed two diagrams on equal scales, one the diagram of a hemisphere divided into circles of declination from the equator to both poles; and into meridians representing sidereal hour angles, or circles of right ascension; a second diagram on celluloid, which is transparent, represents a semicircle marked in circles of altitude from the horizon to the zenith, and of arcs of azimuth 0° to 90° east and west from the meridian.

There is, in addition, on the diagram of right ascension and declination a quadrant at the side marked from 0° to 90° to represent latitude.

Now if the position of the star by altitude and azimuth be marked on the celluloid semicircle, and the semicircle be placed over the diagram of the hemisphere in such a manner that its centre coincides with the centre of the hemisphere, and its horizon cuts the quadrant marked outside the hemisphere at the latitude of the observer, then the position on the celluloid will show on the diagram of the hemisphere under it the declination and hour angle of the star to be identified.

In actual practice this is seldom, if ever, necessary. Star observations at sea are only of use when the horizon is clear and well defined—for instance, at twilight morning or evening, or when Venus or Jupiter passes the meridian at an interval of more than $2\frac{1}{2}$ hours from noon. When the horizon is well defined the stars are nearly always too faint to enable compass bearings of them to be observed.

Stars on or near the meridian can at twilight nearly always be seen through the sextant, when invisible to the naked eye, if their approximate altitude be placed on the sextant. For longitude only very bright stars are available at twilight, and navigators know well where they are situated and where to look for them.

As the celluloid semicircle easily slips out of its place over the diagram of the hemisphere, it would be an advantage if a screw-pin were placed through the centres of both with a clamp and screwed tightly, when the horizon line had been placed on the appropriate latitude on the side of the diagram of the hemisphere.

AN ARABIC ALGEBRA.

Compendio de Algebra de Abenbéder. Texto árabe, traducción y estudio por José A. Sánchez Pérez. Pp. xlvii+117. (Madrid: E. Mastre, 1916.)

THIS work is "a compendium of algebra composed by the sheikh Abu Abdullah Muhammad b. 'Umar b. Muhammad, generally known as Ibn Badr." Practically nothing is known about the author, and not much about the date of the treatise. The MS. on which this edition is based was written in A.H. 744 (=A.D. 1343), and the text contains a reference to Abu Kāmil (trans. p. 57, text p. 39) and "his book about algebra." The editor takes this Abu Kāmil to be Abu Kāmil Shujā' b. Aslam al-Ḥāsib (the reckoner). The treatise comprises a theoretical part and a collection of problems, or rather a set of numerical examples of particular types, followed by problems relating to practical affairs of commerce, etc. The theoretical range includes (in this order) quadratic equations, quadratic surds, law of integral indices, rule of signs for multiplication (given without any comment), multiplication of ordinary polynomials, division of one monomial by another, rule of transposition. Among the problems we have cases of simultaneous equations of various kinds; and it is clear (p. 70) that the author was acquainted with the arithmetical theory of proportion.

To a certain extent Ibn Badr makes up formulæ of the type $f(x, y)=0$ or $f(x, y, z)=0$ to solve a whole set of problems; see, for instance, pp. 88–90. He also discusses some problems which lead to linear Diophantine equations; for instance (pp. 90–92), we have the problem:—

"A man sold three kinds of grain, wheat, barley, and millet; the wheat at 4 dirhems per measure (*qafīz*), the barley at 2 dirhems per measure, the millet at half a dirhem per measure. Altogether he sold 100 measures for 100 dirhems; how many measures of each grain did he sell?"

This leads, of course, to the equations $x+y+z=4x+2y+\frac{1}{2}z=100$, and hence to $7x+3y=100$; but Ibn Badr's analysis is quite different from this. The editor concludes (pp. xix–xx) from the occurrence of problems of this type that the author belongs to the twelfth or thirteenth century.

An interesting feature of the text is the way in which different technical terms are used. Thus *māl,* which properly means "wealth," is used by Ibn Badr not only in the sense of "capital," but also (*e.g.* text p. 18, line 1) in the sense of x^2, and this even when x is a quadratic surd. Does this arise from marshalling troops in squadrons, or possibly from reducing areas to equivalent squares? Other terms are noted by the editor.

So far as we can judge, the editor's work seems to be very well done. Besides the text and translation we have an introduction describing the (unique) MS., now in the Escurial Library, photographic facsimiles of the first and last pages, a very useful summary of the contents (using modern notation), and a few notes on the history of mathematics in Spain.

This and other recently published works indicate that Spain is becoming really alive to the value of scientific research; it may be added that it appears under the auspices of the *Junta para ampliación de estudios e investigaciones cientificas.*

G. B. M.

OUR BOOKSHELF.

Cours de Manipulations de Chimie Physique et d'Electrochimie. Par M. Centnerszwer. Pp. 182. (Paris: Gauthier-Villars et Cie, 1914.) Price 6 francs.

WHEN a student actually measures the quantities involved in theory, a flood of light is frequently thrown on hitherto obscure points, and the object of the present practical course is to assist in the study of theory rather than to provide a training in manipulation. The book is orthodox according to the Ostwald school. It has been gradually evolved from teaching experience in the Riga Polytechnic, and meets with the approval of Walden. It thus has much to commend it.

Following the well-known Leipzig lines, it presents mostly familiar features, except that it is almost unique among books on practical physical chemistry in giving exercises on the measurement of critical constants. No other practical book, except Ostwald-Luther, so far as we are aware, deals with this subject, and in the short practical course at Leipzig the exercises on critical constants are marked as optional. The author's special experience in this field no doubt accounts for this novelty, and what makes it the more welcome is that the methods described have been put to the test.

Practical details are very fully given in the part on electrochemistry, which occupies 77 out of a total of 182 pages. We note, however, that a table of absolute potentials for elements is given instead of the more trustworthy and equally practicable potentials relative to the hydrogen electrode. This is possibly due to the elementary nature of the work, just as in most elementary books on general chemistry it is not considered wise to confuse the beginner by giving arguments in favour of the oxygen basis for atomic weights. The same desire for simplicity also explains the absence of reference to the degree of uncertainty in experimental results.

FRANCIS W. GRAY.

The Nation of the Future: a Survey of Hygienic Conditions and Possibilities in School and Home Life. By L. Haden Guest. Pp. 115. (London: G. Bell and Sons, Ltd., 1916.) Price 2*s.* net.

THIS little book, clothed in an ambitious and somewhat misleading title, deals entirely with the welfare of the school child and with the medical inspection and treatment of school children.

The first section deals with the disabilities to which school children are subject, their results, their treatment, and their prevention.

In the second section the method of carrying out the medical inspection of school children is described, the system being that which has been adopted by the London County Council. Finally, the case for the school clinic is presented to the reader.

The book is a popular one suited to the requirements of education committees, teachers, and health visitors, and as such may be useful. The text is illustrated with several plates.

Stars at a Glance. Pp. 48. (London: G. Philip and Son, Ltd., n.d.) Price 1*s.* net.

THIS simple guide to the stars will admirably meet the requirements of those who are commencing the study of astronomy or who have become interested in the heavens since the lighting restrictions came into operation. It provides an "aspect chart" for each month, which will enable the observer to make a general acquaintance with the stars visible at a specified time and date, and four additional charts showing the constellations in greater detail. An important feature is a calendar-index, whereby the proper chart to be consulted at any time may easily be selected. In conjunction with a compass-card which is provided, the charts may be conveniently used for purposes of night-marching. The text includes a useful introduction to the study of the heavens and some brief notes on the constellations and principal stars.

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.]*

A Plea for a Scientific Quadruple Entente.

THAT result of the present war which will, without the slightest doubt, have the most important consequences for the future is the evidence it has brought to the nations of the Entente of the terrible danger that they have run of being victims of German hegemony in all fields of human activity—economic, technical, and scientific. This danger has diminished since the war burst upon us; it was very great during the long time of peace that preceded the war, but the war warded it off just in time, and the nations of the Entente have hastened to adopt as remedies all kinds of measures of initiative—governmental and private—which will certainly be successful. Thus, new industries have been created, and we are preparing to create others, to make ourselves independent of Germany in the manufacture of certain products of the greatest importance that Germany used almost exclusively to furnish. Again, we are now seeking means to protect ourselves against the "dumping" of German products after the war to the detriment of our national products. Again, institutions and other means are being created expressly to make still closer that co-operation of science and technology which has worked miracles in Germany. Finally, after having become convinced of the power which, as we see by the domination of great enterprises, dwells in organisation, we have undertaken to formulate and spread abroad the fundamental practical principles of organisation for whomsoever can, and should, learn and apply them in any branch of the work of society.

This pacific war of liberation from German hegemony, that is being prepared even during this bloody war and that must be continued more vigorously than ever after peace comes, must also be carried into the scientific domain, of which also Germany was gradually taking sole control. The numberless *Archivs, Jahrbücher, Zeitschriften, Zentralblätter,* and so on, which have been yearly increasing in number and volume, have gradually monopolised the whole of the scientific production of the world by gathering widely, and even demanding, the collaboration of learned men of all countries. Thus were apparently built up international scientific organs, but in reality German instruments of control and monopoly of science.

It is, then, in this domain that it seems necessary to prepare and begin our pacific war of liberation from German predominance. I am far from wishing that, after peace is concluded, we should try to keep alive the hatred that has been stirred up by the war. The friends of science would wish to do so less than anybody. Rather, if the war leads—and it can and must lead—to the establishment of the principles of liberty of peoples and of respect for those of nationality and international justice, which can safeguard the peace of the world for a long time to come, it will be one of the chief tasks of science gradually to appease this hatred and to attempt to place this co-operation between various nations, and that feeling of international solidarity and human brotherhood upon which we seemed rightly to pride ourselves towards the end of the last century, on its old bases, which shall have become firmer because more just. But when we reflect that one of the motives which have been the most powerful in driving Germany to war has certainly been an immoderate pride and the pretension, which appears to us so ridiculous and was yet put forth by them in all seriousness, of being the chosen people, called upon by God to organise other peoples and show them the way towards a higher civilisation, the plan of taking away from Germany its hegemony in the scientific domain to arrive thus at lowering its unmeasured pride and its too high opinion of itself will appear as one of the surest means of guaranteeing peace for the future.

To take from Germany its scientific hegemony, one of the most suitable, efficacious, and prompt means is, it seems, the creation in each of the principal branches of science of "Archives," "Year-Books," and "Journals" in general, which are international in so far as collaboration and content are concerned, but which are edited and published in the countries of the Entente. As an eloquent symptom of that reaction against the stifling of the scientific production of the world thus exercised by Germany, we need only mention the recent creation at Petrograd of *Archives russes d'Anatomie, d'Histologie et d'Embryologie,* the very object of which is to permit Russian investigators to do without German publications.

The editing of each of these proposed publications ought to be done by representatives from the four countries: Great Britain, France, Russia, and Italy, and, if necessary, ought to have the moral and material support of the Ministers of Public Instruction and the most important scientific societies in these countries. Also the publishing should be entrusted to a society of four publishers chosen from among the principal ones of each country. Finally, each author should have the right to publish his work in his own language, but the articles not written in French should be followed, for the convenience of others, by their French translations—French being known to most educated people of all nations.

However, we ought not servilely to imitate the corresponding publications of Germany. Anyone who is even slightly acquainted with these publications will not have failed to notice a marked deterioration, in the case of most of them, in the course of the last few years. In fact, it is only too evident that their object was, not to spread many ideas or to make known the most interesting results of really important scientific researches, but to produce each year a certain number of hundredweights of printed paper, to the great profit of German publishing houses, if not to the honour of German science. The noticeable deterioration of these German publications is, then, due above all to the system of production on a large scale applied to the book-industry. But it is also favoured by the excessively analytic spirit of the Germans, which robs them of broad views and a resulting true perspective of things, and predisposes them to put on the same plane the whole of a collection of facts and researches in which nobody can distinguish what is very important from what is less important or not important at all.

The projected Entente publications must, then, in the first place, print less and select better. Then they must direct their attention to both synthesis and analysis; that is, they must always contain synthetic articles which attempt to group, at the moment of publication, the relations of analytical researches to the ideas or theories which will have been the inspirers and guides of those researches, and of which the seeker will have been more or less conscious. They must take account even of those researches which come from isolated thinkers who work on their own account and at one another's suggestion. Lastly, they must put the various writings into their correct plane by publishing at length the most important ones, giving long summaries of those which are less important, and merely announcing the results of researches which are too restricted or evidently unfruitful.

These publications must be, as I have said, international in so far as collaboration and content are concerned. The collaboration of neutral countries ought to be desired and sought, and, in the future, even German collaboration might be accepted, if the authors should wish to become acquainted with, and appreciated by, the scientific men of the nations of the Entente as well as of their own group of nations. Thus these publications would have the effect of taking away from Germany that monopoly of science at which it has arrived during fairly recent years with so much success. We would thus show it the value of the scientific contributions of other nations, and this would lower its immoderate and ridiculous pride which has been one of the causes of the present war. This, moreover, would be without taking the least hostile action against German science.

It may perhaps be permitted to the writer of this letter to recall how, before the war, amicable proposals were made to him from Germany—both by contributors and by other authorised representatives of German science—that, in the international scientific review which he has the honour of editing, the supplement which contains French translations of all articles written in German, English, or Italian, and published in the text in those languages, should be replaced by a supplement containing German translations of the English, French, and Italian articles. Evidently this international review seemed to them, conducted as it was, and is, by non-Germans, a kind of menace to their scientific hegemony, which they were trying to consolidate more and more. Thus, they tried to arrange that it should at least have a German air and colour to take away its dangerous look of a standard of revolt against German hegemony.

The hour has come to create and develop as much as possible in the principal branches of science, under the ægis and direction of the Entente, international scientific publications and reviews which should be fitted to destroy finally a monopoly which, if it foments sentiments contrary to the establishment of international relations founded on mutual esteem, constitutes a very grave danger for the progress of science. These suggested periodicals will thus contribute to re-establish on bases of independence and equality that equilibrium of nations which will be the greatest guarantee of a peace that is just, long, and to the benefit both of our present Allies and of our present enemies.

EUGENIO RIGNANO
(Editor of *Scientia*).

Stability in Flight.

IN his paper on "Forced Oscillations of a Disturbed Aeroplane" (*Aeronautical Journal*, October–December, 1916), Dr. Brodetsky shows, on theoretical grounds, that among the chief conditions of safety and stability in windy weather are: (1) a small tail, or small ratio of tail/main-plane, and (2) comparatively small wings, or small ratio of total area/load. In a former paper by Prof. Bryan and Dr. Brodetsky (*ibid.*, April–June), the fact that long tails are on the whole disadvantageous is demonstrated. All these conclusions seem to agree well with what we may very easily observe in birds. Those birds the flight of which is what one might call skilful, or agile—that is to say, those which can rapidly dodge and steer, or which do not mind flying in high and shifty winds—are (I should say) all characterised on the whole by small tails and comparatively small and narrow wings. These features are conspicuous in many of our shore birds, sandpipers and the like, and the birds are equally conspicuous for their extraordinary stability, whether against wind or in their own sudden and acute changes of course. Seagulls, solan-geese, albatrosses, and swallows share, more or less, in the same structural characteristics. Powerful or long-continued flight is evidently quite a different thing. Thus the pigeon is a splendid flyer for mere distance, and even for speed; but it goes straight ahead, and its large tail and large rounded wings give it only a moderate "stability." In like manner a multitude of little birds, robins and the like, which we are apt to think of as bad or unskilful flyers, turn out to be very good flyers indeed upon their migratory journeys, when all they have to do is to pursue an even course in high and relatively calm regions of the atmosphere, and also (as we may suppose) in carefully selected weather. On the other hand, the really long-tailed birds, such as the magpie and some of the foreign jays, trogons, etc., are all very poor flyers, and are for the most part birds of the sheltered woodlands.

Another case in point is that of the hawks and falcons. The broad-winged hawks, such as the buzzards and the kestrel (the latter with its long tail, which it uses effectively for another purpose), were all despised of the falconer; the kinds with long and narrow wings, like the merlin and the peregrine, were the ones he prized.

I am curious to know what experts think of another matter, namely, the long, outstretched legs of such birds as the stork and heron. One used to be told that these serve as a rudder, making up for the insignificant size of the tail, but this explanation seems far from satisfactory. I imagine the long legs act as a very useful counterpoise to the long neck and bill; that they help to adjust the position, longitudinally, of the centre of gravity (which Borelli says ought to be directly under the articulation of the wings); and further, that the lengthened axis so formed, from beak to outstretched toes, may play the part of a sort of balancing pole, and contribute very materially to the creature's longitudinal stability. In any case, it is certain that these long-legged birds are extraordinarily graceful flyers, remarkable for their perfect balance and quiet, easy motions.

D'ARCY W. THOMPSON.

An Explosion Effect.

A RECENT explosion has, like all other similar occurrences been productive of many curious results, but one that I have noted seems worth special mention. There is a row of large houses in an exposed situation, directly facing the centre of explosion, but about three miles from it, and in front of one of these houses is a medium-sized pond. In this row most of the houses have escaped, only two or three broken or cracked windows being noticeable among the lot, with one exception. That exception is the house facing the pond, which, so far as glass is concerned, is wrecked. From appearances it might have been played over with a machine-gun. One house near, and also facing the pond, has only one window damaged, but in this case the sashes are destroyed as well as the glass. It appears that nearly every window situated on a line crossing the pond from the explosion centre has suffered extra violence. I believe similar results have been noted before over water, but this seems a very striking instance. I should, perhaps, add that the glass destroyed was of indifferent crown quality, whereas the other houses appear all to have thin plate-glass; but much crown glass has escaped damage in other positions, where heavy plate has gone to pieces, so I think it clear that the pond, and not the quality of the glass, was the contributory cause.

C. WELBORNE PIPER.

THE INFLUENCE OF PHOSPHORUS AND SULPHUR ON THE MECHANICAL PROPERTIES OF STEEL.

IN drawing up specifications of the chemical composition of carbon steels the following five elements are invariably included: carbon, silicon, manganese, phosphorus, and sulphur. With respect to the first three it is always specified that the percentage present shall fall *within* certain limits, whereas as regards the last two only an *upper* limit is demanded. These specifications are based on the assumptions that while carbon, silicon, and manganese confer desirable properties on the iron with which they are alloyed, the character and degree of which can be regulated by the amount introduced, phosphorus and sulphur act unfavourably, and should be kept down to the lowest possible figures. They are universally regarded as embrittling agents, which must on no account be present above a certain limit in any particular case. In fact, if it were possible to reduce the percentage of these elements to nil in commercial steels, few, if any, engineers would hesitate to specify that such steels should be absolutely free from them.

The war, however, has upset a number of views which previously were regarded as well established, and in a paper presented at the autumn meeting of the Iron and Steel Institute in London entitled "The Influence of Some Elements on the Mechanical Properties of Steel" Dr. Stead has given a distinct jog to the opinion that sulphur and phosphorus are always and necessarily deleterious to the properties of the steel with which they are alloyed. The paper is one of considerable length, and deals not only with the five elements mentioned above, but also with copper and tin. It is in the nature of a stocktaking of the results reached in researches bearing on the influence of these particular constituents. Naturally carbon and the heat treatment of steel come in for the lion's share of attention, but it is only in the case of sulphur and phosphorus that Dr. Stead has arrived at conclusions which challenge generally accepted opinions, and which deserve—and on account of their far-reaching practical significance are certain to obtain—the most searching scrutiny and, indeed, criticism.

From first to last the word "shell" is never mentioned in the paper. Nevertheless it is the fact that it was the bombardment of Hartlepool, Scarborough, and Whitby in December, 1914, by the German battle-cruiser squadron which gave the impetus to Dr. Stead's investigation. Pieces of German shells were analysed by him and found to contain considerably higher percentages of sulphur and phosphorus than are permitted in British specifications of similar material. This at once raised in his mind the question whether it is really necessary to adhere to the particular percentages in vogue, and caused him to study anew the evidence upon which existing specifications have been based.

Considering phosphorus in the first instance, it would appear from the researches of Dr. Stead and d'Amico that within certain limits the effect of 0·1 per cent. of this element is comparable with that of carbon, as the following table shows:—

	The effect of 0·1 per cent. of carbon.	The effect of 0·1 per cent. of phosphorus: Stead	The effect of 0·1 per cent. of phosphorus: d'Amico.
	Tons per sq. in.	Tons per sq. in.	Tons per sq. in.
Yield point, raised	1·78	2·5	2·3
Maximum stress, raised	4·18	2·4	4·1
	Per cent.	Per cent.	Per cent.
Elongation, reduced	4·35	0·7	1·36
Reduction of area, reduced	7·40	1·5	3·8

It will be observed that carbon causes a proportionately greater reduction of ductility than phosphorus, and, judged by this test, is a more powerful embrittling agent. Furthermore, it appears from Dr. Stead's experiments that a steel containing 0·30 per cent. of carbon and 0·50 per cent. of phosphorus resisted long-continued rotary stresses better than a steel with the same carbon percentage and only 0·04 per cent. of phosphorus. These steels were in the forged condition, and their structure was "very fine." Dr. Stead also claims that "there is no reliable record showing that sound steel rails containing from 0·07 to 0·09 per cent. of phosphorus break up on the track more frequently than those containing less phosphorus," and that "phosphoretic rails undoubtedly resist wear better than the same rails with less of that element present." He recalls the fact that previous to the use of steel rails, when iron was employed, it was customary "to have iron very rich in phosphorus in the heads of the rails, for it was recognised that the phosphoretic iron wore better than the purer material." His general conclusion is:—"When judging the properties of steel note should be made of the fact that in many cases when carbon is rather low phosphorus may be an advantage, for it has similar influence to carbon which it replaces. Phosphorus has got a bad name, like many other elements, but, far from always being an enemy, is often a friend."

As regards the influence of phosphorus on wrought iron, Dr. Stead affirms that the best Yorkshire and Staffordshire irons contain between 0·10 and 0·15 per cent. of this element, and that for structural purposes they are superior to the best Swedish irons, which contain a smaller amount. The elastic limit, yield point, and ultimate stress are all raised, and the irons weld more easily. The danger limit is put by him at from 0·4 to 0·5 per cent., in which range brittleness develops and also a tendency to very coarse crystallisation if such iron is heated to high temperatures.

Ever since the pioneering work of Brinell, Wahlberg, and Arnold, it has been recognised that provided rather more than sufficient manganese is present to form manganese sulphide with the sulphur in steel, no red-shortness occurs. Arnold and Waterhouse showed this in 1903 for a steel of the following composition:—

Carbon	Silicon	Manganese	Sulphur	Phosphorus
0·460	0·369	1·060	0·560	0·055

which rolled perfectly, and was found to be ductile both in the tensile and impact tests. They also proved conclusively that while sulphide of manganese in steel is not deleterious, sulphide of iron is very deadly in its effect, and showed why this was so. Nevertheless sulphur had got a bad name in the early days of steel-making, chiefly owing to the fact that it was impossible to introduce sufficient manganese without raising carbon unduly, the only material available being German spiegeleisen. When, however, the Ebbw Vale Steel Company was able to produce an alloy containing a much higher percentage of manganese this difficulty vanished. In spite of this, sulphur's bad name has stuck, and even to-day, according to Dr. Stead, steel rails are rejected which pass all the specified mechanical tests because the percentage of sulphur exceeds an arbitrary limit. He states that steel high in sulphur resembles wrought iron, and is, like that material, more or less fibrous. Perhaps his most interesting—certainly his most challenging—statement with regard to sulphur is the following:—"It is a fact that steel called free-cutting fibrous steel is being imported and used in England to-day, and the peculiar properties referred to are due to the deliberate introduction of sulphur into the steel. Such material contains about 0·15 per cent. sulphur. Sulphur, then, may be regarded as a friend when it is used intelligently, and not invariably as the enemy it is represented to be." A point, however, in connection with the question of the possible use of high-sulphur steels that requires careful investigation is whether such materials would be more liable to atmospheric corrosion than low-sulphur steels.

The issues raised by Dr. Stead with regard to the influence of phosphorus and sulphur in steel are of the utmost importance in their relation to the manufacture of steel in this country, both during and after the war. In the discussion on his paper he stated that at the beginning of the war sulphur was restricted to 0·04 per cent. in all shells, and that it was alleged that these would be liable to fail if the proportion was raised to 0·06 per cent., but that, thanks to Sir Robert Hadfield, the limit had been raised to the higher figure, and shells did not fail more in the gun than formerly. This raising of the limit has made it possible to increase the output of shell steel. Can the limit be raised still further? That is the question. The case that Dr. Stead has made out for reconsidering the particular limits imposed on sulphur and phosphorus in ordnance steel specifications is very strong. Chemical analysis is introduced into steel specifications in order to aid in securing that the requisite properties—chemical, physical, and mechanical—are obtained. If steels possessing those properties can be prepared which do not come within the chemical specification the latter requires revision. In such matters chemical analysis is the servant. It should not be allowed to become the master. By all means let the authorities concerned subject Dr. Stead's conclusions to the severest criticism, and test them experimentally in the most thorough way. It ought to be done without delay. He has raised the question in the interests of the nation. It is earnestly to be hoped that the authorities will approach it in the same way.

H. C. H. CARPENTER.

WORK OF THE GOVERNMENT LABORATORY.

FROM the recently issued report of the Government Chemist,[1] it appears that 239,706 samples were analysed at the Government Laboratory during the course of the year 1915–16. This is an increase of some 9300 samples compared with the previous year, and of about 5000 compared with the year 1913–14, before the outbreak of war. The samples comprised a large variety of articles.

The greater part of the work of the department is carried out in the main laboratory at Clement's Inn Passage and in the branch laboratory at the Custom House. There are, however, eighteen chemical stations in different parts of the United Kingdom at which revenue samples alone are examined; these were responsible for the testing of an additional 144,186 samples of dutiable goods during the period in question. At one time the laboratory was devoted solely to revenue work. It was, in fact, established (in the year 1843) with the single object of checking the adulteration of tobacco. From time to time, however, State departments other than those concerned with fiscal questions have found that they required assistance in the form of analytical work or other matters involving chemical knowledge, and the services of the laboratory officials have been requisitioned to meet these demands, as well as to carry out the provisions of certain statutes relating to the adulteration of foods, drugs, and other articles. Thus from a purely revenue establishment the laboratory has in process of time become a general State laboratory for purposes lying mainly in the domain of analytical chemistry, but including also advisory work arising in connection with a considerable variety of chemical questions.

With this extension of scope the status of the laboratory has naturally undergone alteration. Some time ago the department was reconstituted, and it may be of interest to indicate its present standing. Whereas in the early stages of its career the laboratory was a small scientific branch placed under the control of a large fiscal department, it has now been made a separate and independent establishment supported by funds provided under a separate Vote in Parliament—namely, that for the "Department of the Government Chemist." The head is a scientific man responsible directly to Parliament for the expenditure of moneys voted. Thus the laboratory is now under a single administrative control, and, subject to general oversight by the Treasury, enjoys the privilege of independent action.

This alteration of status is a matter of some importance as indicating a sympathetic and sagacious policy for which the authorities deserve due credit. No doubt it might be said that the former arrangement had its counterpart in such instances as the Greenwich Observatory (placed under the Admiralty) or the Geological Survey (under the Board of Education). These, however, are not quite analogous cases. It was a question

[1] Report upon the Work of the Government Laboratory. Cd. 8394. (London: Wyman and Sons, Ltd., 1916.) Price 2½d.

of setting up an establishment to which all the departments should have, as it were, a right of access. The giving of the laboratory an independent position places on the same footing all the departments requiring its services. Necessary chemical assistance can be applied for as a matter of right rather than as a favour asked by one department from another, and the director of the laboratory has a freer hand in utilising his resources for the general benefit.

Thus the functions of the laboratory as now constituted may be briefly described as the giving of assistance, both experimental and advisory, on chemical questions to any other Government department or to any Government committee or commission which may require its aid.

The ordinary work includes a good deal of routine analysis, which falls chiefly into four categories. First, there are analyses made in connection with the collection and safeguarding of the revenue raised from dutiable articles—as, for instance, in the assessment of duty and rebates upon beer, spirits, wines, table-waters, tobacco, tea, coffee, cocoa, sugar, and saccharin. In this branch are also included analyses of medicines examined under the Medicine Stamp Acts, and chemical examinations required in connection with licensing regulations and the manufacture and sale of excisable commodities.

A second category includes work done in connection with the administration of certain Acts of Parliament under which chemical analyses are prescribed. These comprise, for instance, the examination of imported dairy produce under the Sale of Food and Drugs Act, 1899; analyses under the Butter and Margarine Act; samples taken under the Public Health (Milk and Cream) Regulations; disputed analyses of foodstuffs and drugs referred by magistrates for independent analysis under the Sale of Food and Drugs Act, 1875; and analyses of fertilisers and feeding-stuffs submitted by the Board of Agriculture as a preliminary to legal proceedings under the Fertilisers and Feeding-Stuffs Act.

A third branch is concerned with analyses required in connection with administrative regulations issued by various State departments. Such are, for example, analyses made for the Factory Department of the Home Office in reference to dangerous trades and to special inquiries affecting the health of industrial workers; and those for the Board of Trade in respect of medical supplies, disinfectants, and lime-juice required to be carried on board ocean-going ships. During the war this branch of work has been largely increased by the analyses of many articles submitted in connection with the issue of trading licences by the War Trade Department.

In the fourth category is included the examination of stores, supplies, etc., required by the various large departments, *e.g.* the Admiralty, War Office, Post Office, and so on. Thus the report points out—as indeed would be expected from the special circumstances of the time—that heavy demands for assistance have been made during the year upon the laboratory by the first two of these departments. Nearly 8300 samples, chiefly metals, were analysed for the Engineering Department of the Admiralty, and 8901 specimens of foodstuffs were examined in connection with the supply of H.M. Forces.

In addition to the ordinary routine operations, a considerable amount of research work is carried out by the laboratory in connection with questions referred to it by public departments seeking information and advice. Thus researches upon the composition and properties of celluloid and upon the alleged emanation of lead vapours from painted surfaces are described in the recently published reports of the Departmental Committees on Celluloid and on Lead Paints respectively. Other recent researches, carried out for the Board of Agriculture, relate to the utilisation of various by-products as feeding-stuffs, to the effect of air and moisture upon liver of sulphur during storage, and to the solubility of the phosphates in basic slags.

Apart from experimental work, various chemical questions arise on which the laboratory is consulted by public departments. Thus the report notes that numerous references concerning the use of alcohol were dealt with for the information of the Commissioners of Customs and Excise; whilst reports upon a number of subjects, including the supply of potash and the value of various refuse materials as a source of potash, were furnished to the Board of Agriculture and Fisheries. Many matters relating to contraband trading with the enemy (prohibition orders) were also submitted for advice.

In recent years, and especially since the scope of the laboratory has been extended, the work has shown rapid growth, both in quantity and in the variety of samples submitted. Naturally, therefore, questions of ways and means to cope with the increased demands have arisen. The present premises at Clement's Inn Passage were erected about twenty years ago, and at that period they were sufficient; but it is understood that they have now for some time been inadequate, and that the question of building-extension was actually under consideration when the outbreak of war caused the postponement of the matter. But the demands have not been postponed, and it requires no seer to foretell that, in view of the importance of science to administration which recent events have emphasised, the demands will, in fact, continue to increase. It is fairly evident that if the chemical work assigned is to be properly carried out the necessary equipment in buildings, staff, and appliances must keep pace with the requirements. A department devised to render service on chemical matters to all branches of the Executive is an excellent conception, but the effective carrying out of the idea depends, of course, upon the provision of adequate means. It may confidently be hoped that the project so well begun will be suitably completed, and provision made not only to cope with the pressing work of to-day, but to allow of the expansion which will certainly be needed to-morrow.

THE SCARCITY OF WASPS.

THE correspondence in NATURE recently (October 12 and 26 and November 16) on the scarcity of wasps during the late summer and autumn of last year raises some interesting and difficult questions. In various parts of Great Britain—from Wigtownshire, Cheshire, and Gloucestershire to Kent—this scarcity has been observed, following on an abundance of queens in spring. The wet and cold conditions prevailing in spring and early summer are suggested as the explanation by most of the writers who contributed observations, and this inclement weather would naturally be accompanied by a scarcity of the insects—caterpillars, greenfly, diptera, etc.—on which wasps feed their grubs. In a letter to the *West Kent Advertiser* for November 24, Mr. G. W. Judge suggests that famine rather than cold was responsible for the mortality. Mr. W. F. Denning's definite observation (*supra*, p. 149) of the dying out of five nests of *Vespa vulgaris* near Bristol in June is noteworthy in this connection. Mr. A. O. Walker's theory that the queens of last year's spring were largely infertile would be difficult to support by observation. Mr. O. H. Latter[1] has suggested that a mid-winter with much "open" weather—such as prevailed in January, 1916—is deadly to queens by tempting them out of safe winter quarters. This cause can, however, scarcely be invoked to explain the paucity of autumn workers after a spring like that of 1916, rich in queens.

The fact that worker wasps were abundant enough in some places makes it likely that other factors affecting the numbers of these insects still require investigation. Mr. H. St. G. Gray wrote (p. 209, *supra*) that they were too plentiful on the Somerset hills, and they certainly swarmed in the neighbourhood of Dublin during September. Referring to past records, I find that 1897 and 1907 were years marked by great scarcity of wasps in Ireland; the latter of these summers, at any rate, was abnormally wet and cool.

Most writers in NATURE and elsewhere express satisfaction at the temporary reduction in the wasp population. The damage done by wasps to fruit is undoubtedly great in normal seasons, and they also take a valuable portion of our food-supply by their habit of robbing bee-hives of honey. On the other hand, as Mr. Latter and Mr. Denning point out, wasps are of considerable service in destroying multitudes of harmful insects, with which they feed their larvæ. The fierceness of wasps has been greatly exaggerated; unless attacked or annoyed, their disposition is placid, though one requires, perhaps, to be an admirer of the insects to be able to watch with serenity a dozen of them crawling over one's food. From the point of view of rural economy, it seems desirable to encourage wasps until the fruit season, and then to wage such war on them as may be found necessary.

GEO. H. CARPENTER.

[1] "Bees and Wasps" (Cambridge University Press), p. 44.

NOTES.

ONE of the saddest incidents of the recent terrible explosion in a works engaged in refining explosives is the death of Mr. Andrea Angel, who was at the time acting as chief chemist and assistant-manager. The exact cause of the disaster is at present unknown, but it was preceded by an outbreak of fire. When the alarm was given, Mr. Angel, who was in his quarters, went at once to the scene of the fire and warned the operatives, many of whom undoubtedly owe their lives to his devotion to duty. Mr. Angel was born at Bradford in 1877. He was educated at Exeter School, from which he went to Christ Church, Oxford, as an exhibitioner. He took a first class in chemistry in the Honour School of Natural Science in 1899, was afterwards elected Dixon research scholar, proceeded to the degree of M.A. in 1903, and took the B.Sc. degree three years later. He acted for some years as lecturer in chemistry at Brasenose, and latterly at Christ Church, and was also tutor in chemistry to non-collegiate students. Shortly after the outbreak of war he gave up his work at Oxford and took up that on which he was engaged at the time of his tragic death. Mr. Angel was a fellow of the Chemical Society, and although the exacting duties of a college tutor left him little leisure for research, he was able to make several original contributions to the subject which have appeared in the Transactions of the society. He first published in 1902, in conjunction with his tutor, Mr. Harcourt, "Observations on the Phenomena and Products of Decomposition when Normal Cupric Acetate is Heated," and afterwards papers on "Cuprous Formate" in 1906 and on "The Isomeric Change of Halogen-substituted Diacylanilides into Acylaminoketones" in 1912. He was a man of a very lovable and unselfish nature, and will be greatly mourned by a wide circle of friends and old pupils.

AN important letter from Lord Blyth appeared in the *Times* on January 22 emphasising the necessity for the close co-ordination of science with practice in agriculture for the purpose of increasing the food production of the country. Lord Blyth's proposal is the immediate appointment of a Commission of men of science who shall devote their time exclusively to research in connection with the varying characteristics of the soil throughout the country, the crops most suited to each locality, the best methods of treating and manuring such land, the most suitable artificial manures to be used for each purpose, and the best substitutes for such of these as may be temporarily unobtainable by reason of scarcity or cost. As time is pressing the work should be put in hand at once and information promptly circulated through the War Agricultural Committees. This proposal will, we are sure, be received sympathetically on all sides, though, as a matter of fact, it is understood that such a Commission is already in process of formation. Throughout the war the agricultural colleges and experiment stations have rendered useful service, and have demonstrated more convincingly than ever the close connection between science and agriculture. Indeed, never before has agricultural science had so much recognition as now, either from farmers or from men engaged in pure science, and it is hoped that the new conditions will do much to strengthen still further the development of scientific agriculture in this country.

PARTICULAR attention is directed to the important letter which appears in another column from Prof. Eugenio Rignano, the well-known psychologist and editor of the Italian scientific monthly, *Scientia*. The question as to the establishment of year-books and international scientific journals in the countries of the

Entente is one of the most pressing at the present time. Hitherto, as is well known, we have been largely dependent on Germany for those yearly condensed and detailed reviews of progress in the different branches of science which form such an indispensable aid to all scientific workers. It is urgently necessary that the countries of the Entente should take a share—and perhaps the whole burden—of such publications in the future. Indeed, both because of the industrial harm that Germany has done us in the past by monopolising, to all intents and purposes, this department of scientific work, and because we ought certainly to overcome that inertia which German activity seems to impress on the rest of the world, it is very advisable to follow the leadership of commerce and produce more of the labour which is of such great use in science outside Germany. The present is the time for action, and we hope that Prof. Rignano's letter will meet with a ready response from those in power, as well as suggestions from British men of science.

DR. SIMON FLEXNER, director of the Rockefeller Institute for Medical Research, New York, has been elected a foreign associate of the Paris Academy of Medicine.

A PROPOSAL to introduce summer time again this year has been rejected by a majority of the Committee of the Prussian Diet, as it is considered that the change was a failure last year.

THE death is announced, at seventy-one years of age, of Mr. A. E. Jamrach, widely known among zoologists as a dealer in wild animals, which he imported from all parts of the world for zoological gardens, menageries, and private persons. For a long time almost the whole of the wild beast trade, both in this country and on the Continent, was under Mr. Jamrach's control.

THE death is announced, in his seventy-fifth year, of Dr. Henri Emile Sauvage, founder, and until recently director, of the Station Aquicole, Boulogne-sur-Mer. Dr. Sauvage studied fishes, both recent and fossil, from every point of view, and published a long series of memoirs and papers bearing both on zoology and geology, and on several economic questions connected with these sciences. From 1874 to 1883 he was assistant-ichthyologist in the Paris Museum of Natural History, and made many contributions to knowledge of the fishes of West Africa, Indo-China, and Madagascar. In 1891 he also contributed a large volume on the fishes of Madagascar to M. Grandidier's well-known work on that island. His most important writings on fossil fishes related to those of the French coal-bearing formations, but his smaller papers dealt with new species from many sources, among which may be mentioned Jurassic fishes from Catalonia (Spain) and from his own neighbourhood of Boulogne-sur-Mer. He was also for many years director of the Boulogne Museum, and took a deep interest in all local affairs. Dr. Sauvage was elected a foreign correspondent of the Geological Society of London in 1879, and a corresponding member of the Zoological Society in 1904.

THE death, on January 16, of Mr. Benjamin G. Cole brings to a close a remarkably long period of service as hon. secretary of a local scientific society. The Essex Field Club was founded in 1880 by Mr. William Cole, A.L.S., who is still its hon. secretary; but, two years later, his brother, above-mentioned, became associated with him as assistant hon. secretary, and served for thirty-five years continuously. Mr. Cole, a son of the late Mr. Julius Cole, of the Trinity House, was approaching the age of seventy, and was unmarried. In his earlier days he was a very ardent entomologist. In company with his brother William, Prof. Raphael Meldola, Mr. E. A. Fitch, Mr. W. J. Argent, and others, he collected very actively, chiefly in the fields (now built over) around Clapton, in Epping Forest, on the Essex marshes, and elsewhere. The pages of the *Essex Naturalist* and the entomological journals record not a few of his more interesting captures. Of late years his collecting was done mainly on the saltings and marshes around St. Osyth, where he lived in an old Martello Tower, converted into a dwelling, which enjoys a remarkably fine and extensive view over sea, land, river-mouth, and adjacent islands. Mr. B. G. Cole also assisted his brother as hon. curator of the Epping Forest Museum at Chingford.

THE death of Prof. J. B. Auguste Chauveau, which we announced in our issue of January 11, removes from among us one of the most famous and many-sided biologists of our time. He was born in 1827, and at the age of twenty-one was elected on the staff of the Lyons Veterinary School, of which he became director in 1875. He was later appointed Inspector-General of Veterinary Science in France, and at the time of his death he was professor of comparative pathology at the Paris Natural History Museum, where he built a new institute for the study of comparative physiology and pathology. His pathological work dealt mainly with the nature of contagion and of viruses, and included important work on tuberculosis, septicæmia, and smallpox. His treatise on the comparative anatomy of the domesticated animals is a monument to his fame as a veterinarian, but he is perhaps best known as one of the makers of physiology during the latter half of the last century, and one of the founders of the *Journal de Physiologie et Pathologie Générale*. Although he did work on the biochemical side (glycogenesis and sugar utilisation), the mechanical side more especially was his *forte*; the cardiac sound of Chauveau and Marey, and the dromograph of Chauveau and Lortet, are classical instruments which did much to perfect our knowledge of the circulation, and will live in scientific history. Personally he was an attractive figure; his fine presence was striking, his amiable characteristics made him much beloved, his untiring energy, even until late years, and his catholicity of outlook inspired the young generation of investigators who came in contact with him. Such men the world can ill spare.

THE report of the Bristol Museum and Art Gallery for the past year indicates that in spite of the war steady progress has been continued. Many convalescent soldiers have made use of the institution, and one Australian, invalided to England, has presented a collection of beetles made while he was on service in Egypt. A special exhibition of flowers, fruit, and insects to commemorate the Shakespeare tercentenary was on view, and to this department the late Mme. G. Jervis presented valuable botanical works. The insect collection has been rearranged, and is now more than of local importance. The inclusion of the Chaning Pearce collection of fossils from the Great Oolite, Bradford Clay, and Forest Marble of the west of England is of great value as an addition to the older series. A collection of sketches in oils illustrates events in the past history of the city.

PROF. FLINDERS PETRIE publishes, in *Ancient Egypt*, part iv. for 1916, an important paper on "Funereal Figures in Egypt." To reach the beginning of the use of such figures he goes back to existing beliefs in Africa, where the love and veneration of the family still remain in full force. Hence a token in some form of the dead is preserved in the household. The Egyptians seem to have retained the savage custom of keeping in the family the head of the deceased. For his benefit, however, it was held necessary to return it to the grave; and the next stage was the provision of a stone image of the head in the grave, in case the actual head was lost or injured. The stone mummy figures appear at first as a plain, bandaged mummy, without any hands or detail except the face, which gave it personality. It is on rough wooden figures of the Seventeenth Dynasty that the wood *shuabti,* whence came the name of the well-known Ushabti figures, first appears. Prof. Petrie gives a fine series of illustrations of the later developments of these figures, and provides a transcript and translation of the formulæ inscribed upon them.

THE *Indian Journal of Medical Research* for October, 1916 (vol. iv., No. 2), contains valuable papers on the epidemiology of malaria in Malaya and on anopheline mosquitoes by Mr. C. Strickland. Mr. E. H. Hankin details several simple tests for narcotic and anæsthetic drugs which should be of much use. Major Harvey discusses birth and marriage rates and fertility among Brahmins and Indian fighting communities. Capt. Fox describes experiments undertaken to ascertain the relative values of the various kinds of cholera vaccines. The most effective seems to be a heated vaccine without phenol, the next in order being living culture. A useful feature of the number is a summary of recent medical research in Germany dealing with dysentery, epidemic jaundice, paratyphoid fever, and methods of cholera diagnosis.

THE prize essay on "A Scheme for Maternity and Child Welfare Work," by Miss Isabel Macdonald and Miss Kate Atherton, is published by the Royal Sanitary Institute, price 1s. The essay is divided into two parts: (1) preliminary organisation, and (2) the scheme in operation. For a typical district with, say, 2500 births a year, the cost per annum for such a scheme is estimated at 1230*l.* for staff and 1500*l.* for buildings (rent, rates, upkeep, etc.). The accommodation suggested comprises (*a*) waiting-room; (*b*) dressing-room; (*c*) weighing- and recording-room; (*d*) one or two consulting-rooms; (*e*) isolation-room; (*f*) dispensary; (*g*) office; (*h*) staff rooms and offices; (*i*) sanitary accommodation. As regards the scheme, it is remarked that ante-natal care can only be dealt with incidentally, as no machinery exists for the notification of pregnancy. This difficulty might, however, be met to some extent by co-operation with the district visitors of religious denominations. The compulsory notification of births enables the health visitors of the centre to visit the home within two or three days of the notification. Teaching would be given to mothers and voluntary workers on the feeding and health of children and general care of the infant. Infant consultations with a supply of milk and medicine would be available at the centre. Health lectures, day nurseries, and many other activities in connection with the centre are dealt with.

THE question of the physiological aspect of mountaineering is discussed at some length in a paper by Dr. A. M. Kellas on a consideration of the possibility of ascending the loftier Himalaya (*Geographical Journal* for January, xlix., No. 1). The physiological difficulties depend upon the deficiency of oxygen. The evidence from balloon ascents to high altitudes would tend to prove that the ascent of peaks of 28,000 ft. or 29,000 ft. would be impossible, but the balloonist ascends so rapidly that he has no opportunity of becoming acclimatised. The fact is of fundamental importance, for experience has shown that men can become accustomed to air deficient in oxygen. The case of Pike's Peak (14,109 ft.) is cited. Four factors concerned in acclimatisation to high altitudes are: first, the oxygen pressure in the alveolar air which rises; secondly, the number of red-blood corpuscles and the quantity of hæmoglobin in the blood, which increase in due proportion to each other; thirdly, the possibility of actual secretion of oxygen in the lung epithelium; and, fourthly, the more rapid circulation of the blood-stream during exercise. The conclusion which Dr. Kellas arrives at, after discussing these factors, is that towards the summit of Mount Everest (29,141 ft.) the climber would probably be near his last reserves in the way of acclimatisation and strength, but that he could accomplish the feat provided that the physical difficulties above 25,000 ft. are not insuperable.

THE Proceedings of the United States National Museum, vol. li., 1916, contains a long report, by Messrs. C. H. Gilbert and C. L. Hubbs, on the Japanese Macrourid fishes collected by the U.S. Fisheries steamer *Albatross* in 1906, with a synopsis of the genera. The authors find themselves in disagreement with previous workers on this group of fishes, not merely in the matter of nomenclature, but also on the more important questions of classification and the characters on which this is founded. They regard the branchiostegal rays as being more trustworthy than the dentition. The serration of the dorsal spine they also regard as affording a valuable character, while the position of the coracoid foramen, used by Regan and others, they consider as of no generic value in this group. But it remains to be seen whether the purely superficial characters adopted as a systematic basis in this report will stand the test of time.

THE Annals of the South African Museum (vol. xv., part v.) is devoted to the description of some South African Ichneumonidæ, and new, or little-known, Orthoptera. The account of the Ichneumonidæ has been written by Mr. Claude Morley, who describes several new species. Dr. L. Péringuey is responsible for the section on the Orthoptera. He describes a number of new genera and species of the families Acrididæ and Locustidæ. In his account of the remarkable and non-saltatorial Pneumorinæ he makes some interesting remarks on their powers of stridulation. Camping, on one occasion, in a waterless spot near the seaboard of Saldanha, he tells us, the deep voice of *Bulla immaculata* could be heard above the din made by innumerable geckoes, occupying clumps of reeds growing in this sandy spot. This was just after rainfall, when the noise made by the lizards was like the croaking of countless frogs. Dr. Péringuey also makes some noteworthy observations on the coloration of these extraordinary insects. His paper is illustrated by several text-figures and one plate.

IN the Journal of the Washington Academy of Sciences (vol. vi., No. 20) Mr. T. Wherry publishes the results of an interesting investigation on the soil conditions favoured by the walking fern, *Camptosorus rhizophyllus*. This fern, it is always stated, prefers a calcareous habitat. In the course of the present investigation, however, it has been collected not only on limestone, but also on granite, shale, sandstone, tree-trunks, and other substrata not usually classed as calcareous. Chemical analysis has shown that the actual soils in which the fern grows are rather high in their percentage of both total and soluble lime. Rocks with much lime suffer leaching during soil formation, and those poor in lime gain it through the decay of vegetable matter, and the average lime content of the soil on which the walking fern was found was about 4 per cent. The occurrence of chalk-loving plants therefore does not necessarily indicate the presence of lime in the underlying rock strata, except in cases where circumstances preclude the accumulation and decay of vegetable matter, and the resulting accumulation of lime in the soil. This investigation throws some light on the question of rhododendrons growing on limestone rocks referred to in NATURE of November 2, 1916 (p. 171).

MR. LEONARD HAWKES, in a paper on "The Building-up of the N. Atlantic Tertiary Volcanic Plateau" (*Geological Magazine*, 1916, p. 385), shows that the numerous red partings in the basaltic series of Iceland are due to layers of glassy volcanic dust. Similar dust is often carried over wide areas of the lava-deserts by wind-storms at the present day. The colour is due to oxidation, which here seems unconnected with any tropical climatic cause. The connection of a red layer with underlying decomposition of the basalt, as is the case in the great red zone in Co. Antrim, has not been proved in Icelandic observations.

GEOLOGISTS as well as mineralogists will always find new suggestions in Mr. W. T. Schaller's "Mineralogic Notes." In Series 3 (Bull. 610, U.S. Geol. Survey, p. 106, 1916) a new member of the melilite group is described under the name of Velardeñite, and the whole group is then discussed. A graphic tabulation of analyses indicates that melilite, which has hitherto occupied a very uncertain position, is an isomorphous mixture of åkermanite and sarcolite. On p. 138 an illustrated note deals with the giant crystals of spodumene in the pegmatites of the Black Hills, S. Dakota. These are often 30 ft., and may be 42 ft., long, and are about 4 ft. in diameter.

THE restrictions on the export of coal from the British Isles and its rising price are having serious results in Scandinavian countries. The deposits of coal at Andö, in the Vesteraalens, are of small importance, but are the only ones in Norway. Lately, however, Norway has sought to overcome her difficulties by the purchase from an American syndicate of vast coalfields in Spitsbergen. The coal, although of Tertiary origin, is of good steam quality. Lignite has been known in Iceland for some time, but so far has had no economic value. However, according to *La Nature* (December 16, 1916), a Danish company is now extracting large quantities at Stalfjall, in the north-west of the island, both for local use and for export to Norway. The lignite occurs in bands of clay among basaltic strata, and its average depth is only six metres. Iceland should have no difficulty in exporting large quantities of this lignite provided it proves sufficiently useful to be in demand. It is said to occur among the same basalts in the Faröe Islands.

IN the *Geographical Journal* for December (vol. xlviii., No. 6) Mr. R. C. Mossman has an important paper on the physical conditions of the Weddell Sea. The paper is based on the work of the *Scotia* and the *Deutschland*, the only two ships which had scientifically explored the Weddell Sea previously to the *Endurance*, the work of which is, of course, not yet available. The observations from the South Orkneys observatory have also been utilised. In meteorology the most striking results are the correlations which Mr. Mossman has been at pains to work out between temperature and pressure conditions in the Weddell Sea and those in other parts of the southern hemisphere, and even in Iceland. For the last twelve years the August and September temperatures at the South Orkneys have been a direct index to the temperatures at Kimberley, South Africa, during the three months following, and there is also a marked sympathy between the South Orkneys barometric pressure in December and the height of the River Parana at Rosario, which is, of course, dependent on the rainfall over southern Brazil, and this is related to the barometric pressure. In December there is a marked tendency for high pressure to the south and south-east of Cape Horn, and Mr. Mossman suggests that when the Graham Land lobe of the Antarctic anticyclone is intensified the pressure over the interior of Brazil is correspondingly diminished, and *vice versa*. More remarkable perhaps is the pronounced opposition between the barometric pressure at Stykkisholm, Iceland, and the South Orkneys. Data from 1902 to 1914 show no break in this sequence.

THE nature of the particles of mineral matter which become embedded in the lung tissue in cases of miners' phthisis has been determined by Drs. W. Watkins-Pitchford and J. Moir by microscopical examination in polarised light of specially prepared sections of silicotic lungs, their results being given in Publication No. VII. of the South African Institute for Medical Research (Johannesburg, 1916). In polarised light the field is suggestive of a starlit sky, but in ordinary circumstances only the larger particles are so visible. The particles have the form of irregular and angular, more or less elongated, chips or flakes, the majority being less than 2 microns in diameter, and very rarely reaching as much as 14 μ. The smaller flakes, when lying flat, have not sufficient thickness to react on polarised light, and they are only seen as streaks when they are set edgeways (the light then traversing a longer path through the doubly refracting medium). Further, the particles are obscured by the tissue in which they are embedded. The method previously adopted of destroying the lung tissue by means of hydrochloric acid and potassium chlorate also resulted in the destruction of some of the mineral matter. This objection is overcome by treating the sections with nitric acid or strong hydrobromic acid. Such prepared sections were compared with preparations of the dust collected from the air in the Rand gold mines and of the powder obtained by finely grinding the rock ("banket") from these mines. The mineral species identified include quartz (constituting more than 99 per cent. of the particles), sericite-mica, rutile, zircon, and tourmaline, and perhaps chlorite. Similar particles of mineral dust were also detected in the tissue of normal lungs; for example, the two lungs of a farmer, who had never worked in the mines, were estimated to contain a hundred thousand million particles of foreign mineral matter, whereas in the lungs of a miner affected with the disease the estimate reaches the appalling number of twenty to thirty millions of millions of such particles.

THAT the zodiacal light owes its origin to the remains of comets captured by Jupiter was the theory proposed fairly recently by Fessenkoff. A criticism of this theory is now given by G. Armellini in the *Atti dei Lincei*, xxv. (2), 9, in which it is shown that one formula arrived at by Fessenkoff is in direct opposition to an analogous one given by Schiaparelli in 1871. The author is, however, led to accept a modification of Fessenkoff's theory in which collisions between the meteoritic material of the captured comet play an important part.

IN the *Atti dei Lincei*, xxv. (2), 10, Mr. G. Körner and Dr. A. Contardi describe the properties of the sixth form (eta) of trinitrotoluene, recently discovered by them, as announced in a previous number of the *Atti* (xxiv. (1), 9, May, 1915). In arriving at the preparation of this new trinitrotoluene it was not possible to have recourse to direct nitrification, and it was therefore necessary to employ the substitution of an amidic group with a nitroxyl in a convenient dinitrotoluidine. Of these latter, three were suitable for leading to the necessary transformation. An additional result obtained by these authors was the production of 60 per cent. of one of the dinitrotoluidines, of which previously it had been only possible to obtain 20 per cent. from the material employed. The paper also describes the properties of a considerable number of the corresponding dinitrotoluene halogen compounds.

A PAPER by Dr. S. Brodetsky, on the longitudinal initial motion and forced oscillations of a disturbed aeroplane, appears in the *Aeronautical Journal* for October–December, 1916 (No. 80). The main conclusion is that "the ideal aeroplane is one that combines the following characteristics: large velocity, small angle of attack, small ratio area/load, small tail fairly far behind the main plane, and considerable margin of stability." The practical man will probably say that this is what common sense would predict, but it is interesting to see how these conclusions follow mathematically from a few simple assumptions, and the history of modern aviation shows that they have not always been acted upon. As in the case of a balance, the increase of one virtue involves the decrease of another, and we have to make a compromise; examples of this will be found in the paper. Fortunately stability and speed go together, and the disturbing elements, in all probability, will be gradually eliminated in the case of rapid machines. Then will come the problem of combining comparatively low speed with sufficient stability: a question of design, as in the case of a bicycle. Prof. G. H. Bryan has contributed an interesting introduction.

IN the Journal of the Franklin Institute for December last Mr. I. Langmuir describes a new form of exhaust pump for the production of high vacua, which he proposes to call the "condensation pump." It may be constructed of metal or of glass. The metal form of the pump consists of a tall cylindrical vessel containing a shallow pool of mercury, which is heated electrically and gives off mercury vapour. The upward stream of vapour is concentrated towards the centre of the vessel by an inverted funnel, and on issuing from the funnel strikes the under surface of a bell-shaped deflector, which sends it downwards along the outer walls of the upper portion of the containing vessel. The space above the bell is in communication with the vessel to be exhausted, and the moving mercury vapour drags along with it the gas from this vessel. The outer wall of the containing vessel along which the mixture passes is cooled by an outer water-jacket, and the mercury vapour is condensed on it, and runs down into the pool at the bottom of the vessel. The gas continues its motion, and is taken from the lower part of the vessel by an auxiliary pump giving a pressure of 200 to 600 bars. A pump of this form, 7 cm. in diameter, exhausts 3000 c.c. of gas per second, and will reduce the pressure to 10^{-5} bar (1 atmosphere $= 10^6$ bar).

A COPY of the "List of Publications of the Carnegie Institution of Washington," issued on December 1 last, has been received. Copies of each publication, except the monthly issues of the "Index Medicus," are sent gratuitously to a carefully selected list of the greater libraries of the world, while the remainder of the edition is offered for sale at a price sufficient only to cover the cost of publication and the carriage to purchasers. Persons desiring price lists or descriptive lists as issued may have them by applying to the Carnegie Institution of Washington. The catalogue received contains both price and descriptive lists, and the latter is a most useful guide to the character and precise contents of each of the volumes indexed, so that would-be purchasers may know exactly the kind of book they are ordering.

MR. LEONARD HUXLEY, who, it will be remembered, was his father's biographer, has written for early publication by Messrs. Smith, Elder and Co. "The Life and Letters of Sir J. D. Hooker, O.M., G.C.S.I."—a work which is sure to be of interest to very many readers of NATURE. It will be illustrated by photogravures and be in two volumes.

A SECOND and much enlarged edition in two volumes of Mr. A. Marshall's "Explosives: their Manufacture, Properties, Tests, and History," is to be brought out by Messrs. J. and A. Churchill. The first volume, containing a portrait of the Prime Minister, to whom the work is dedicated, will be published almost immediately. The work as originally published was reviewed in NATURE of June 3, 1915, and the author contributed an additional chapter, under the title of "The Nature of Explosives," to our issue of February 3, 1916.

OUR ASTRONOMICAL COLUMN.

ECLIPSES OF JUPITER'S SATELLITES.—In Harvard Circular No. 198 Prof. E. C. Pickering directs attention to the need for continued observations of the eclipses of Jupiter's satellites. He points out that the observations are easy and interesting, and such as can readily be undertaken by amateurs. While the probable error of a photometric determination of the time of an eclipse is about 2 seconds, the average deviation from the time computed by the tables of Prof. Sampson is about 7 seconds. These deviations appear to be real, and a possible explanation is that the apparent diameter of the planet, and therefore of its shadow, varies with the cloudiness of the Jovian atmosphere. Several independent observations tending to confirm large deviations from theory would thus be valuable.

PECULIAR STELLAR SPECTRA.—In a paper read at the nineteenth meeting of the American Astronomical Society Miss Cannon directed attention to some of the peculiar spectra which had been noted in the preparation of the New Draper Catalogue (*Popular Astronomy*, vol. xxiv., p. 656). It appears that while less than one-fifth of one per cent. of the 218,000 stars which have been classified fall outside the classes B, A, F, G, K, M, many stars which may be classed in these divisions show abnormal features. In all classes some stars have been found which show lines of unusual intensity; thus several hundred additional stars have been found to show the silicon lines λ 4128 and λ 4131, or the strontium line λ 4077, stronger than normal. The latter group is of special interest, as λ 4077 was the first line shown by Adams to be related in intensity to the absolute magnitudes of the stars. In C.P.D. $-59°$ 3038, mag. 7·2, a line near λ 3869, which may be a reversal of a well-known nebular line, has been found to be very strong. Real changes in the spectra of several stars have also been observed; thus in η Carinæ, as photographed in 1895, the hydrogen lines were stronger, and other bright lines fainter, than on the more recent plates. An extreme case of variation is R. Scuti, which ranges from G5 at maximum to Mb at minimum. The only new type of spectrum which has been found is that exhibited by the very red star B.D. $+43°$·53, the spectrum consisting entirely of light near the region of $H\alpha$, and the colour-index amounting to 5·4 magnitudes. This and

S Cephei, which has a similar spectrum, are the two reddest stars known at the present time.

THE TOTAL SOLAR ECLIPSE OF 1916, FEBRUARY 3.—A summary of the results of observations of this eclipse made at Tucacas, Venezuela, by an expedition from Cordoba, has been given by Prof. C. D. Perrine (*Monthly Notices*, R.A.S., vol. lxxvii., p. 65). The morning of the eclipse was unpromising, with heavy rain, but conditions improved to such an extent that there was only a slight haze during totality. The corona was of the intermediate type, somewhat resembling that of 1898, and the negatives show streamers to a distance of one and a half solar diameters. Five groups of prominences appeared at the bases of the four principal wings of the corona, and a series of well-marked hoods surrounded the prominences in the south-west quadrant. Photographs of the coronal spectrum were obtained with the prismatic camera, and with a slit spectrograph, but none of them show any trace of gaseous radiation. Good records of the chromospheric spectrum at the beginning and end of totality were secured, and these will give valuable data relating to the heights of different vapours in comparison with previous results. The photometric plates show that at the beginning of totality the total light of the prominences and chromosphere was greater than that emitted by the corona proper.

PARIS ACADEMY OF SCIENCES.

PROGRAMME OF PRIZES FOR 1918.

MATHEMATICS.—The Poncelet prize (2000 francs), to the author, French or other nationality, of the work most useful to the progress of pure mathematics; Francœur prize (1000 francs), for discoveries or works useful to the progress of pure or applied mathematics.

Mechanics.—The Montyon prize (700 francs), for the invention or improvement of instruments useful to the progress of agriculture, the mechanical arts, and the practical and speculative sciences; the Fourneyron prize (1000 francs), question for 1918: the theoretical and experimental study of ball bearings; question set for 1916 and carried on to 1918: important improvements in motors used in aviation; the Boileau prize (1300 francs), for researches concerning the motion of fluids contributing to the progress of hydraulics—these researches, if theoretical, must be verified by the results of experiment or observation; Henri de Parville prize (1500 francs), for original work in mechanics.

Astronomy.—The Lalande prize (540 francs), for the most interesting observation or memoir most useful to the progress of astronomy; Benjamin Valz prize (460 francs), for work in astronomy, conforming to the same conditions as the Lalande prize; the Janssen prize (gold medal), to the author of a work or discovery in physical astronomy; Pierre Guzman prize (100,000 francs), to anyone (without distinction of nationality) who finds a means of communicating with a celestial body—*i.e.* to make a signal to the body and receive a reply. (The planet Mars is excluded.)

Geography.—The Delalande-Guérineau prize (1000 francs), for services to France or to science; the Gay prize (1500 francs), subject proposed for 1918: recent progress in geodesy; the Tchihatchef prize (3000 francs), for recompense or assistance of naturalists of any nationality distinguished in the exploration of the Asiatic continent or the adjacent islands, especially the less known regions—the explorations may be in any branch of natural, physical, or mathematical science; the Binoux prize (2000 francs), for work on geography or navigation.

Navigation.—The prize of 6000 francs for work increasing the efficiency of the French naval forces; the Plumey prize (4000 francs), for improvements in steam-engines or for any other invention contributing to the progress of steam navigation.

Physics.—The La Caze prize (10,000 francs), without restriction of nationality, for the best work in physics (the prize cannot be divided); the Hébert prize (1000 francs), to the author of the best treatise or most useful discovery in popularising or using electricity; the Hughes prize (2500 francs), to recompense the author of an original discovery in physical science, especially electricity and magnetism or their applications; the Danton foundation (1500 francs), for the encouragement of researches relating to radiant phenomena; the Victor Raulin prize (1500 francs) (limited to Frenchmen), for facilitating the publication of works relating to meteorology and the physics of the globe.

Chemistry.—The Montyon prize (unhealthy occupations) (a prize of 2500 francs, a mention of 1500 francs), for the discovery of a means of rendering some mechanical art less unhealthy; the Jecker prize (10,000 francs), for work most useful to the progress of organic chemistry; the La Caze prize (10,000 francs), for the best work in chemistry (open to foreigners and cannot be divided); the Cahours foundation (3000 francs), for the encouragement of young chemists of promise; the Houzeau prize (700 francs), similar conditions to the Cahours foundation.

Mineralogy and Geology.—The Cuvier prize (1500 francs), for the most remarkable work in mineralogy and geology.

Botany.—The Desmazières prize (1600 francs), to the French or foreign author of the best publication during the year on cryptogams; the Montagne prize (1500 francs), for important discoveries or work on the cellular plants; the de Coincy prize (900 francs), to the author of a work on phanerogams, to be written in Latin or French.

Anatomy and Zoology.—The da Gama Machado prize (1200 francs), for the best memoirs on the colour of animals, including man, and its origin in the animal kingdom; the Savigny foundation (1500 francs), for the assistance of young travelling zoologists, not receiving grants from the Government, and who occupy themselves more especially with the invertebrates of Egypt and Syria; the Jean Thore prize (200 francs), for a memoir on the habits or anatomy of a species of European insect.

Medicine and Surgery.—The Montyon prize (three prizes of 2500 francs, three honourable mentions of 1500 francs, citations), for improvements in medicine or surgery; the Barbier prize (2000 francs), for a valuable discovery in surgical, medical, or pharmaceutical science, or in botany in relation to the art of healing; the Bréant prize (100,000 francs), to the discoverer of a means of curing Asiatic cholera or of the causes of this disease (failing the award of the capital sum, the interest will be given as a prize for contributions to our knowledge of cholera or any other epidemic disease); the Godard prize (1000 francs), for the best memoir on the anatomy, physiology, and pathology of the genito-urinary organs; the Mège prize (10,000 francs), to the author who continues and completes the essay of Dr. Mège on the causes which have retarded or favoured the progress of medicine, from antiquity to the present time; the Bellion prize (1400 francs), for work or discoveries especially profitable to the health of man; the Baron Larrey prize (750 francs), for the best work presented to the academy in the course of the year, by a doctor or surgeon in the Army or Navy, dealing with medicine, surgery, or military hygiene.

Physiology.—The Montyon prize (750 francs), for the most useful work on experimental physiology; the Lallemand prize (1800 francs), to recompense or encourage work relating to the nervous system; the L. La Caze prize (10,000 francs), for the work which has most contributed to the progress of physiology (the prize cannot be divided, and foreigners can compete); the Pourat prize (1000 francs), for the experimental study of some of the conditions which produce a variation in the quantity of water in different tissues; the Martin-Damourette prize (1400 francs), for therapeutic physiology; the Philipeaux prize (900 francs), for experimental physiology.

Statistics.—The Montyon prize (1000 francs) and two mentions (500 francs), for statistical researches.

History and Philosophy of Science.—The Binoux prize (2000 francs).

Medals.—The Arago, Lavoisier, and Berthelot medals.

General Prizes.—Prize founded by the State (3000 francs), question for 1918: to improve in an important point the study of the successive powers of the same substitution, the exponent of the power increasing indefinitely; the Bordin prize (3000 francs), for a study of the effects of pressure on chemical combinations in general, and in particular on those which are susceptible of a practical application; the Estrade-Delcros prize (8000 francs, undivided), for work in the physical sciences; the Le Conte prize (50,000 francs; encouragements), one-eighth for encouragements, the whole or part of the remaining seven-eighths in a single prize for new and capital discoveries in mathematics, physics, chemistry, natural history, medicine, or for new applications of these sciences; the Houllevigue prize (5000 francs), for work in mathematics; the Parkin prize (3400 francs), for work on the curative effects of carbon in cholera and other diseases; the Saintour prize (3000 francs), for work in physical science; the Henri de Parville prize (1500 francs), for original work on science or the popularisation of science; the Lonchampt prize (4000 francs), for a memoir on the diseases of man, animals, and plants from the point of view of the introduction of excess of mineral substances as the cause of these diseases; the Henry Wilde prize (one of 4000 francs, or two of 2000 francs, without distinction of nationality), for a discovery or work on astronomy, physics, chemistry, mineralogy, geology, or experimental mechanics; the Caméré prize (4000 francs), for a French engineer who has personally conceived, studied, and realised a work resulting in progress in the art of construction; the Gustave Roux prize (1000 francs, undivided), as recompense to a young French scientific worker; the Thorlet prize (1600 francs); the Lannelongue foundation (2000 francs), to one or two scientific men (or their widows or children) in needy circumstances; the Laplace prize of books, for the highest student leaving the École Polytechnique; the L. E. Rivot prize, to the four students leaving the Ecole Polytechnique and holding the first and second places in the two sections of the school; the Trémont foundation (1000 francs), for assisting works attaining an object useful and glorious for France; the Gegner foundation (4000 francs), to assist a poor scientific man, already known for the quality of his work, to enable him to continue his researches; Jérome Ponti foundation (3500 francs), for the encouragement of mathematical science.

THE BONAPARTE FUND.

Grants from this fund are made for facilitating the researches of workers who have already given proof of their capability in original work, and who lack sufficient resources to undertake or pursue their investigations. Requests for grants may be made directly by the candidates or proposed by a member of the academy. The request should contain an exact description of the work proposed and indicate the sum necessary to carry it out. Twelve months after the receipt of a grant, a report must be sent giving details of expenditure and of the first results obtained; after two years a *résumé* of the work carried out with the aid of the grant must be forwarded. The whole of these reports will form a special publication under the title of "Recueil du Fonds Bonaparte."

WORKSHOP METHODS OF OPTICAL TESTING.

AT the request of the Ministry of Munitions the Optical Society held an exhibition of workshop methods of optical testing at King's College, Strand, on January 11, in order that by the interchange of workshop methods of test, the production of optical instruments for naval and military use might be expedited. Amongst others, Messrs. Chance Bros. exhibited a method for the rapid approximate assessment of strain existing in glass. A plate of mica is cemented between glass plates, the mica being of such thickness as to give a phase difference in the two beams of one wave for sodium light. This plate therefore gives approximately the sensitive first order purple colour between crossed Nicols. According to the orientation of the specimen double refraction will be evident from the change of the purple colour to a tint of a lower or higher order. Each tint corresponds to a definite phase variation produced by the double refraction of the glass, and hence an estimation of the tints exhibited gives an estimation of the phase difference produced in a beam on passage through the glass. The colours given in conjunction with the wave plate are independent of the intensity of the light; thus greater uniformity in testing for bad annealing is obtained than by the use of crossed Nicols alone, where the sensitiveness of the tests depends largely on the intensity of the source of light.

Messrs. Adam Hilger exhibited a new apparatus and process for finishing prisms and lenses which are imperfect in consequence of non-homogeneous material or inaccurate surfaces. The apparatus consists of a modification of the Michelson interferometer. A beam of light is passed through the optical element under test in such a way as to produce a series of interference fringes which constitute what may be called a contour map of imperfections. This map can be drawn on one of the surfaces of the prism or lens; superfluous material is then removed by local polishing until light is transmitted as in a perfect optical element.

Prof. Herbert Jackson exhibited samples of glass which had undergone a *weathering* test, by submission to the action of steam in an autoclave. The condition of glass surfaces after a standard test is an index of the behaviour of the glass when subjected to normal atmospheric exposure.

The National Physical Laboratory exhibited the photometer used in testing the luminosity of radium-painted dials. The dial under test is placed between two "artificial dials" illuminated by an electric lamp placed behind a suitable green filter; the candle-power of the lamp is varied by means of a resistance. The instrument is standardised by the use of a surface brightness photometer for various currents through the lamp. Samples of glass were also exhibited made from sands obtained in England, to replace sands hitherto obtained from the Continent.

SCIENTIFIC RESEARCH IN RELATION TO INDUSTRIES.[1]

INDUSTRY, and with it all our modern civilisation, depend on engineering. Engineering, however, is nothing but applied science, and science thus is the foundation, and scientific research the ultimate means, which have created our civilisation. Through ages the chief homes of scientific research have been the universities and other educational institutions. During the last generation, however, the industrial development has been so rapid, and the demand for the results of scientific research so great and urgent, that the universities have not been able to supply it, and the industries, especially the more powerfully organised modern industries, as electrical engineering, chemistry, etc., had to enter the field of scientific research. The country's educational institutions did not advance in fostering scientific research to the same degree as the industries advanced, and many universities and educational institutions rather retrograded in scientific research, became submerged in a false commercialism which figured the output of the college in student hours per professor, judged efficiency by the percentage of students graduated, and altogether too often wasted the university's best assets—its professors. Thus we find in our colleges men who had shown themselves capable as investigators to do scientific research work of the highest order overloaded with educational or administrative routine, and deprived of the time for research work. Private industries rarely commit such crimes of wasting men on work inferior to that which they can do; industrial efficiency forbids it.

Thus, when with the advance of industry a more rapid extension of our scientific knowledge was demanded than was given by the educational research institutions, scientific research laboratories were established in the industries. Some of them very soon showed their ability to produce scientific work of high character. As illustration, I may mention how an entirely new branch of chemistry, the chemistry of the free atom, has resulted from the work of Langmuir in the electrochemical research laboratory of the General Electric Company, and has been communicated to the literature of the subject by numerous papers.

Theoretically, there is a limitation imposed on scientific research work in industrial establishments. It should be of such a character that it may lead to results which are industrially useful. In reality, however, this is no limitation at all, but there is no scientific investigation, however remote from industrial requirements, which might not possibly lead to industrially useful developments, and obviously no immediate or direct usefulness is expected; any investigation offering a definite prospect of industrial utility is not scientific research, but is industrial development or design. Experience, indeed, has shown that it is rare that sooner or later some industrially valuable results do not follow, no matter how abstruse and remote from apparent utility a scientific investigation may appear, and any scientific research whatsoever is thus industrially justified.

To illustrate, when, by the consulting engineering laboratory of the General Electric Company, research work was undertaken on the electrostatic corona, and in general on the dielectric phenomena in the air, no immediate or direct benefit could be seen for the industrial company which financed the work, but it was justified by the consideration that a greater knowledge of these phenomena may extend the economic limits of long-distance power transmission, and thereby increase the industrial demand for transmission apparatus. Nevertheless, before the research was completed—if research can ever be considered completed—it had led to a re-design of practically all high-voltage transmission apparatus, and thus proved essentially valuable in industrial design.

Some research work can be carried out more efficiently by educational institutions, others by the industry. In general, for industrial research, better facilities in materials and in power are available, but high-class skilled labour, of investigators and research men, such as is available in university research by the graduate students, is expensive in the industry. Thus researches requiring little in facilities, but a large amount of the time and attention of research men, are especially adapted to educational laboratories, while investigations requiring large amounts of material or of power rather than the time of the investigators are specifically adapted to the industry, and often beyond the facilities of the educational institution. Efficiency thus should require a division of research between educational and industrial laboratories in accordance with their facilities, and where this is done the results are splendid. Thus, for instance, the phenomena of the dielectric field beyond the elastic limit—or, in other words, those of the disruptive effects in air and other dielectrics under high electric stress—were almost entirely unknown a very few years ago, and it was even unknown whether there is a definite dielectric strength of materials, analogous to the mechanical strength. This field has been very completely cleared up, and a comprehensive knowledge of the phenomena of the dielectric field gained, not only under steady stress, but also under oscillating stress, and under the transient stress of sudden electric blows or impulses, ranging down to the time measured by micro-seconds, as the result largely of the work of an industrial research laboratory—the consulting engineering laboratory of the General Electric Company under Mr. F. W. Peek—and an educational laboratory—Johns Hopkins University under Prof. Whitehead—both laboratories working independently and devoting their attention to those subjects for which they are specifically fitted, though naturally often overlapping and checking each other.

Unfortunately, this limitation of research work in accordance with the available facilities is not always realised, and especially educational institutions not infrequently attempt research work for which industrial laboratories are far better fitted, while research work for which the educational institution is well fitted, which the industry needs but cannot economically undertake, is left undone. It is usually the desire to "do something of industrial value" which leads universities to undertake investigations on railroading and similar subjects, in which the probability of adding something material to our knowledge is extremely remote, or to undertake investigations on industrial iron alloys in competition with the vastly greater and more efficient research of industrial laboratories in this field of magnetism, while all other magnetic research is largely neglected. Our knowledge of the phenomena of magnetism is therefore still very unsatisfactory, and it is obvious that a material advance can be expected only from a comprehensive study of the entire field of magnetism, and the little investigated non-ferrous magnetic materials thus would be the ones most requiring study.

The closer relation of industrial research laboratories to engineering practice leads to a tendency which, in general, may be expressed by saying that in the results of industrial research the probable error is greater, but the possibility of a constant error less, than in educational research. In any investigation typical conditions are selected. As these conditions naturally

[1] Presented at a joint meeting of the Franklin Institute and the Philadelphia Section, American Institute of Electrical Engineers, on October 18, 1916, by Dr. C. P. Steinmetz, Chief Consulting Engineer, General Electric Company, Schenectady, N.Y. Abridged from the Journal of the Franklin Institute, vol. clxxxii., No. 6.

never can be perfect, two ways of procedure are feasible: either to investigate the errors and disturbing factors and correct for them, or to select the condition of experiment so that the disturbing factors are negligible—for instance, experiment on a large scale. The latter method cannot give as high accuracy as the former, but the former method, while theoretically more accurate, may give a constant error, possibly of hundreds per cent., if some of the assumptions on which the corrections are based are not completely justified. Industrial research leans towards the first method as giving results which are safer in trustworthiness, even if somewhat less accurate, while educational research leans towards the method of applying corrections. As illustration, in magnetic investigations, the effect of joints in the magnetic circuit, etc., may be determined and corrections for it applied, or such a magnetic circuit may be chosen, that the effect of joints, etc., is negligible, and can be neglected, or taken care of, by a correction which is so small that its accuracy is not material.

In industrial research the liability exists of limiting the work to such a narrow field that it has little general scientific value; for instance, to determine the hysteresis loss in a magnetic material, without determining the magnetisation curve. In educational research inversely there is sometimes the tendency to generalise beyond the limits justified, and so draw wrong conclusions. For instance, numerous investigations have been made and conclusions drawn therefrom in treatises on the "arc," while in reality the investigation was made with the carbon arc only and applies only to this kind of arc; and as the carbon arc is not typical, but rather exceptional, for most other arcs the conclusions are wrong.

As regards the quality of the scientific research work done in industrial organisations compared with that done in educational establishments, there is no material difference, but the work done in the industry, just as that done in universities, varies from scientific research of the highest quality down to investigations which are of little, if any, value—investigations crude and inaccurate or directly erroneous in premises, in method, and in results and their interpretation, or investigations which, while correctly conceived and correctly made, are useless because essential conditions have not been controlled or recorded. Still worse are those pseudo-scientific investigations occasionally met which owe their conception to the desire of self-advertisement or are made for commercial or legal purposes, such as, for instance, to give the appearance of a scientific standing to some theory which some inventor had recorded in his patents. Such work—met occasionally, though less and less frequently—in industrial as well as in educational institutions, tends to discredit scientific research in the eyes of the layman, who cannot discriminate between science and pseudo-science.

The essential difference between industrial and educational research, however, is met in their method of publication: the publication mediums of scientific research carried on in educational institutions are the scientific publications published more or less under the direction or supervision of universities, while the publication mediums of the scientific research carried on in the industry are the technical or engineering papers, and only occasionally an abstract reaches the scientific publications. Unfortunately, a large number of men of science still look on publications in the technical Press as unscientific, take no cognisance of them, do not recognise them in scientific abstracts, reviews, etc., and, as a result, a large and steadily increasing part of the scientific research of the country is practically lost to men of science, and is not available or easily accessible, by not being recorded, abstracted, or indexed in the records of scientific progress. If, for instance, in the tables of physical constants published only a few years ago, under "hysteresis" are published the losses in a Siemens cable transformer (a type which had ceased to exist a quarter of a century ago), and practically all the mass of data on magnetism recorded in the engineering proceedings neglected, apparently as not "scientific," it shows that there is something wrong with the attitude of those responsible for the records of science. Amongst the worst offenders in this unjustified exclusiveness are the physicists, while the chemists make a commendable exception. In the "chemical abstracts" published by the American Chemical Society, the results of industrial research, as well as those of the chemical university laboratories, are recognised, and these abstracts are therefore comprehensive and valuable, which cannot be said of the abstracts of some other sciences. Possibly the reason is because applied chemistry is chemistry just as well as theoretical chemistry, while applied physics goes under the name of engineering, and the average theoretical physicist is rather inclined not to recognise engineering as scientific.

Some excuse may be found in the nature of the two classes of publications, the physical science publications and the engineering publications. The former accept for publication only scientific papers, exert a critical judgment, and the appearance in the scientific publication medium thus implies that the article, at least in the opinion of the editors, is of scientific value. This is not the case, and cannot be the case, with the engineering or technical publications. The technical Press is the medium of all the publications of those engaged in the industry, from scientific research of the highest value to mere commercial statements, and the appearance of an article in an engineering paper or transaction does not imply, nor is intended to imply, that it is of scientific value, but the discrimination of scientific worth, which in the scientific publications is attempted by the editors, has in the engineering Press to be left to the reader or abstractor. If, however, the purpose of the engineering publication is to bring together all classes of industrial records—and it thus includes commercial and other articles—this is no justification to refuse recognition to scientific papers contained in the same publication, but rather makes it desirable, and indeed necessary, in the interest of our nation's scientific efficiency, to find some means or organisation to carry out this discrimination and make available to the scientific world at large the scientific work contained in the annals of applied science—that is, engineering.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—In the course of the term just beginning, Congregation will be invited to consider an important proposal for establishing a new status for advanced students, and for enabling persons admitted to this status to obtain the degree of doctor under new conditions. It is proposed to limit admission to the status to persons who have taken the degree of B.A. at Oxford; or who, if they come from another university, have taken a four years' course and a degree, and have produced satisfactory evidence of their fitness to pursue a course of advanced study. The time to be devoted to study by advanced students before the degree of doctor can be taken will be either two or three years, according to circumstances. Opposition may be expected to this proposal, both in principle and detail, and it is yet too early to forecast the result of discussion. The advocates of the scheme speak of it as an attempt to meet a need which is likely to be of considerable importance at the end of the war.

The usual announcements of lectures and practical work have been issued by the various scientific departments. The number of undergraduates resident during the term is not expected to exceed four hundred.

DR. JOHANNA WESTERDIJK has been appointed extraordinary professor of phytopathology in the University of Utrecht; she is the first woman to receive such an appointment in Holland.

THE University of Stockholm has received from Mrs. Amanda Ruben the sum of 50,000 kronor (*circa* 2700*l.*) to found a readership in experimental zoology, the first post of the kind in Sweden.

ACCORDING to the *Nieuwe Courant*, Dr. P. N. van Kampen, University lecturer at Amsterdam, has been appointed professor of zoology and comparative anatomy in the University of Leyden, in succession to the late Prof. Vosmaer.

FOUR lectures will be delivered on "Climate and Health," on January 30, January 31, February 1, and February 2, by Dr. H. Campbell, at Gresham College, Basinghall Street, E.C. The lectures are free to the public, and will begin each evening at six o'clock.

DR. H. B. FANTHAM, Christ's College, Cambridge, recently chief protozoologist to the British Forces in Salonica, has been elected to the professorship of zoology in the South African School of Mines and Technology, Johannesburg, University of South Africa, and is shortly proceeding to take up the appointment.

A SPECIAL introductory medical course in physics, chemistry, and biology for students desirous of beginning their medical studies will be held at University College, and will begin on March 1. Intending students should communicate forthwith with the secretary, University College, Gower Street, London, W.C.

THE staff of the new Flemish University of Ghent includes six of the old professors and seven Dutchmen, but for the most part Flemings of various standing have been appointed by the Germans. A considerable number of Dutchmen refused. The students at present are chiefly between eighteen and twenty years of age; the older students who were at the University when war broke out are mostly at the front.

"THE Value of Drawing to the Scientific Worker" was the subject of a lecture, with lantern illustrations, given by Dr. F. A. Bather at the January Conference of Educational Associations, on the invitation of the Royal Drawing Society. As a means of expression, said Dr. Bather, drawing is no less useful than writing to the scientific worker. It is also an important method of scientific work. In the descriptive branches of science the researcher should be able to draw because he alone understands the points that are to be brought out. Even if he employs a draughtsman, he must make sketches for the artist's guidance, and must have sufficient knowledge of the craft to be able to control the result. The act of drawing directs his attention to features that might otherwise escape notice, and forces him to consider structural relations and meanings. In formulating and checking hypotheses, a drawing or model is of the greatest assistance. This is exemplified in such diverse fields as the restoration of extinct animals and the presentation of crystal structure. The power of visualisation, trained by the practice of drawing, enables one to appreciate verbal descriptions with rapidity and accuracy, and to translate them when necessary into concrete form. Accuracy of observation and an understanding of structure are more important in professional illustration than the skilled conventional technique of the pictorial artist. It is doubtful whether the scientific draughtsman can be trained elsewhere than in the laboratory. At any rate, the necessary training does not at present appear to be obtainable elsewhere. It should include the various modes of measurement and drawing to scale, the use of the simple and compound microscope, of the camera lucida and the photographic camera, a thorough knowledge of all process work, lithography, and working on photographs. Above all, the draughtsman must have a loving comprehension of the objects he portrays.

A REPORT from Manchester on "Engineering Education and Research," reviewed in NATURE for August 24, 1916, carefully distinguished between the problem of educating workmen on one hand, and members of the higher engineering staff on the other. Observing this distinction, another report, primarily concerned with the education of workmen, has been prepared by a committee of the Manchester Association of Engineers. The report recommends compulsory part-time *day* classes for all apprentices up to the age of seventeen, and suggests that the best apprentices should then be selected for further attendance at part-time day classes, evening classes being provided for the remainder. The recommendation that attendance at part-time day classes should be made compulsory for all employed persons under seventeen or eighteen years of age has already been made in the report on "Engineering Education and Research" mentioned above, as well as in the programmes of educational reconstruction issued by the Education Reform Council, by the Workers' Educational Association, and by the British Science Guild. Its repetition in the present report affords additional evidence of the willingness of employers to co-operate in giving effect to an Act of Parliament on these lines. This is excellent. So also is the advocacy of further co-operation between employers and education authorities. The principle upon which one paragraph in the report is based will not, however, meet with general acceptance; it is that all boys who are to leave school at fourteen should receive the same education up to that age. But the course at the Royal Naval College, Osborne, has taught us that general education improves by being focussed, especially on post-school activities. Objection may also be raised to the "Diagram of Scheme of General Education" that accompanies the report. The diagram shows separate schools (as in Germany), instead of separate "sides" (as is usual in England), for classics, modern studies, and other departments of higher secondary education. It also reproduces the complete divorce, from which Germany suffers, between technology and other university work.

SOCIETIES AND ACADEMIES.

LONDON.

Aristotelian Society, January 8.—Dr. H. Wildon Carr, president, in the chair.—C. D. **Broad**: Hume's theory of the credibility of miracles. Hume's general argument against miracles is weak. On his definition two miracles of the same kind (*e.g.* two raisings from the dead) could not occur. Yet believers in miracles hold this to be possible. If one reported exception to an alleged law ought to make *no* difference to the strength of our belief in it, why should two or more? But if one reported exception makes *some* difference in the strength of our belief in the law, how can we be sure *a priori* that it may not in certain cases reduce our belief to doubt or disbelief? If people had acted on Hume's theory, many scientific discoveries would not have been made. For exceptions to many alleged general laws ought, if Hume be right, to have been treated, except by their discoverers, as alleged miracles and disbelieved. Since those who observe the exceptions are experimentalists, and those who explain them are often mathematicians, such exceptions would never have been explained if the mathematicians had taken up Hume's attitude. Actually the belief of most people in most laws itself depends on testimony. Hence the arguments for and against an alleged miracle are arguments of testimony against testimony. Strictly, in accordance with his view of belief and induction, Hume had no right to talk about what we *ought* to believe as to matters of fact, but only to discuss the causes of our beliefs. And love of the wonderful is as good a cause of belief in a miracle as constant experience is a cause of belief in a natural law.

Mineralogical Society, January 16.—Mr. W. Barlow, president, in the chair.—A. **Holmes** and Dr. H. F. **Harwood**: The basalts of Iceland, Färoe Islands, and Jan Mayen. The basalts described fall into four well-marked types based on the presence or absence of olivine and the porphyritic or non-porphyritic character of the structure. They resemble the Greenland basalts previously described by the authors, and the whole series is closely matched by the basalts of Skye and Co. Antrim. Chemically the most striking feature of the lavas is their high content of titanium dioxide, which in the seven analyses made varies from 2·36 to 5·68 per cent. The olivine-free rocks are remarkable for their abundance of titaniferous magnetite. In the olivine basalts this mineral is less abundant, and much of the titanium is presumably in the pyroxene, which in the olivine varieties only is of a purple-brown tint. A peculiarity of the olivine basalts is their comparative richness in alkalies, a feature that brings them into relationship with the titaniferous-olivine basalts of the western Mediterranean described and analysed by Washington. The Arctic province, however, is distinguished by the abundance of alkali-poor basalts, which, in spite of the fact that their silica percentages are low, are thoroughly over-saturated rocks.—Prof. H. **Hilton**: The use of the orthographic projection in crystallography. The method of preparing a projection and its use in the drawing of crystals were explained, and the advantages of this projection of the sphere were pointed out.—J. V. **Samojloff**: Palæophysiology, the organic origin of some minerals occurring in sedimentary rocks. In connection with the exploration of the phosphate deposits of Russia, the occurrence of barytes has been noted over a wide area in the Governments of Kostroma, Kazan, and Simbirsk, and also farther to the north-east in the basin of the Pechora River. The mineral occurs as nodules in the clays and marls of the Upper Jurassic, and is confined to the Oxfordian-Sequanian horizon, though extending up to the Kimmeridgian in some of the districts. Nodules of barytes have been dredged from the sea-floor off the coast of Ceylon, and granules of barium sulphate have been detected in the bodies of certain marine organisms, namely, the Xenophyophora. If, therefore, during the Upper Jurassic period such organisms, capable of extracting barium salts from sea-water, were more abundant, they would account for the accumulation of barium in these strata, where the barytes occurs as a primary mineral. Similarly, the mineral celestite has been found over a very wide area in Turkestan in the beds of Upper Cretaceous age. The presence of strontium sulphate has been detected in the skeletons of the Acantharia, a group of the Radiolaria. It is conceivable that similar organisms were relatively more abundant during the Cretaceous period, and that their remains gave rise to the deposits of celestite. Although the iron compound hæmoglobin plays an important function in the blood of present-day animals, yet cases are known amongst the Crustacea and Mollusca in which the copper compound hæmocyanin performs the same function, and vanadium has been detected in the blood of the Ascidia. During former periods of the earth's history these, and perhaps some other, metals may have been predominant in the blood of animals then living. In this connection the persistent occurrence in the Permian strata of copper minerals and ores associated with abundant animal remains is significant. Similarly, there may have been at different periods variations in the chemical composition of the ash of plants. The recurring presence of minerals of primary origin in certain sedimentary strata therefore suggests that there may have been varying physiological processes during past periods, and for this new branch of palæontology the name "palæophysiology" is suggested.—E. S. **Simpson**: Tapiolite in the Pilbara Goldfield, Western Australia. The mineral, which was discovered at Tabba-Tabba Creek and Greens Well, lying in a large area of granite intersected by pegmatite veins and greenstone dykes and bosses, occurs in fairly well-defined crystals, which analysis proved to contain little niobium. At the first locality the crystals displayed the forms 100, 001, 111, 101, 320, and were twinned as usual on 101, and often distorted; while at the second they displayed the forms 100, 111, 101, 320, and showed twinning about 106 and 301, as well as 101. A curve was prepared showing the specific gravity obtaining in the tetragonal isomorphous series of meta-tantalates and metaniobates of iron, manganese, and calcium.

Mathematical Society, January 18.—Prof. H. M. Macdonald, president, in the chair.—G. H. **Hardy** and S. **Ramanujan**: Asymptotic formulæ in combinatory analysis.—Prof. M. J. M. **Hill**: The singular solutions of ordinary differential equations of the first order.—H. **Bateman**: The nature of a moving electric charge and its lines of electric force.—Prof. L. J. **Rogers**: The expansion of the variables of a hypergeometric equation in terms of the ratio of two solutions.—Prof. H. J. **Priestley**: A problem in the theory of diffraction.

PARIS.

Academy of Sciences, December 26, 1916.—M. Camille Jordan in the chair.—G. **Bigourdan**: The first scientific societies of Paris in the seventeenth century. The meetings at the Bureau d'Adresse.—E. **Branly**: The electrical conductivities of air and mica.—H. **Le Chatelier**: Cristobalite. In a previous paper the author has shown the existence of a form of silica, X, characterised by a point of transformation at 215° C., and probably identical with cristobalite. Further work has proved the correctness of this view, and crystals of this form of silica have been detected in various artificial products. The paper is illustrated with eight photomicrographs.—C. **Richet** and H. **Cardot**: The influence of small rises of temperature for short periods of time on the course of fermentation. A study of the effect of short periods of heating on the lactic fermentation.—M. de **Sparre**: Water hammer in a main formed of two sections of different diameters.—E. **Ariès**: A form of the temperature function in the Clausius equation of state. A discussion of the best means of determining n in the equation

$$p=\frac{RT}{v-a}-\frac{K}{T^n(v+\beta)^2},$$

from experimental data.—C. E. **Guillaume**: The homogeneity and expansion of invar. In spite of the many causes affecting the expansion of invar, it has been proved possible to make ingots so homogeneous as to make certain that the specimen tested and the specimen utilised have identical coefficients of expansion.—J. P. **Morat** and M. **Petzetakis**: The experimental production of retrograde ventricular extrasystoles and of inverse rhythm by inversion of the conduction of stimulations in the heart.—S. **Mangeot**:

A construction of the osculating sphere and of the radius of torsion at a point of the curve of intersection of two given surfaces.—W. H. **Young**: The conditions of convergence of Fourier's series.—M. **Baticle**: The application of the theory of integral equations to certain calculations relating to the stability of constructions.—J. **Repelin**: New species of Rhinocerotidæ of the Oligocene of France. The Laugnac deposit discovered by Vasseur contains the remains of at least three new forms of rhinoceros. The best represented is the oldest European Teleoceras known. It appears towards the end of the Oligocene period in the middle of a fauna undoubtedly Oligocene, and may perhaps be considered as the direct ancestor of *T. aurelianense*.—J. **Georgévitch**: The evolutive cycle of *Ceratomyxa herouardi*.—J. **Danysz**: The causes of anaphylaxy: the nature and formation of the antibodies. The antigens are substances which cannot be directly assimilated, the antibodies the substances which transform the antigens into assimilable products, and which each organism can produce specially for each antigen. This change can be compared with a digestion, and consists of two successive reactions, the formation of a precipitate, and the resolution of this precipitate. When, after a special preparation, the blood of an animal contains a sufficient quantity of this digestive reagent, the digestion is effected in the interior of the blood-vessels, and the formation of a precipitate under these conditions causes the troubles described under the name of "crisis," or anaphylactic shock. The intravascular digestion may give rise, in certain cases, to toxic by-products.—H. **Judet**: An attempt to reconstitute losses of substance of the long bones resulting from war wounds.

BOOKS RECEIVED.

Catalogue of the Collection of Skulls and Teeth in the Odontological Museum of the University of Birmingham. Pp. 64. (Birmingham: Cornish Bros., Ltd.)

British Agriculture: The Nation's Opportunity. By the Hon. E. G. Strutt, L. Scott, and G. H. Roberts, and a Preface and Appendix on the Reclamation of Land, by A. D. Hall. Pp. xi+168. (London: J. Murray.) 3*s*. 6*d*. net.

The Flying Machine from an Engineering Standpoint. By F. W. Lanchester. Pp. viii+135. (London: Constable and Co., Ltd.) 4*s*. 6*d*. net.

Food and Fitness, or Diet in relation to Health. By Prof. J. Long. Pp. ix+208. (London: Chapman and Hall, Ltd.) 5*s*. net.

The Problems of Physiological and Pathological Chemistry of Metabolism for Students, Physicians, Biologists, and Chemists. By Dr. O. von Fürth. Translated by Prof. A. J. Smith. Pp. xv+667. (Philadelphia and London: J. B. Lippincott Co.) 25*s*. net.

The Reality of Psychic Phenomena, Raps, Levitations, etc. By Dr. W. J. Crawford. Pp. vii+246. (London: J. M. Watkins.) 4*s*. 6*d*.

The Lack of Science in Modern Education, with Some Hints of What Might Be. By Sir Napier Shaw. Pp. 42. (London: Lamley and Co.) 1*s*. net.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 25.

ROYAL SOCIETY, at 4.30.—The Dynamics of Revolving Fluid: Lord Rayleigh.—Spectroscopic Observations on the Active Modification of Nitrogen. V.: Hon. R. J. Strutt.—Magnetic Induction and its Reversal in Spherical Iron Shells: Profs. J. W. Nicholson and E. Wilson—The Two-dimensional Motion of a Plane Lamina in a Resisting Medium: S. Brodetsky.

FRIDAY, JANUARY 26.

ROYAL INSTITUTION, at 5.30.—Epicurean Philosophy: Prof. G. Murray.

PHYSICAL SOCIETY, at 5.—A Clock of Precision: C. O. Bartrum.—The Effect of the Water Vapour in the Atmosphere on the Propagation of Electromagnetic Waves: Dr. F. Schwers.

SATURDAY, JANUARY 27.

ROYAL INSTITUTION, at 3.—The Lakes and Mountains of Central Africa: A. R. Hinks.

MONDAY, JANUARY 29.

ROYAL SOCIETY OF ARTS, at 4.30.—Town Planning and Civic Architecture: Prof. A. Beresford Pite.

TUESDAY, JANUARY 30.

ROYAL INSTITUTION, at 3.—The Old Brain and the New Brain, and their Meaning: Prof. C. S. Sherrington.

ROYAL SOCIETY OF ARTS, at 4.30.—Imperial Industries after the War: O. C. Beale.

WEDNESDAY, JANUARY 31.

ROYAL SOCIETY OF ARTS, at 4.30.—The Work of the Y.M.C.A. in France: Miss Ella C. Sykes.

ROYAL SANITARY INSTITUTE, at 4.30.—*Discussion*: The Physical Welfare of Children after Infancy from the National, Social, and Public Health Standpoints, to be opened by Dr. W. Leslie Mackenzie.

THURSDAY, FEBRUARY 1.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: An Application of the Theory of Probabilities to the Study of *a priori* Pathometry. Part II.: Sir Ronald Ross and Miss H. P. Hudson.—An Investigation into the Periodicity of Measles Epidemics in London from 1703 to the present day by the Method of the Periodogram: Dr. J. Brownlee.—The Causes responsible for the Developmental Progress of the Mammary Glands in the Rabbit during the latter part of Pregnancy: Capt. J. Hammond.—The Post-œstrous Changes occurring in the Generative Organs and Mammary Glands of the Non-pregnant Dog: F. H. A. Marshall and E. T. Halnan.

ROYAL INSTITUTION, at 3.—The Mechanism of Chemical Change: Prof. F. G. Donnan.

CHEMICAL SOCIETY, at 8.—Chromium Phosphate: A. F. Joseph and W. N. Rae.—The Detection of Traces of Mercury Salts in Toxicological Work: K. C. Browning.—"Stepped" Ignition: R. V. Wheeler.—The Catalytic Bleaching of Oils, Fats, and Waxes: H. Rai.—Alkaloidal Derivatives of Mercuric Nitrite: P. C. Rây.—Synthesis of a Derivative of the Lowermost Homologue of Thiophene: P. C. Rây and M. L. Dey.—The Detergent Action of Soap: S. U. Pickering.—The Occlusion of Iron by the Phospho-molybdate Precipitate: E. H. Archibald and H. B. Keegan.

MATHEMATICAL SOCIETY, at 5.30.

FRIDAY, FEBRUARY 2.

ROYAL INSTITUTION, at 5.30.—The Supply of Gaseous Energy: Dr. C. Carpenter.

SATURDAY, FEBRUARY 3.

GEOLOGISTS' ASSOCIATION, at 3.—President's address: The Study of the Archæan Rocks, with Special Reference to Scotland: G. Barrow.

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