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

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European war—Commercial and financial aspects
Germany—Commerce

THURSDAY, JANUARY 27, 1916.

GERMANY'S AIMS AND METHODS.

IN the debate on January 10 on Mr. Hewins's motion that Britain should co-operate in the closest manner with her colonies in prosecuting the war, he pointed out that the Germans do not separate their military from their commercial policy. "From the German point of view, the war began some years ago in certain economic measures, and the war will continue after the conclusion of military operations in certain economic measures which they already have in preparation." This is profoundly true, and some of the details of these economic operations are very clearly put by Mr. Hewins in his speech. He went on to point out that the present hope of Germany is not so much a complete military victory, as a position from which they will be able "to foist upon conquered territories German contracts, German aims, and German traditions." He does not think that a customs-union with the Dominions and the Allies is a possible method of opposing Germany, but counsels control of raw materials produced in the Empire, so that they may never again come into German hands. The question of shipping, too, should be an imperial one; also that of treaties. There must be a spirit of solidarity among the Allies in any treaties with Germany which may in future be made. The writer agrees; but ventures to think that a refusal to make any treaty whatever with Germany and her allies would be a better measure.

The seconder of the resolution, Mr. Peto, discussed the question of shipping more fully, and dissented from the present Government policy of keeping all knowledge of our intentions from the Germans. If they knew that German shipping would in future be placed under rigorous control, that would be bound to influence their conduct of the war.

Sir Alfred Mond feared that the policy sketched by the two previous speakers would damage our own trade. Moreover, he dissented from Mr. Hewins's view that the present war was being waged in support of an economic policy; he attributed it to racial and imperialistic, and not to commercial motives, and said that to his knowledge Germany and her allies had confused notions of what they were fighting for. He attributed German success to their scientific and technical skill, and to the influence of their banking system. He regarded the United States as likely to be a more formidable trade rival than the Germanic nations.

Mr. Shirley Benn advocated a return to the old navigation laws, and Mr. Prothero thought that a joint system of credit with our Dominions would have a great influence in countering German aggression. Mr. Chaplin counselled joint action with the Dominions in imposing a tariff against the entry of German goods. Mr. Mackinder welcomed the attitude of Sir Alfred Mond towards a tariff, and suggested that we might at once utilise a large sum belonging to Germany, which we hold, and which might be used for the production of materials necessary to our country at the present moment. He pointed out that Germany is organising the territory which she has conquered to help her in the war with materials, and he counselled that we too should organise. There are necessary materials which demand the expenditure of money on plant; manufacturers are unwilling to risk capital on business which may come to an end with the war, and require a guarantee that the Empire should stand by them and assure them against loss. Mr. Pennefather pointed out that while the Teutonic nations have only some 18 per cent. of the world's trade, the Allies control 50 per cent., and strongly pressed for an economic union with our Dominions.

Some of Mr. Runciman's remarks were reproduced in NATURE of January 13; he recommended improvement of research methods, the education of our people, and the training of our young men. The main points in his speech were the shortage of food in Germany, from which he drew comfort. His attitude of mind was shown by his hope for the recuperation of Germany, as well as of the other belligerent Powers; and here Mr. Runciman showed his complete failure to grasp the situation. The fact is that the Allies do not wish Germany to recuperate. Recuperation means power to intrigue, to use all means to prosecute an economic warfare, and to conquer other nations and destroy their trade. It is lamentable to find the head of a great Government department so blind to present conditions, and so unable to forecast the future. He fears that the suppression of Germany would entail suffering on the Allies; perhaps it might; but the waging of the present war entails suffering on the Allies, and yet no one proposes to sue Germany for peace. Mr. Runciman then dealt most unsatisfactorily with the question of contraband. Had it not been for his opposition and that of the Board of Trade, had the Admiralty been granted full control, we should not have seen those

departments obliged to climb down, only in consequence of the expression of an irresistible public opinion, and doing "too late" what should have been done at the beginning of the war. We have been guilty of incredible folly in allowing a man to retain a position of enormous influence who, by his sayings before the outbreak of war, showed himself totally unfit to deal with the situation as it manifested itself in August, 1914. Towards the end of his speech he said, "A man would indeed have to be blind if he could not see the fact that commercially Germany is a beaten nation." Well, no German thinks so, and it is the supremest of blunders to assume it. It may conceivably be true; but if it is, it is no business of ours to act as if we thought so. Indeed, the debate has had the virtue of inducing Mr. Runciman to reveal his entire incompetency for the position which he holds.

Mr. Bigland brought forward specific instances of German methods of capturing trade, and urged the adoption of a definite protective policy on the part of the Empire and the Allies; and Sir John Rees advocated the inclusion of India and Ceylon. Sir John Spear, representing an agricultural community, and Mr. Montague Barlow, speaking for an industrial community, supported Mr. Hewins's motion. The latter described how the Germans captured the wolframite supply of Cornwall, owing to State subsidies, cutting down the price from 5*s*. 6*d*. to 2*s*. 6*d*., and killing an English company with a capital of 20,000*l*. Having secured a monopoly, they raised the price to 7*s*. 6*d*.! It would be well if instances like this were collected and published, so that the public might know the extent of previous German aggression. Mr. Barlow also described the effects which German banking credits have on their industry. Mr. Fell doubted whether a boycott of German goods could possibly be permanent, and in this the writer agrees. Goods of German origin would certainly enter England from neutral countries, and it would be impossible to exclude them.

Mr. Lynch gave a sketch of Wilhelm von Humboldt's work in organising German education in 1809, and described German methods of trade aggression. He imputed the capture of many British industries to the educational policy of the Germans, especially on technical lines, and related his experience at the hands of the Government "pundits" when he applied for the modest sum of 10,000*l*. for the encouragement of research. This speech concluded the debate.

It is indeed time for drastic reform in most of our Government departments. It has been frequently pointed out that the prominence given to classics, and the under-estimation of science in Civil Service examinations, has resulted in the staffing of our Government offices with men, not only absolutely ignorant of science, but incapable of appreciating scientific advice when it is tendered. It would be a breach of confidence were the writer to tell of the appalling "howlers" enunciated in his presence by those in high places. Whereas very few men of science are entirely ignorant of the spirit inculcated by a study of the classics, while they can at least appreciate the attitude of mind of the cultured classicist, those who have been educated solely on classical lines in our public schools and universities are quite incapable of taking the point of view of men who have been trained scientifically or commercially. Precedent, and precedent alone, rules the minds of the classicist; the scientific man demands proof, and has small respect for precedent. Nor are our classically trained heads of departments able to form a useful opinion on recommendations pressed on them by scientific advisers. They have not the training required; nor can they acquire the mental attitude. The writer has in mind a law-suit in which an eminent judge spent three weeks in learning his lesson; barristers versed in science stated the case to him, and he himself cross-examined competent scientific experts. In my view, his decision was a just one. In the Court of Appeal the judges were unqualified to re-judge the case, for they had not had the benefit of three weeks' instruction; they reversed the first judgment. And the House of Lords, on further appeal, had not the glimmering of an idea of the scientific principles which had influenced the judge of first instance in making up his mind, and injustice was done when they upheld the verdict of the Court of Appeal. But the just decision of the first judge showed that with willing intelligence, time, and sufficient instruction a man can educate himself to form a correct opinion on an abstruse scientific point.

Now the head of a Government department has not the training, nor can he afford the time to understand scientific arguments which may be brought before him; he therefore "makes a shot," influenced by expediency and by an inclination to take a course which will least commit him, needless to say, usually with disastrous results.

Reform of the Civil Service examinations would doubtless remedy this dangerous state of affairs, but it will take a generation to do it. And immediate action is called for. Take the Board of Trade as an example. There *is* a Board of Trade;

it consists of Mr. Runciman, the President, of his Grace the Archbishop of Canterbury, of the Speaker of the House of Commons, and of the *Speaker of the Irish House of Commons*. On the 20th inst., Mr. Lynch asked the President whether it would not be desirable "to reconstitute the Board so that it may contain two men of recognised ability in the industrial world, and two men of science, noted for their knowledge of technical education and interested in the problem of providing for its application to industrial development?" Mr. Pretyman said there were grave objections to any scheme which would divide the responsibility of the President among the members of a board, and that the object was attained by the development of advisory committees of experts whom the President can consult. But what if you have a President unable to understand their recommendations? We have only to remember the ghastly blunder committed at the beginning of the war in the non-recognition that cotton and fats are potential ammunition. We cannot afford to make any more blunders, and it is a good maxim that when a man has blundered once, he should not have any further chance of endangering the Empire. This is a time for drastic action; how can it be achieved? Can our Dominions exert pressure? There is no means by which public opinion can manifest itself except by a general election, and that is denied us. But time is passing, and the enemy is gaining ground. Must we still "wait and see"?

Sir WILLIAM RAMSAY.

PHYSICS FOR ENGINEERING STUDENTS.

(1) *Introduction to Magnetism and Electricity.* By E. W. E. Kempson. Pp. viii + 240. (London: Edward Arnold, 1915.) Price 3*s*.

(2) *A First Course in Engineering Science.* By P. J. Haler and A. H. Stuart. Pp. viii + 191. (London: University Tutorial Press, Ltd., 1915.) Price 2*s*. 6*d*.

(3) *Practical Shop Mechanics and Mathematics.* By J. F. Johnson. Pp. ix + 130. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.) Price 4*s*. 6*d*. net.

(4) *Continuous and Alternating Current Machinery Problems.* By Prof. W. T. Ryan. Pp. vii + 37. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.) Price 2*s*. 6*d*. net.

(1) MR. KEMPSON'S book on magnetism and electricity is based on the course given to the science forms in the Upper School at Rugby. The ground covered is fairly extensive, and the matter is dealt with more from the experimental side than the mathematical. The phenomena of induced currents, however, are not touched. Part of the author's aim in writing the book has been to bring out clearly the connecting link between static and current electricity. He contends that the impression left on the average pupil after perusal of most text-books is that static and current electricity are separate and distinct phenomena. The only link usually attempted is the experiment with the voltaic cell and condensing electroscope. In our opinion, the chief advantage of the old method is cheapness; the method suggested by the author necessitates the provision of much more expensive apparatus than is usually found in school laboratories, viz., electrostatic voltmeters and condensers.

The author states in his preface that the relatively large and varying capacity of static voltmeters is likely to give trouble if not borne in mind. We entirely agree, and would add that it is scarcely possible for the pupil at this stage to follow the method by which the teacher calculates size of condensers, speed of rotating commutators, etc., necessary to ensure success of the experiments suggested. In the section on magnetism, p. 11, we should prefer a more precise definition of unit magnetic pole; the medium in which the poles are placed should be stated; and we object to the words in brackets in the same paragraph, thus: "1 dyne (1/981 of a gramme's weight)." The book is provided with a large selection of numerical exercises to which answers are supplied. The student working through this book will have familiarised himself with many electrical testing instruments.

(2) Haler and Stuart's "First Course in Engineering Science" covers the ground suggested by the Board of Education in its "Memorandum on the Teaching of Engineering in Evening Technical Schools." The book is divided into two parts. Part i. deals with measuring instruments, experimental mechanics, and the testing of materials. Simple experiments are described illustrating the principles, and the apparatus needed is such as can be easily constructed in the school workshop. The text is illustrated by a good selection of clear diagrams, and each chapter is provided with a set of numerical exercises. The second part of the book is devoted to the elementary principles of heat, and includes chapters on the steam engine, indicator diagram, and the use of steam tables. On p. 118 there is an error in the formula given for the expansion coefficient of a liquid by the specific gravity bottle; the quantity in the denominator should be the weight of liquid filling the bottle at the higher tempera-

ture. The experiment on p. 135, "to find the temperature of a furnace," is misleading. A piece of nickel is placed in the furnace and then transferred to a calorimeter containing water, the rise of temperature being noted. At 1000° C. the specific heat of nickel differs very considerably from the value at the ordinary temperature. On p. 163 the authors cite the boiling of water in a paper vessel as an effect similar to that obtaining in a boiler plate. In a boiler plate of good conducting material there is, of course, little difference of temperature between the two sides, but paper is a bad conductor of heat, and the reason the paper does not burn is due to an entirely different cause. When water is boiled in a paper vessel the escape of vapour through the paper is considerable, and the flame is usually quite $\frac{1}{4}$ in. from the paper.

(3) Mr. Johnson's book is written for the ambitious artisan, and is based upon notes made by the author during nine years' teaching experience in evening vocational and technical schools in the United States. For its perusal no further mathematical knowledge is required than the elementary rules of arithmetic, simple equations, and the trigonometrical ratios of an angle. It includes chapters on engineering measuring instruments, calculations of areas and weights, pulleys and belting, gearing, properties and strength of materials. Two chapters dealing with the elements of statics are fully illustrated by practical examples from the workshop. The book is clearly written and the diagrams are well executed. A large number of numerical exercises are interspersed in the text, but the workman bent on self-improvement would find the book of considerably greater value if the author had furnished answers to these examples.

(4) The collection of problems by Prof. Ryan (upwards of one hundred) is intended to be used with Morecroft's elementary text-book on "Continuous and Alternating Current Machinery." No answers are provided.

METALLURGY OF GOLD.

The Metallurgy of Gold. By Sir T. K. Rose. Sixth edition. Pp. xix + 601. (London: C. Griffin and Co., Ltd., 1915.) Price 22*s.* 6*d.* net.

SIR THOMAS ROSE'S "Metallurgy of Gold" has been recognised for the last twenty years as the best general treatise on the metallurgy of the metal; the appearance of this new edition, which by revision and expansion is practically a new book, will hence be warmly welcomed by all metallurgists. Since the last edition was published in 1906 the changes which have been introduced in the metallurgy of gold have been greater than those in any other metal; the need for a new edition of the book was therefore imperative, and this need has been admirably satisfied in the present volume.

As stated in the preface, "the most important function which a book on metallurgy has to fulfil is to help those who are taking part in attempts to improve existing practice," and with that aim in view the whole book has been thoroughly revised and much new matter added. The early chapters, which have been rewritten and greatly enlarged, now contain a remarkably full and accurate account of the properties of gold, its compounds and alloys, and throughout the volume special attention is given to the principles underlying the various practical operations involved in the extraction of the metal, and in the refining and preparation of gold bullion for the market and for minting. In this connection it will be admitted by all that without a knowledge and clear understanding of these properties and principles, an acquaintance with mere practical details, however extensive, will not be sufficient to enable the metallurgist to cope successfully with the difficult problems which will confront him from time to time in the practical operations of the metallurgy of gold.

The remarkable success which during recent years has attended the introduction of the filtration of slime on the vacuum principle has led to a complete change in the functions of the stamp battery as a crushing machine; the chapters dealing with stamps, crushing, fine grinding, and amalgamating machinery have hence been largely rewritten and brought thoroughly up to date.

But it is in the cyanide process that we find the most conspicuous changes and advances, hence the chapters devoted to it are for the most part new. These chapters contain an authoritative account of the various mechanical developments of the process of the principles involved in working it, and of the latest and most approved practice in modern cyanide works. Detailed descriptions are given of the plant and appliances in current practice for the treatment of sand, and of the various agitators, vacuum filters, filter presses, &c., employed in the treatment of slime. Further, the reactions which take place in the cyanide process, the conditions necessary for the success of the various operations, and the best means of carrying them out, from the crushing of the ore to obtaining the gold as bullion, are all given clearly and concisely. In chapter xvii. modern practice is exemplified by the operations at typical plants. These chapters contain, in fact,

an account of the process of the greatest value to those practically engaged in cyaniding, and also to students.

The author's chapter on the electrolytic parting of gold and silver, which bids fair to displace the old methods of treatment with sulphuric or nitric acids, is one of the most important in the book. It is not only an excellent *résumé* of the practice followed, but also embraces the valuable experimental work done by the author himself.

Of the chapters on the assay of gold ore and bullion it need only be said that they are worthy of the assayer of the Royal Mint.

Much care has been taken, as in previous editions, in quoting the sources of the information given throughout the book, and the wealth of references in the footnotes is a valuable bibliography of the literature of the subject.

We unreservedly commend the book as being indispensable, not only to students, but also, and especially, to all who are practically engaged in the metallurgy of gold. W. GOWLAND.

PSYCHICAL RESEARCH.

Apparitions and Thought-Transference: An Examination of the Evidence for Telepathy. By F. Podmore. New and enlarged edition. Pp. xviii + 467. (London: The Walter Scott Publishing Co., Ltd., 1915.) Price 6*s*.

THIS is a new edition, in the Contemporary Science series, of a book which still remains, after twenty-one years from its first appearance, one of the best introductions to the subject (see review in NATURE, December 6, 1894). The illustrative cases have now inevitably a rather ancient history appearance, and many of them are duplicated in other books, such as Myers's "Human Personality" and Sir Oliver Lodge's "Survival of Man"; it may be urged, therefore, that an entirely fresh treatment of the subject, with due attention to the experiments of Miss Miles and Miss Ramsden and to the S.P.R. cross-correspondences, would have been preferable to a *rechauffé*. Moreover, the author being dead, various slips occur: the American S.P.R. is no longer a branch of the English society; the latter's publisher is now the firm of Maclehose, not R. Brimley Johnson; Dr. Sidis's name is wrongly spelt on p. 260, as Sir Joseph Barnby's is in the index; and there is an inventive misprint of "Boding" for "Bodily" on p. 459, in the reference to Myers's "Human Personality." But these are not very important matters.

Mr. Podmore's thesis is that communication is possible between mind and mind otherwise than through the known channels of the senses. Beginning with the early mesmerists, who in some cases seem to have hypnotised patients at a distance, he proceeds to cases of transference of pain or of visual images, in the experiments of Dr. Liébeault and the Nancy school generally, and of Prof. and Mrs. Sidgwick and Sir Oliver Lodge; thence to spontaneous cases in dream or hallucination, culled largely from the monumental collection, "Phantasms of the Living," which is now out of print. Possible sources of error are carefully considered and allowed for, and the author's conclusion is—quoting Prof. De Morgan—that either the thesis as above stated is a justified hypothesis, or we must say at leisure what David is reported to have said in his haste. And if the latter—if human testimony is completely untrustworthy—there is an end of history and various other sciences.

It is a somewhat remarkable fact, considering the newness and difficulty of the research, that the opinions expressed in the book would call for little alteration, after twenty-one years, if they were to be revised by a committee representative of the present leaders of the S.P.R. Probably their only qualifying remark would be that it is not quite as certain as Mr. Podmore thought that such phenomena as Mrs. Piper's are completely and truly explained by telepathy. Other hypotheses, more far-reaching but not less essentially scientific if we can free our minds from prejudice, are possible.

Finally, we may remark that the present war presents a scientifically good if morally regrettable opportunity of making exceptional records in psychical research. There is reason to believe that a moment of stress, of great excitement or emotion or concentration, is favourable to the initiation of a telepathic impulse. It is probable that many people at home have become aware of their soldier-relative's wound before the news arrived by normal means. A dream or hallucination may show the nature of the wound, as in Mr. Colt's case in "Human Personality." These experiences should be at once recorded; and if the percipient will send the account, before verification, to the S.P.R., 20 Hanover Square, W., he or she may be assured of sympathetic interest and may be furnishing useful data. Obviously, expectation will account for some of these experiences; but when there is much true detail other suppositions may become necessary. J. A. H.

OUR BOOKSHELF.

Penrose's Annual, 1916. Vol. xxi. *The Process Year Book.* Edited by W. Gamble. Pp. 112 + illustrations. (London: Percy Lund, Humphries and Co., Ltd., 1916.) Price 5*s*. net.

IN taking up an annual that deals with the progress of a handicraft at such a time as this, one naturally looks for the effects of the unprecedented conditions that now afflict us. On the

face of it there is little evidence of adversity. The volume is well produced, the articles are interesting and hopeful, and the illustrations, which show what photo-mechanical work in its many branches is capable of, are numerous and excellent. But the editorial *résumé* of the year's progress gives us a truer idea as to how matters really stand. We learn that colour work is under a cloud because of a reduced demand, and the working of it suffers much from the shortage of collodion, and the difficulty of getting dyes for sensitising plates and for the preparation of inks.

In line and half-tone work there is nothing new except that the demand for high-class blocks has much diminished, and with it the consumption of copper, while zinc is about four times the price it was; and so on to other branches of work. But rotary photogravure, that is, photogravure as adapted to rapid machine printing, has been taxed to its utmost in the production of publications illustrating the progress of the war. Even in Paris, where we are apt to think that all business is at a standstill, "a large amount of really excellent work is being done."

It is also developing rapidly in Spain, Sweden, Holland, Russia, Switzerland, Canada, and the United States. Perhaps the most pleasing aspect of the Annual is the evidence it contains of a confident hope that after the war there will be a great industrial revival, and that it is now being duly prepared for, while even at present matters are far from being as bad as one might have expected.

Stars of the Southern Skies. By M. A. Orr (Mrs. John Evershed). Pp. xii+92. (London: Longmans, Green and Co., 1915.) Price 2*s.* net.

THIS little book is apparently intended as a companion to a star atlas for the use of those who have only small instrumental means for observation or no instruments at all. Although it refers almost exclusively in detail to the more remarkable objects of the southern hemisphere, the author has managed to interweave a good deal of interesting information which is applicable to the stars in general. The book opens with a brief account of the southern constellations, accompanied by a simple map, and this is followed by a series of chapters dealing with such subjects as "the ten brightest stars," "eclipsing stars," "star clusters," and "the clouds of Magellan." The descriptions of the various objects are notable for the numerous references to the results obtained by the use of the spectroscope, and in this connection it would have been an improvement to include either a photograph or a diagram illustrating the chief types of stellar spectra. A more generous supply of illustrations would also have been advantageous in other respects. Apart from this, the book will doubtless be welcomed by many readers, being brightly written and the facts well up-to-date. Those who have learned to recognise the stars, and have no special knowledge of astronomy, will find here just that little additional information which will help to maintain an intelligent interest in the wonders of the heavens.

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.]*

Pre-Columbian Representations of the Elephant in America.

I NOTE with no little interest that the subject of "the elephant in America" has been revived in a communication to NATURE by Prof. G. Elliot Smith. The animal pictured by Prof. Smith has been interpreted by Dr. Allen and myself as a blue macaw (*Ara militaris*) in the following passage:—"The (figure) has even been interpreted as a trunk of an elephant or a mastodon, but is unquestionably a macaw's beak. In addition to the ornamental cross-hatching on the beak, which is also seen on the glyph from the same stela, there is an ornamental scroll beneath the eye, which likewise is cross-hatched and surrounded by a ring of subcircular marks that continue to the base of the beak. The nostril is the large oval marking directly in front of the eye" (Tozzer and Allen, Peabody Museum Papers, vol. iv., No. 3, p. 343, Cambridge, 1910).

If Prof. Smith will look on the back of the monument on which his figure is found (Maudslay, vol. i., pl. 38), he will note at the bottom the drawing of the glyph referred to in the quotation. This is unmistakably a macaw. A comparison of this with the "elephant" shows that the two represent the same animal. Other drawings of the same bird may be seen in Maudslay, vol. i., pl. 93, glyphs 10, 25, 28, and pl. 112*a*, glyph 12.

The two drawings in Bancroft to which Prof. Smith refers lose their significance as "elephants" when one examines the photographs of the originals from which these early and crude drawings were taken. The first (Maudslay, vol. iv., pl. 35) is the "long-nosed god," called by Schellas, "God B." The second is the projecting nose of a grotesque mask, one of the most common features in the decoration of the buildings in Yucatan. Other references to elephants which are given are the "elephant mound" of Wisconsin and the "elephant pipes" of Iowa. The first has been found to represent, in all probability, a bear. The projection called the trunk does not belong to the original earthwork, but is due to an accumulation of sand. The "elephant pipes" have long been accepted as forgeries by all competent archæologists who have examined them.

ALFRED M. TOZZER.
Peabody Museum, Harvard University,
Cambridge, Massachusetts, December 15, 1915.

IF a note from across the sea is not so delayed as to be no longer timely, may I reply to Dr. G. Elliot Smith's remarkable communication on pre-Columbian representations of the elephant in America in NATURE of November 25? The identification of the details on Stela B at Copan as elephants is neither new nor unanswered, and the same may be said of the extension of this identification to the conventional faces with outward curving noses that decorate the buildings of northern Yucatan.

Of course, there is a tremendous weight of improbability to be counted against such an identification, and the suggestion that these heads may represent tapirs would seem more reasonable, since this animal is a native of Central America, while the elephant is not. But in making either guess we should have failed to take account of the peculiarities of Maya art.

There appears to be little doubt that the heads under discussion on Stela B at Copan are intended to represent the blue macaw, while those on the buildings of northern Yucatan are but manifestations of the serpent that gives its proper character to Maya art. These somewhat ludicrous extremes in identification are reached by comparison with other Maya representations rather than by comparison with drawings made in China. In the first instance, it was arrived at independently by F. Parry in his "Sacred Maya Stone," a fanciful study written in 1893; by G. B. Gorden in "Conventionalism and Realism in Maya Art at Copan," 1909; by A. M. Tozzer and G. Allen in their "Animal Figures in Maya Codices," 1910; and by the present writer in his "Study of Maya Art," 1913.

Three drawings will serve to illustrate the point, all taken from Copan, and one from the back of Stela B itself. The first (*a*) is a full, round sculpture of a macaw head, in which the characteristic long upper bill, short under bill, and thick tongue are drawn rather realistically. The eye is surrounded by raised knobs, and below the eye there is a spiral

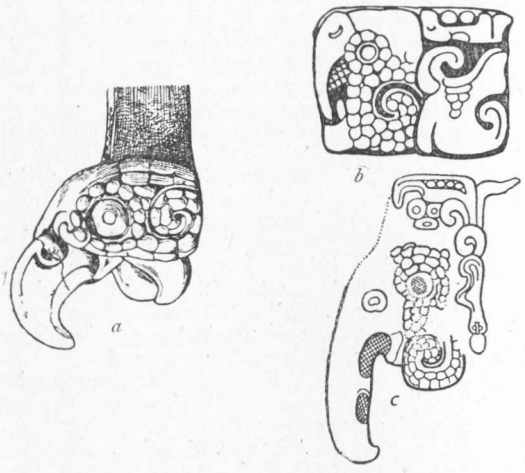

FIG. 1

formed by knobs. The nostril is seen in its proper position, and a line of demarcation appears along the lower edge of the upper bill. In (*b*) the left-hand half of the hieroglyph represents the same head, and it is to be noted that the under part of the upper bill is now differentiated from the upper part by cross-hatching. When we come to *c* (the drawing is taken from the side, and shows details not visible on the front) we can trace all the parts shown in the two previous faces. The eye is surrounded by knobs, but the spiral below the eye is turned in the opposite direction. The nostril is in plain view, and parts of the under side of the upper bill are marked by cross-hatching. The lower bill and the tongue are lacking, but the omission of the lower jaw is very frequent in Maya drawings of animal heads. There is added, however, an ear, above which rises a flamboyant ornament. This detail of the ear with its ornament is unnatural, but is found, nevertheless, on most Maya drawings of reptile and bird heads. The Central American artists were not concerned only with the realism of natural motives, but having put in their drawing enough fact to identify the subject, they felt free to let their fancy range. Dr. Seler was not so absurdly mistaken as might be supposed in his suggestion of tortoise heads, because the Maya draw the head of this reptile very much as they do those of the macaw. The glyph for the day Kayab is now admitted to represent a bird's head, although previously explained as that of a tortoise.

That the heads with projecting snouts used as architectural decoration are connected with the concept of the snake rather than the elephant is easily proven by a study of homologous parts in a series of designs. Space forbids me to go into this subject, but I have already treated it rather fully in the paper referred to. As for the elephant-mound and the numerous "elephant-pipes," they have long since been discredited as regards the original identification, and not a few have been cast into the limbo of plain frauds.

It is not a mere difference of opinion upon rather minor details of archæology that prompts this reply to Dr. G. Elliot Smith's communication. It is because he ventures to draw conclusions of great importance as regards cultural connection between China and Mexico in ancient times from this tainted evidence. In dealing with the hydra-headed fallacy of Old World origins for New World civilisations it is necessary to cut off each head in turn with a searing sword.

HERBERT J. SPINDEN.
American Museum of Natural History,
December 18, 1915.

IN my second letter on this subject, which was published in NATURE on December 16 (p. 425), I have already dealt with the main point raised by Prof. Tozzer's letter; and since then I have presented to the Manchester Literary and Philosophical Society, for publication in its Memoirs, a detailed examination of the whole problem, with a series of illustrations and a full discussion of all the evidence. The account given in my memoir sheds a remarkable light upon the psychology of Americans, both ancient and modern, and especially upon the ethnological "Monroe doctrine," which demands that everything American belongs to America, and must have been wholly invented there. The Maya civilisation was American in origin only in the same sense that Harvard University is—immigrants from the Old World supplied the ideas and the technical knowledge, which enabled an institution to be built up, no doubt with certain modifications prompted by local conditions and the contact of a variety of cultural influences.

FIG. 2.

As it may be some time before my lengthy memoir can be published, I should like to refer to Prof. Tozzer's other arguments now.

Like the other American ethnologists, to whom I referred in my last letter, he lays great stress upon the fact that "the ornamental scroll beneath the eye" (see the figures taken from Spinden's monograph) is found both in the elephant- (*c*) and the macaw-sculptures (*a*) at Copan; and he uses that fact as an argument in favour of what I regard as the picture of an elephant having been intended for a macaw. Has it ever occurred to Prof. Tozzer to inquire into the origin and meaning of the scroll to which he attaches so much importance? If he will do so, he will learn that, so far from the elephant having borrowed the scroll from the macaw, the scroll was an essential part of the elephant-design before it left Asia, and, in fact, is found in conventionalised drawings of the elephant in the Old World from Cambodia to Scotland. There is no doubt whatever that there was a certain amount of confusion in

the mind of the ancient American sculptor between the pictures of the elephant (*b* and *c*) and that of the macaw (*a*). Thus he provided the modern American ethnologist with an additional argument for refusing to admit that the sculptures *b* and *c*, as well as that which I reproduced in NATURE of November 25, and now repeat (Fig. 2), cannot have been intended for anything else than an elephant. Never having seen an elephant, and not being aware of its size, no doubt the Maya artist conceived it to be some kind of monstrous macaw; and his portraits of the two creatures mutually influenced one another. The geometrical pattern around the macaw's eye is an excellent conventialisation of the peculiar marking of the Central American macaw (Fig. 3): the pale area surrounding its eye occupies approximately an area relatively corresponding to the Indian elephant's pinna. The ear-ring often depicted (in Indian drawings) over the auditory meatus gives it an eye-like appearance. Is it any wonder, then, that the Maya artist should have taken the elephant's meatus (in a picture) for its eye, and have confused its pinna with the pale area on the macaw's head? Therefore, it was a natural thing to use the same convention for representing it as he had done in the case of the macaw. But the macaw's scroll was derived from the elephant-design. These and several other considerations, when the facts are set forth and examined in detail, as I have done in my memoir, make every stage in the history of the confusion so transparently clear that one can reconstruct the psychology of it with the utmost confidence. It is equally certain that the scroll below the ear, as well as the tree-like appendages above the head (shown in Fig. 1, *c*), are parts of the conventional waves breaking around the sea-elephant type of the Indian "Makara," which was the commonest form of the elephant spread abroad by the seamen of southern India, whence the great migrations started. This is admirably demonstrated also in the Scotch and Scandinavian pictures of elephants.

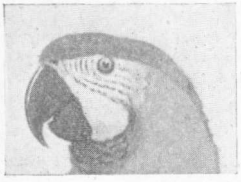

FIG. 3.—The Central American Macaw.

The Copan sculptor has provided the elephant with a new ear (Fig. 1, *c*), also modelled on the Makara's ear, and provided with a characteristically Cambodian pendant. If *c* was meant to be a macaw, why was it given a mammalian ear?

It is significant that the American ethnologists who entertain the macaw-hypothesis do not refer to the perfect example, which I have used (Fig. 2), but only to the cruder, damaged remains of the other Copan elephant (Fig. 1, *c*), in which the compromising turbaned-rider and his elephant-goad, as well as the distinctive profile of the Indian elephant's head, have been destroyed. In this sculpture also the artist was influenced to a greater degree than in the more perfect head (Fig. 2) by the macaw-design, and instead of restricting the geometrical pattern, as in the latter, to the area of the pinna, encircled the eye with it (*c*). This occurs in a more striking form in the glyph (*b*), to which Prof. Tozzer refers. In other respects, however, this also represents an unmistakable elephant.

Prof. Tozzer argues that Bancroft's drawings do not represent elephants, but the long-nosed god B. But the "long-nosed god" of the old codices is as unmistakable an elephant as the Copan sculpture is. As Prof. Stempell remarked, in reference to it (see my first letter), no zoologist can have any doubt that it was the artist's intention to represent an elephant —or, as I would prefer to put it, to copy the drawing of an elephant. In this case again the method of conventionalising the elephant, and especially his tusk, is a close parallel to the Cambodian prototype.

As to the so-called "elephant mound" and "elephant pipes," I may say that in my memoir I have not based any part of the argument upon them. If they are genuine, they are of trifling value as corroboration, in comparison with the consideration that the whole of the legends centred around the rain-gods of India and Mexico (NATURE, December 16) witness to the truth of the identification of the "long-nosed god B" as the elephant of Indra, who has been confused with Indra himself. If the pipes are forgeries —and I am not unaware of the literature relating to the point raised by Prof. Tozzer—the maker of them must have been one of the most remarkable archæologists America has yet produced.

I may add, in conclusion, that the evidence provided by these American pictures of the elephant is merely one link in the chain of connection between the early civilisations of the Old World and the New, which my collaborators and I are now putting together. It will be so strong that it can never be broken.

Out of the vast mass of proofs which we have now accumulated I selected the elephant-story for publication in NATURE, because the criticism that invariably is levelled at most of our other evidence cannot be used in this case. It is usually argued that even the most complex designs and the most fantastic customs and beliefs may be invented independently the one of the other in widely separated localities. But even the Maya artist, skilled as he was in conventionalising, could not invent the elephant, even by making a grotesque caricature of a macaw.

Since I posted the foregoing comments on Prof. Tozzer's letter, the Editor has kindly submitted Dr. Spinden's letter to me. With the previous instalment of my letter, so as to put the critics' case fairly before readers of NATURE, I sent the same three of Dr. Spinden's drawings which he has now submitted to illustrate his letter. My letter in NATURE of December 16, as well as my reply to Prof. Tozzer, cover most of the issues raised by Dr. Spinden.

These two distinguished interpreters of Central American art can decide between themselves what the Yucatan "heads with projecting snouts" were really intended to represent.

As for the real intentions of the Copan artists, I am quite content to leave it to the readers of NATURE to decide for themselves whether the sculpture reproduced on November 25, p. 340, and here repeated (Fig. 2), was or was not meant to depict an elephant with his Indian rider. If further corroboration is wanted, I might refer them to the manner of representing such a rider and his head-dress in early Indian and Cambodian sculptures; and as for the spiral ornament, which probably originated in the Indian representations of Makara, I might direct attention to the Cambodian and Chinese variations of the spiral, all of which reappear in Mexico and Central America. I would especially refer to Laufer's monograph on "Jade" (Chicago Field Museum of Natural History, 1912, pl. xliii.), where a perfect prototype of the Copan spiral is represented upon a jade ornament of the Han dynasty.

Dr. Spinden's refusal to admit that the Copan sculptures represent elephants becomes more intelligible when one reads the statement in his monograph on "Maya Art" that he "does not care to dignify by refutation the numerous empty theories of ethnic connections between Central America and the Old World" (p. 231). This is the attitude of mind not

of the scientific investigator, but of the medieval theologian appealing to the emotions in defence of some dogma which is indefensible by reason.

G. ELLIOT SMITH.

The University, Manchester.

The Board of Education and Laboratory Work: A Correction.

ON p. 548 of NATURE (January 13) I stated that the Board of Education had suggested the substitution of lecture-demonstrations for laboratory work in schools. I have been informed that the apparently trustworthy information on which I relied was incorrect. It is satisfactory to be able to state authoritatively that the Board has made no such suggestion, nor was the Board responsible for the recent adoption of this form of retrenchment in certain schools.

G. F. DANIELL.

A TERRESTRIAL CRATER OF THE LUNAR TYPE.[1]

ALTHOUGH the memoir before us was read before the U.S. National Academy of Sciences so far back as six years ago, it has only recently been received, and it must always be regarded as a chief source of our information concerning one of the most striking features presented anywhere on the earth's surface. The author, who was one of the firm which obtained possession of the locality, has accumulated by persistent and accurate observation such a wealth of valuable information that his memoir will always remain of the highest scientific value.

Among the interesting phenomena revealed by the exploration of the western territories of the United States, none yield in importance to the remarkable ringed depression which received the name of "Coon Butte." Situated 70 miles from the famous Grand Canyon of the Colorado, and only 2½ miles from the Canyon Diablo, with its innumerable scattered meteorites, the strata underlying all three localities are the same and are perfectly horizontal. These well-known strata consist of 40 or 50 ft. of purplish-red sandstone, underlain successively by 250 to 300 ft. of limestone (carboniferous), and 1000ft. of white sandstone. Although these beds underlying the "butte" have been explored by numerous borings, neither in the strata themselves nor in the dark red sandstone rocks below them has the smallest indication of volcanic materials been met with; neither has the faintest trace of solfataric or other volcanic action been detected. The nearest scene of volcanic activity is found on a small scale nine miles away, and on a grander scale 40 miles farther. On the other hand, fragments of the famous "Canyon Diablo meteorite" (which contains diamonds with platinum and iridium) have been found in countless numbers in and around the "butte," and up to a distance of five miles around it.

The "crater" of Coon Butte is a depression, circular in form and about 4000 ft. in diameter, with a rim that rises 570 ft. above a floor, which is quite level except where obscured by talus from the rim. In this rim the limestone and sandstone rocks are seen to have undergone the most violent disturbance; they dip away from the centre at various angles up to 90°. For distances up to two miles from the "butte" ejected fragments of the strata are found, those of the limestone being great angular blocks up to thousands of tons in weight, while the sandstone is usually finely divided and often in a completely pulverised condition. The minute study of the ejected sandstones shows evidence of their having been subjected to most intense mechanical forces. In many cases the individual sand-grains are pulverised into a fine "silica-meal"; where, as generally happens, the original bedding planes are visible, they are seen to have been bent and twisted in the most striking manner, and in some cases a lamination cutting across the bedding planes has been induced strikingly similar to the cleavage of slaty rocks. More rarely fusion of the silica has taken place, and portions of the original sand-grains are involved in chalcedony, a pumice-like material being formed which floats in water.

Scattered among the other ejected fragments as well as in the "butte" itself are numerous examples of what the author calls "shale-balls," by others, perhaps more appropriately, designated

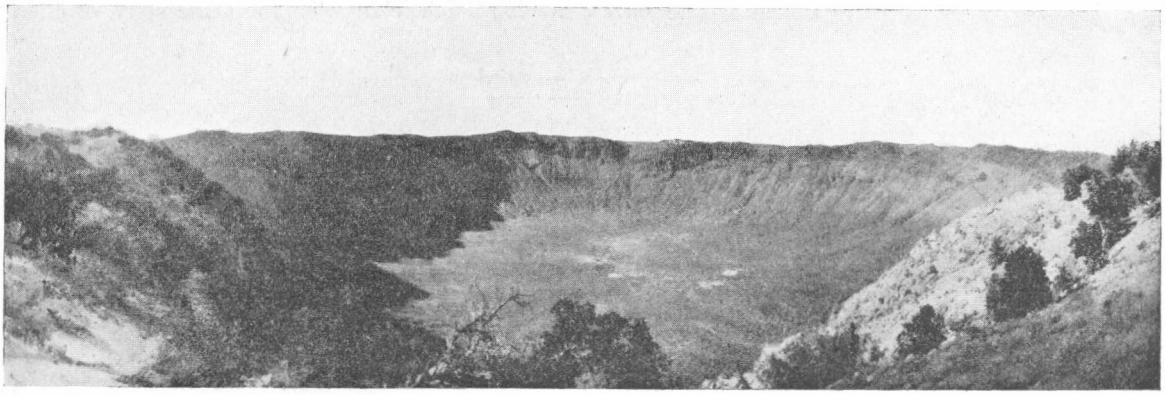

FIG. 1.—Interior view of crater, looking N.N.W.

[1] "Meteor Crater (formerly called Coon Mountain or Coon Butte) in Northern Central Arizona." By D. M. Barringer. Paper read before the U.S. National Academy of Sciences.

"iron-shale." They are rounded or globular in form but never angular, and have the same "shaly" appearance as some of the sandstone fragments. On examination they prove to be oxidised masses of nickel-iron, and in some cases, in spite of their alteration, the Widmanstätten figures may be clearly recognised in them; they sometimes contain nuclei of unaltered nickel-iron. The larger of the well-known Canyon Diablo meteorites, which are of weights up to 300 or even 1000 lb., show no trace of alteration, but exhibit the pitted surfaces and other features of independent meteorites. Thus it would appear that at this locality there were two types of meteorites, one very easily acted upon by oxidation, and it is possible that some of the smaller "Canyon Diablo meteorites" may be only nuclei of the oxidisable variety.

All the American geologists who have studied the locality are in agreement as to the non-volcanic origin of this "crater"; Prof. G. K. Gilbert, however, has suggested a theory which has found wide acceptance. It is that the "crater" is due to the impact of a great meteorite or group of meteorites, which has produced the violent mechanical effects everywhere visible. The only analogous case that can be cited—and it is a rather remote one—is that of the meteorite of Knyahinya in Hungary, which weighed 660 lb., and, according to Haidinger, buried itself when it fell in 1866 to the depth of 17 ft., forming a circular pit 4 ft. in diameter and 4½ ft. deep. Coon Butte may not unnaturally be accepted as supplying a very suggestive explanation of the origin of the far larger lunar craters which present so many features in common with it.

It must be confessed, however, that many unsolved difficulties remain to prevent our unhesitating acceptance of the meteoric theory. Chief among these is the question of what has become of the vast mass of matter capable of producing the shattering impact. Only scattered fragments of nickel-iron have been detected at the depths reached by the borings, and the existence of a vast mass of meteoric iron at greater depths finds no confirmation from the magnetic observations carried on in and around the "butte." In an appendix to the memoir an account is given of a striking suggestion on the subject by Prof. H. N. Russell. He argues that a great meteorite or group of meteorites, moving with planetary velocities, would, on reaching our atmosphere, drive before it a "wad" of air capable of crushing out the great circular cavity, while this same air, in its upward escape, would effect the upheaval of the rocks of the rim and the ejection of materials to distances up to two miles from it. The problem of the existence of the great meteorite at considerable depths or its gradual disappearance by oxidation still remains.

It is evident that the striking characters of this singular "crater" are of no less interest to astronomers—so suggestive are the characters in which it agrees with the vast lunar craters—than to geologists, who up to the present have been chiefly attracted by the phenomenon.

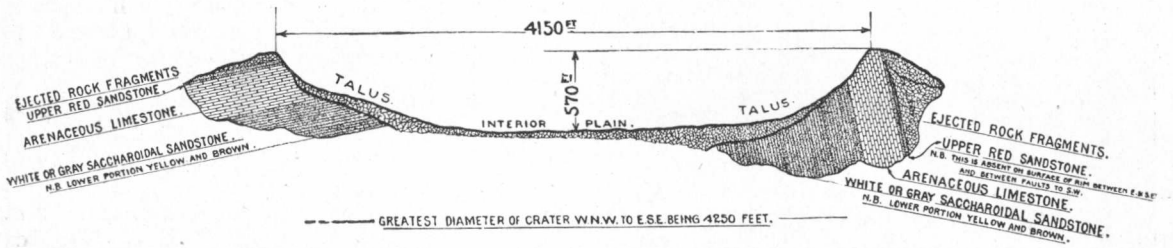

FIG. 2.—Cross-section of crater along a line approximately N.W. to S.E. Scale, about 1290 ft. = 1 in.

RECENT PUBLICATIONS OF THE CAPE OBSERVATORY.[1]

ALTHOUGH Sir David Gill retired from the direction of the Cape Observatory early in 1907, and died just seven years later, the volumes from that observatory which have recently been distributed are essentially his work. Even in the contributions of successor and collaborator Gill's inspiration and design are evident. It is not too much to say that the same spirit of energy and thoroughness will endure in the pages of future publications long after his name has disappeared from the title. No greater tribute can be paid to the memory of a great man. His personal achievement was considerable, but beyond that his influence on others will surely live.

These three volumes are typical of the three main currents to be observed in Gill's purely astronomical work. There is a zone of the Cape Astrographic Catalogue, a contribution to the great scheme of registering the positions of the stars by photography, with the inception and execution of which Gill was so largely identified. There is a volume of meridian work dealing both with the old transit circle and the new instru-

[1] Cape Astrographic Zones. Vol. ii., Catalogue of Rectangular Coordinates and Diameters of Star-Images derived from Photographs taken at the Royal Observatory, Cape of Good Hope, commenced under the direction of Sir David Gill, completed and prepared for press under the supervision of S. S. Hough. Zone −42°. (Edinburgh: H.M.S.O.; London: Wyman and Sons, Ltd., 1914.) Price 20s.

Results of Meridian Observations of Stars made at the Royal Observatory, Cape of Good Hope, in the Years 1905 to 1908, under the direction of Sir David Gill and S. S. Hough. (Edinburgh: H.M.S.O.; London: Wyman and Sons, Ltd., 1914.) Price 30s.

Annals of the Cape Observatory. Vol. xii., Part i. Determination of the Mass of Jupiter and Elements of the Orbits of its Satellites from Observations made with the Cape Heliometer by Sir David Gill and W. H. Finlay. Reduced and discussed by Dr. W. De Sitter. Pp. 173. (Edinburgh: H.M.S.O.; London: Wyman and Sons, Ltd., 1915.) Price 6s.

ment which he designed with such careful attention to detail for the fundamental astronomy of position in the southern hemisphere. And finally there is a volume, or part of a volume, containing a fine series of measures with the heliometer, the instrument with which Gill's reputation as a practical observer is associated. The reductions in this case have been made by the present professor of astronomy at Leyden, and illustrate Gill's remarkable power of attracting young and talented astronomers to a distant observatory and enlisting collaboration from outside in the schemes which he had at heart.

The present instalment of the Astrographic Catalogue bears the date 1914. Since the first volume is dated 1913, and each contains nearly a tenth of the whole share allotted to the Cape Observatory, it may be surmised that the publication of the whole will be completed towards the year 1925. With some allowance for preliminary work, this means that about thirty years will have been spent in carrying out the project. Two observatories, Greenwich and Oxford, have already finished and published their sections. If this appears to imply that the Cape Observatory has been dilatory, it is fair to notice that the portion undertaken at the Cape is about 30 per cent. in excess of the average; that it was necessary to observe the reference stars simultaneously with the meridian circle; and that an extremely high standard of accuracy has been aimed at and probably attained. It is also quite possible that in spite of the apparent delay the Cape Observatory will be the third to finish. If this be confirmed by the event, the first three observatories to accomplish their task will all be British. This may prove to be the only satisfactory feature in an undertaking which bids fair to be a dismal failure in the field of international co-operation.

One feature presents itself at a casual glance through the catalogue. On the whole, the number of stars per plate is very high. But the run of the numbers is far from regular, and can scarcely correspond with real variations of the star density in the sky. The minimum magnitude recorded on a plate is not constant. This is confirmed by the result of comparing each plate with the overlapping plates, which often shows that the majority of the stars on one plate are unrecorded in the contiguous zones. It is not, of course, a defect peculiar to the Cape plates, though perhaps more conspicuous here because no indication is given of the magnitude scale, and because those stars are marked which are missing in the overlapping zones. It is a small point, doubtless, and the irregularity could scarcely have been avoided. But it illustrates the wisdom of the conference, which, starting out with the avowed object of securing a certain minimum magnitude, laid down a hard and fast rule defining the times of exposure without any regard to the quality of the night or the speed of the plates. As a matter of fact, the sensitiveness of the plates used has probably increased by at least one magnitude since the rule was formulated. Thereby, as though the work had not palpably overtaxed the resources of most of the observatories already, the labour and expense have been augmented in two ways, first by the increase in the number of star images, and then by the supposed need of revising earlier plates in order to conform with the higher numerical standard. When all is said and done, the limiting magnitude on any given astrographic plate is practically an undetermined quantity.

The volume dealing with the meridian observations made during the years 1905–8 contains much descriptive and tabular matter chiefly of interest to the specialist. The individual results obtained with the new reversible transit-circle and given here will be ultimately combined to form a fundamental catalogue. Most of the work done with the older instrument was carried out at the request of the late Prof. Boss, and has already appeared in catalogue form. A further list of 381 miscellaneous stars is now published in the same form. The individual observations of both lists will be found in this volume.

The heliometer observations of Jupiter's satellites, to the discussion of which the first part of vol. xii. of the Cape Annals is devoted, were made chiefly by Gill and on a few nights by Finlay in the autumn of 1891. They connect satellite with satellite, and do not involve the limb of the planet, the observation of which entails a lower order of accuracy. The main object in view was a determination of the mass of Jupiter, and this requires a most accurate knowledge of the scale value, to which the most careful attention was given. Corrections to all the elements of the satellites, except the mean motions, are involved, and no fewer than twenty-nine quantities enter into the final equations of condition. Duplicate solutions were made, one under the supervision of Mr. Hough, the other with different treatment by Prof. de Sitter. As regards the mass of Jupiter the final result is

$$1/1047{\cdot}50 \pm {\cdot}06.$$

Compared with the best results previously obtained, this value of the denominator seems a little high. H. C. P.

THE CLOSING OF MUSEUMS.

ACCORDING to the Secretary to the Treasury, "His Majesty's Government are of opinion that the following museums and galleries should be closed to the public: British Museum, Natural History Museum, Science Museum, Geological Museum, Bethnal Green Museum, Tate Gallery, National Portrait Gallery, Wallace Collection, London Museum." The precise sense of the word "should" will appear from events. At any rate, the decision has been made definite in the case of all departments of the British Museum except the reading-room, but the National Gallery and the Victoria and Albert Museum are not to be closed.

This decision will come as a severe blow to those who have been urging the need of a greater regard for science and education, but, in view of

European war—Commercial and financial aspects

the remarkable outburst of public opinion, it may still be possible to get its incidence modified. Let us consider what it means.

Fortunately, so far as we understand, it does not mean anything more than the closing of the galleries to the public. The ground alleged for this is not greater safety (a matter already attended to); it is in the main a question of economy and the turning of some of the staff on to more urgent work. But, as was well pointed out in a letter to Saturday's *Times* signed by "A Biological F.R.S.," the curatorial work must of necessity go on, some office staff must be kept up, and accredited students, many of whom are engaged on actual war-work, will presumably be admitted. The saving effected, whether considered absolutely or in relation to the total expenditure of ordinary times, is therefore small; the Government estimate is £50,000. In the case of the Natural History Museum, the largest of those with which our readers are chiefly concerned, it would seem possible to dispense with about sixteen commissionaires, two lavatory attendants, three or four cleaners, and perhaps as many police. There are, we believe, a very few employees still available for military service, and awaiting their call. For the rest, the staff cannot, consistently with the safety of the collections, be much further depleted. The museum estimates have already been enormously reduced, and any additional saving would be quite trivial in proportion. Not that the actual money will be saved, for the Government could not cast its employees adrift, but the labour can be directed to other purposes. This does not mean that two dozen stalwart men are set free to fight their country's battles, or even, for the most part, to make munitions. Perhaps some of these candidates for pensions are capable of light horticultural or clerical work, in any case of work for which they have not been trained.

Now is this really worth while? Here is a great building, which with its vast exhibited collections alone has been appraised at a million pounds, about to be closed to the public for the sake of so trivial a saving. Here is the centre of our Empire, thronged with its citizens from near and far, and they are to be precluded from seeing the gathered scientific (and many of the artistic) treasures of their nation. Here are our soldiers seeking refreshment for their minds deadened by the din of battle, and they are to be turned out to the public-house, the revue girl, and Charlie Chaplin. On grounds of pure economy we venture to predict that as much money will be wasted to the nation by this step as will ever be gained by it. Then there are the children, whose school-hours in many cases are shortened, whose teachers have obeyed other calls—they will no longer be able to have recourse to the museum which they are gradually learning to love; their pleasures must again be the pleasures of mean streets. As for the public with some leaning to nature or to art, those who spend a hard-earned half-holiday in gaining some useful knowledge, the public whom we have been trying to lead to a better appreciation of science—what will they think when they see that the first Government establishments to be closed are those devoted to the highest learning and the noblest forms of art? And we, what are we to think of a responsible Minister who can describe the museums as merely "places of pleasant resort"?

The truth is, the Government has been badgered to "give the country a lead" in this matter of economy; and at last it has led—along the line of least resistance. It is not because these are the departments in which anyone has ever hinted at waste; those who never have enough to spend are not likely to waste it. It is merely that the easy but conspicuous action of closing the museums may convince people that the Government "means business." Sensible folk here will soon see that as a business proposition there is nothing in it, and across the Channel, where they are trying to reopen such museums as had perforce to be closed, it will certainly not count as *un beau geste*.

NOTES.

ONE of the effects of the war has been to bring home more forcibly to the general public the part played by science in the growth of Germany's greatness as a nation. Several articles have already appeared in the reviews emphasising this, and the January number of the *English Review* contains a short sketch by Mr. H. L. Heathcote of the development of Germany's chemical industry. This will help to make better known the principles of action underlying Germany's success, in the past, in capturing so large a share of the world's trade. The growth of the industries of porcelain, glass, sugar, cyanide, and of acids and alkalis, is briefly described, and a short account is given of the inception of new industries, such as those of the incandescent mantle, the metal filament lamp, and the fixation of atmospheric nitrogen. In a sketch of the development of the dyestuff industry, it is pointed out that no amount of baseness in her conduct of war will ever quite eclipse, from the chemists of all nationalities, the greatness of Germany's achievements in organic chemistry, the most difficult of all chemical work. "State-aided chemical industry runs like a vein of gold through the statecraft of Germany, and if ever we learn what Kultur means we shall find that German chemical industry is its vital part." That the industry can be used in an almost unique way to assail the wealth of other nations is proved beyond question by past facts. It remains to be seen how far we, in the future, will profit as a nation from the most important lesson the war has to teach—that national greatness and even national security depend primarily on the degree to which science is encouraged and fostered by the State.

THE threatened prohibition by Sweden of the exportation of wood pulps awakens political interest in an important branch of our cellulose industries. The papermaking industry of Great Britain is chiefly dependent upon imported raw materials, of which about 80 per cent. are the wood pulps. In evidence of the growth of the industry, as of its collateral dependence upon exotic supplies, the importation of these wood pulp shows a tenfold increase for the period of 1887 to

1915—*i.e.* from 500,000*l.* to 5,000,000*l.* The values of total imports for 1915 are above six millions sterling, which includes esparto grass (700,000*l.*), rags and rag pulps, and miscellaneous raw materials. As to the distribution of the sources of supply of the wood pulps, a large part of the total—60 to 70 per cent.—is derived from Scandinavia, Norway sending a larger proportion of "mechanical" pulp, which is the basis of our newspapers, and Sweden the larger proportion of chemical pulp, used in higher class printings and also writings. The chemical pulps of the American continent, *i.e.* including Canada, are little exported, but a fairly large amount of "mechanical" pulp, that is, ground wood pulp, is obtained from Canada, and some from Newfoundland. Our dependence upon Scandinavia is obviously reciprocal; their wood-pulp industry, which is now a very important means of exploitation of their pine forests, is certainly of primary importance to them. The general conclusion of specialists is that Sweden cannot afford to enforce any such prohibition. It is probably a card played in the game of *haute politique*, and the solution of the matter is to be expected in some form of licence to export, similar to our licences in the case of sulphur and other products ranking directly or indirectly as "munitions."

ON Thursday next, February 3, Prof. W. H. Bragg will deliver before the Chemical Society his lecture entitled "The Recent Work on X-Rays and Crystals and its Bearing on Chemistry."

AT the annual general meeting of the Royal Meteorological Society held on January 19 the Symons Memorial gold medal, which is awarded biennially for distinguished work in connection with meteorological science, was presented for transmission to Dr. C. A. Angot, Bureau Central Météorologique de France.

AT a meeting of the council of the Royal Society of Arts on Monday, January 24, the society's Albert medal was presented to Sir J. J. Thomson, "for his researches in chemistry and physics and their application to the advancement of arts, manufactures, and commerce." The medal was founded in 1863 as a memorial of H.R.H. the Prince Consort, and is awarded annually "for distinguished merit in promoting arts, manufactures, and commerce."

IN order to secure the integrity of the estate of the Zoological Station at Naples, and to provide that its scientific function shall not be interrupted, the Royal Italian Government has appointed a committee, of which Prof. F. S. Monticelli is president, for the temporary and extraordinary administration of the Zoological Station. The committee will endeavour to provide the station with financial means for the development of its activities, particularly the fulfilment of its obligations towards the table-occupants. All communcations—financial and scientific—which may concern the station should be sent to Prof. Monticelli.

IN view of the uncertainty as to the sufficiency of the supplies of sulphate of ammonia to meet the home demands during the next few months, it has been decided, on the recommendation of the Fertilisers' Committee, with the approval of the President of the Board of Agriculture and Fisheries and the President of the Board of Trade, to suspend for the present the issue of licences for the export of sulphate of ammonia. Under normal conditions it is well known that the production of sulphate of ammonia considerably exceeds home requirements, but Lord Selborne confidently hopes that farmers will this year greatly increase their demands for fertilisers of all descriptions so as to stimulate so far as practicable the production from the land, and thus reduce the importation of foodstuffs.

WE referred in a leading article on December 23 to the question of an adequate supply of nitrates for agricultural and other purposes, and we commended it to one of the scientific committees which have been established since the outbreak of war. What is mainly wanted is a careful consideration of all available facts, so that a precise statement may be made of the possibilities of the synthetic production of nitrates in this country as a commercial enterprise. The subject is one that intimately concerns the Board of Agriculture; and it seemed to us that it could be considered appropriately by the Departmental Committee appointed by the President of the Board to make arrangements with a view to the maintenance, so far as possible, of adequate supplies of fertilisers for the use of farmers in the United Kingdom. We are glad to see, therefore, that the omission of a chemist from this committee, to which we directed attention in our article, has now been rectified. It has just been announced that the President of the Board has appointed Sir James J. Dobbie, F.R.S., Government Chemist, and Mr. J. R. Campbell, of the Department of Agriculture and Technical Instruction for Ireland, additional members of the committee. Mr. H. Chambers has been appointed secretary to the committee *vice* Mr. H. D. Vigor, resigned.

WE learn from the *Chemist and Druggist* of the death, at seventy-five years of age, of Dr. R. C. Engel, professor of chemistry at the Ecole Centrale des Arts et Manufactures, Paris, and a corresponding member of the Academy of Medicine.

THE death is announced, at the age of sixty-nine years, of Mr. H. M. O'Kelly, formerly superintendent of Government telegraphs in India. He joined the Indian Telegraph Department in 1866, was appointed superintendent in 1886, and retired in 1898.

WE regret to announce that in the list of deaths due to the loss of the *Persia* is included the name of Mr. Robert Vane Russell, of the Indian Civil Service. Mr. Russell joined the service in 1893, and at the time of his death had reached the rank of Deputy Commissioner in the Central Provinces. His ability, powers of work, and knowledge of the people marked him out for early distinction, and in 1901 he conducted the census of the province and wrote a valuable report. After the completion of the census he was engaged on the revision of the series of district gazetteers, of some of which he was sole author, and all were improved by his wide knowledge of the country. But his most important work was the ethnographical survey of the province, to which his later years were devoted. He carried on this work with unfailing energy, in spite of the fact that a painful disease compelled him to

be almost entirely a recluse. He published as the preliminary studies of this work a series of monographs on castes, which are full of interest, particularly those devoted to the little-known forest tribes. It is a melancholy satisfaction to know that before he started on his last fatal voyage he was able to complete this great work on the "Tribes and Castes of the Central Provinces of India," which is announced for early publication by Messrs. Macmillan and Co., Ltd. By his early death the Indian Civil Service loses an officer of exceptional ability, and anthropology an energetic field worker and a competent authority on the general questions of ethnology, comparative religion, and folklore.

DR. REGINALD KOETTLITZ and his wife have died from dysentery at Somerset, South Africa, where Dr. Koettlitz was in practice. Born in 1861, educated at Dover College and Guy's Hospital, Dr. Koettlitz settled in a country practice in England, where he remained eight years, until he joined the Jackson-Harmsworth Polar Expedition in 1894. He remained three years continuously in Franz Josef Land, for he refused to return home when he had the opportunity, and leave the expedition without a medical officer. Dr. Koettlitz's geological researches in Franz Josef Land were most important and carried out under very adverse conditions. In 1898 he joined Mr. Weld Blundell when the latter accompanied Captain Harrington to Addis Abbeba, on his appointment to the court of the Emperor of Abyssinia. This entailed a journey through Somaliland and south Abyssinia to the Berta country and the Blue Nile, and home by the Sudan and Egypt. Later Dr. Koettlitz travelled in Brazil, and in 1902 joined the late Captain Scott as senior medical officer of the *Discovery*. He served throughout that expedition, and did much useful work. The Koettlitz Glacier remains as a memorial to his enthusiasm for travel and scientific research, and will keep alive the memory of his kindly and unselfish nature.

BY the death of Lieut. William Inchley, of the 2nd Duke of Wellington's Regiment, under shell fire in France, on December 19, 1915, a scientific career of great activity and high promise was cut short at the age of thirty-two years. On leaving school, Lieut. Inchley attended the engineering course at University College, Nottingham, and graduated B.Sc. (Engineering) with honours in the University of London. He was a brilliant student. In his second year at college he gained first prize and silver medal of the City and Guilds of London Institute in mechanical engineering, and in the next year their bronze medal and prize in electrical engineering. He was apprenticed to Messrs. R. Hornsby and Sons, Ltd., Grantham, and engaged on the design, construction, and testing of internal-combustion engines and steam boilers, and for two years acted as technical assistant to this firm. As a graduate of the Institution of Mechanical Engineers he gained a prize for a paper on "Steam Engine and Boiler Trials." From January, 1907, he was lecturer in mechanical and electrical engineering at University College, Nottingham. His paper on "The Calorific Value of Solid and Liquid Fuels" gives the results of a research, using the latest form of Mahler-Cook bomb calorimeter. He also recalculated Mahler's figures, and deduced simple empirical formulæ for the heating value of fuels which agree more closely with the values obtained by the bomb calorimeter than those given either by Dulong or Mahler. Lieut. Inchley wrote several books on engineering; his "Theory of Heat Engines" gives in a concise form thermodynamic and mechanical principles with many numerical examples. His book on "Steam Boilers" avoids advanced mathematics, even when dealing with heat transmission. He was also joint-author of "Elementary Applied Mechanics." All who were associated with him in his life-work will long cherish the memory of his devotion to duty. His death is not only a severe loss to his wife and three young children, but also to University College, Nottingham, and his country.

WE learn with regret of the death, in his seventy-seventh year, of Prof. Paul Sorauer, of the University of Berlin. He early won recognition by his "Beiträge zur Keimungsgeschichte der Kartoffelknolle," published in 1868. Six years later appeared the "Handbuch der Pflanzenkrankheiten," written whilst Sorauer was director of the Experimental Station for Plant Physiology at the Imperial Cider Institute of Proskau. This work, which was the first comprehensive presentation of the rapidly growing science of plant pathology, immediately raised the author to a leading position. A new edition, twelve years later, is noteworthy for the author's acceptance of the then heretical doctrine of the importance of bacteria as causal agents of disease in plants. The last edition, completed in 1911, must remain for many years the most authoritative exposition of this subject, and we are glad to note that it is being rendered accessible to English readers. In the meantime appeared many other of his valuable works dealing with various aspects of plant pathology, and the eminently readable "Populäre Pflanzenphysiologie," which has since been translated into English by Weiss. In 1891, the *Zeitschrift fur Pflanzenkrankheiten* was founded under the auspices of the "Internationalen Phytopathologischen Kommission," and Sorauer became editor, a position he occupied until his death. During that time he contributed more than thirty articles embodying original research to this publication alone, which latter under his guidance remained the leading phytopathological journal. Whilst it is by his "Handbuch," the successive editions of which mark epochs in the history of the study of disease in plants, that Sorauer will live, his enthusiasm and untiring energy in all international phytopathological activities are worthy of the fullest recognition, and have had a predominating influence in what has been achieved to that end.

THE *Scotia*, which was the vessel that carried the Scottish National Antarctic Expedition to the south polar regions, under the command of Dr. W. S. Bruce, has been burnt in the Bristol Channel, and has been run ashore at Sully. It was hoped at the end of the expedition that the *Scotia* might be further endowed and handed over to the universities of Scotland as a well-fitted oceanographical ship, but this was not to be, and she fell to the hammer as a whaler. Later,

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however, she was chartered by the Board of Trade as the most suitable vessel on which to carry out ice observation, meteorology, and oceanography in the North Atlantic Ocean after the wreck of the *Titanic*. The results obtained during this voyage in 1913 have been published by the Board of Trade in two volumes.

THE Midlands earthquake of January 14 proves to have been felt much more widely than was at first supposed. Though less strong than several other British earthquakes of the last quarter of a century, it was perceived by a large number of persons on the first and second floors of houses at a great distance from the centre. The disturbed area includes all England, with the exception of the counties of Northumberland and Durham, the northern half of Cumberland, and the southern counties bounded by a line drawn from Bridgwater in Somerset, by Salisbury, and Guildford, to the mouth of the Thames. It thus includes about 45,000 square miles. From a first rough analysis of the accounts received by him, Dr. Davison concludes that the centre of the innermost isoseismal line was not far from Stone, in Staffordshire. The western boundary of the disturbed area, however, is somewhat uncertain, and Dr. Davison (whose address is 16 Manor Road, Birmingham) would be very glad to receive notices of the earthquake from any part of Wales. He is also anxious to obtain many more observations from the central area, especially from the district within twenty or thirty miles of Stone, and would send forms to anyone able and willing to supply the information desired. We have also received a request from Mr. J. J. Shaw (Sunnyside, West Bromwich), secretary of the Seismological Committee of the British Association, for information with reference to the time of occurrence and the nature and intensity of the shock.

MR. L. MACLENNAN MANN has issued an interesting pamphlet on archaic sculpturings, in which he proposes a new explanation of the mysterious cup-markings. Plotting them on sheets, he believes that he has discovered that they assume well-defined geometrical forms. The north and south line often runs through one centre, and through another centre runs another north and south line diverging from the first by two to four degrees. Up to the present his survey seems to have been practically confined to the districts of Dumfries and Galloway. With this theory in the minds of inquirers, it is desirable that a wider examination of these sculpturings in other localities should be prosecuted.

THE number of birds new to the British list is steadily increasing, though it is probable that many now recognised for the first time have frequently occurred on our shores, but have escaped detection. The vigilance of our ornithologists is greater than it was, and their powers of discrimination are keener. Hence it is now possible to distinguish not only between our own sedentary species and the Continental races thereof, which more or less frequently visit us, but also between different Continental races of species which visit us, apparently, only on rare occasions. No fewer than six species new to the British list are described in the *British Birds* magazine for January. The value of such records would surely be materially increased if some attempt were made to discover the prevailing weather conditions just before and during each of these recorded visitations.

FOR some time past a correspondence has been carried on in the daily Press as to the fate of the house-fly and the bluebottle, or blow-fly, in the autumn. Do they die, leaving pupæ to continue the race, or do they hibernate, and, reappearing in the spring, produce new generations of larvæ? The latter view is advocated by the non-experts, some of whom claim to have found hibernating individuals of both the species in question. It would seem, however, that but little trust can be placed on their evidence, for though numerous consignments of supposed hibernating individuals of these species have been sent to the British Museum of Natural History, not one contained either house-flies or bluebottles. In one case more than 200 supposed house-flies were sent, but on examination about 80 per cent proved to be cluster-flies (*Pollenia rudis*); there was not a single house-fly among them. The fact is not generally known that there are two or three distinct species of fly which closely resemble the house-fly, and these actually do hibernate, choosing our houses for that purpose, hence the confusion that has arisen.

AT the monthly general meeting of the Zoological Society, held on January 19, Prof. Lucien Cuénot, Dr. Clementi Onelli, and Count Mario Peracea were elected corresponding members, and Prof. Eli Metchnikoff a foreign member of the society. The additions to the menagerie numbered 107, including three species new to the collection: a Salt Desert cat (*Felis salinarum*), two sand hamsters (*Cricetulus griseus*), and an Allemand's Grison (*Grison allemandi*). Though the number of visitors for the year 1915 showed an increase of 3520 over the number admitted during 1914, the receipts for admission at the gates showed a decrease of 1283*l.*, as compared with the previous year. The total number of visitors during 1915 amounted to 1,058,728. In normal times this decrease in the receipts might well cause anxiety; as it is, these figures rather afford an occasion for congratulation. Far otherwise is it with similar institutions among those now at enmity with us. In Budapest we learn that the lions are now fed on half rations, which are partly furnished by the slaughter of the less valuable examples of goats and sheep. The seals have had to be killed for lack of fish, and a similar fate has overtaken the polar bears, for the shooting of which the director opened a competition, by way of raising a little ready cash! The herbivorous animals are in no better case, for the shortage of hay is so great that the deficit has to be made good by substituting wild chestnuts.

THE Geological Survey of New Zealand is making progress with well-illustrated descriptions of the fossils of that colony, which have long been desired for comparison with the corresponding fossils of other regions in the southern hemisphere. In Palæontological Bulletin No. 3, just received, Mr. H. Suter continues his revision of Hutton's type specimens of Tertiary Mollusca.

THE last number of the *Revista* of the National University of Cordoba (Argentine Republic) deals chiefly with subjects of medical and historical interest. In one article, however, Prof. Angel Gallardo refers to the richness of the collections in different institutions in the city, and urges the importance of the foundation of a Provincial Museum, with facilities for original research.

THE *National Geographic Magazine* for November, 1915 (vol. xxviii., No. 5) maintains its reputation for well-illustrated articles. The greater part of the issue is devoted to a general descriptive article on France, with more than one hundred illustrations, by Mr. A. S. Riggs. Many of the pictures are excellent, and most are quite new. A short article on the Citizen Army of Switzerland, with some pictures of the army amid the alpine snows, completes the number, except for sixteen colour photographs of miscellaneous geographical subjects illustrating, in the main, types of European peasants.

MR. P. W. STUART-MENTEATH is well known through his geological studies in the Pyrenees, which have now extended over forty years, and it is highly probable that in many points of detail he can correct the maps and sections of those who have made sweeping surveys of the chain. The twelfth part of his descriptions of the "Gisements métallifères des Pyrénées-Occidentales" has appeared in the *Boletin de la Sociedad Aragonesa de Ciencias Naturales,* and is chiefly concerned with the retention in the Cretaceous system of beds placed by Prof. Termier as Silurian, and the extension of the Cretaceous zones in areas recently mapped as Palæozoic. A close acquaintance with the strata would be required for the appreciation of the merits of the author's controversy with M. Léon Bertrand, or the older one as to the age of the overfolds in the Pyrenees, and of the alleged Carboniferous granite of Gavarnie ("La nueva Geologia en los Pirineas de Aragón," *Mem. del primer Congreso de Naturalistas Españoles,* 1909).

A SUMMARY of temperature, rainfall, and bright sunshine for the year 1915, obtained from the records of the fifty-two weeks ending January 1 of the present year, has been given by the Meteorological Office. The mean temperature for the year is in fair agreement with the average over the whole of the United Kingdom, but is generally slightly deficient, the greatest deficiency amounting to 1° in the east of Scotland and to nearly that amount in the west of Scotland. The rainfall for the year was in excess of the average in all the eastern districts, the amounts ranging from 130 per cent. of the average in the south-east of England, where commonly of late the rains have been abnormally heavy, and 123 per cent. in the east of England to 107 per cent. in the north-east of England. In the western districts the rainfall was more variable, ranging from 111 per cent. of the average in the south-west of England and 105 per cent. in the south of Ireland, to 80 per cent. in the west of Scotland, which has the greatest deficiency. In the north of Scotland the rainfall was 82 per cent. of the average, and in the Channel Islands it was 114 per cent. of the normal. The number of rainy days was less than the average except in the east of England and in the south of Ireland; in the south-east of England, where the greatest excess of rain was experienced, the rainy days were fourteen fewer than the normal. The duration of sunshine differed very little from the average, except in the north-west of England, where the total for the year had the average excess of half an hour per day.

THE seventh volume of the Journal of the Municipal School of Technology, Manchester, records the research work published by the staff and students during 1913. It extends to 200 pages, and includes important papers by Mr. W. C. Popplewell on the properties of reinforced concrete, by Prof. Knecht and by Mr. Hubner on dyeing and its history, by Prof. Miles Walker on the training of the engineer, and eleven other papers mainly on technical chemistry. In addition to the scientific interest provided in these records there is a preparatory note of a page and a half which tells something about the work of the school, and will serve as a guide to the authorities of many schools who have not yet realised what is the great need of the country in the matter of technical education. The first place in the note is given to the three or four hundred university students who have passed the matriculation examination and are taking a three years' course in order to graduate. It appears that the school cannot turn out graduates fast enough to meet the industrial demand for such men. As this is also the experience of the Central Technical College in London, it is a serious question whether those technical schools which complain that the industries show no appreciation of their students are turning out properly qualified men, or only men who, to make up for the deficiencies of their early training, obtain a smattering of scientific knowledge by attending evening classes when tired out with their day's work?

COSTING, in round figures, 1¾ million pounds, and comprising 880,000 cubic yards of cyclopean concrete masonry, the Kensico Dam, one of the principal features of the Catskill water supply system of New York City, has just been completed. The event is the more notable for the fact that the work has been carried out in the relatively short space of four and a half years, or three years less than the contract time—a remarkable achievement in days when experience is usually of the reverse kind. The Kensico Reservoir, destined to provide storage capacity for two and a half months' supply, is formed in the valley of the Bronx River, on the east side of the Hudson, thirty miles north of New York City. The dam takes the place of an earlier structure of much less height, enclosing a correspondingly smaller area; the increase in effective height is actually 110 ft., and in area, 3200 acres. According to the *Engineer* of January 7, the preparation of the foundation involved the removal of 2½ million cubic yards of earth and rock, and, in one place, the rock had to be drilled and blasted to a depth of 65 ft. The work of laying the masonry reached the record figure of 84,450 cubic yards in a single month. Electric power plant was extensively employed, and a special installation was laid down for the purpose. For the measurement of the water

drawn from the reservoir, there is provided a very large Venturi meter, 410 ft. long, formed in reinforced concrete, with bronze throat castings and piezometer ring. The protection of the surrounding area has been effected by planting the banks with *Arbor vitæ*, with pine and spruce seedlings in the rear, which will also serve the purpose of minimising the evil of drifting deciduous leaves.

WE are asked by Mr. J. Reid Moir to state that the arrangement of the collection of flint implements which, as announced last week (p. 572), has recently come into the possession of the Ipswich Museum, is entrusted to the curator, Mr. Frank Woolnough, and himself, and not to Mr. J. Reid Moir alone.

OUR ASTRONOMICAL COLUMN.

COMET 1915*e* (TAYLOR).—The following is a continuation of the ephemeris based on the orbit given last week :—

	h.	m.	s.	°	′		h.	m.	s.	°	′
Jan. 28	5	13	48	+19	8·1	Feb. 3	5	19	44	+21	29·5
30		15	35	19	56·3	5		22	6	22	14·4
Feb. 1		17	34	20	43·4	7		24	40	22	58·2

It will be seen that the comet is moving on the line 15 Orionis–114 Tauri, and should be close to the latter on February 5. According to an observation made at the Hill Observatory on January 22, the ephemeris required corrections of −22 sec. in R.A., and −15′ in declination. The former has more than doubled since January 13, but the latter has remained practically unchanged.

THE NOTATION OF STAR COLOURS.—The combination of photographic and photovisual photometry, as well as more direct methods, provide a measure of the colour index which can be expressed as a sum of terms due to the spectrum of the star, its absolute magnitude, and its distance. To break up into defined groups the numerical colour indices Prof. F. H. Seares proposes colour classes corresponding to the means for the typical spectra of classes B, A, F, etc., with the designations *b*, *a*, *f*, etc. By making certain numerical definitions, the difference between the colour symbols and the spectrum symbols expresses the abnormality of the individual as regards luminosity and distance. Such colour symbols may be termed "hypothetical spectra."

SATURN'S RINGS.—Speculation is only beginning to become again active in regard to the ring system of Saturn since Keeler elucidated the mystery of its constitution. Thus there is the question of its origin, perhaps indeterminate, as it admits of a number of almost equally plausible suggestions. A more limited problem concerns the subdivisions. What is the meaning of the manifold "rings"? In bringing forward this problem, Dr. Lowell (Lowell Observatory Bull., No. 68) suggests, and advances proof in the form of filar micrometer measures of their dimensions, that many of the newly-detected divisions on ring B are due to the perturbative action of Mimas (the nearest of Saturn's satellites, half the diameter and half as far away as the moon is from the earth). The proof offered is the fact that most of the new divisions occur where a particle of the ring would have a period of revolution commensurate with that of Mimas in some simple ratio. New divisions are situated 1/4, 3/7, 4/7, 1/3 − and 1/3 + way out from the inner edge of ring B respectively, and the corresponding periods would be 3/8, 2/5, 3/7, 4/9, and 5/11 that of Mimas. Dr. Lowell some time ago directed attention to simple commensurabilities among planetary periods (NATURE, July 24, 1913). The question naturally arises whether Mimas is making new satellites for Saturn out of the meteoritic material of ring B.

STEREOSCOPIC MEASUREMENT OF PROPER MOTIONS.—M. Comas Solà recently gave an example of the use of an ordinary stereoscope for the detection of proper motions (NATURE, August 26, 1915). Apart from Prof. Barnard's criticism of the results, this simple instrument obviously cannot yield quantitative information. This deficiency, however, appears to be removed by the addition of an arrangement M. Comas Solà has named a stereogoniometer (*Comptes rendus*, clxii., p. 39). This is a device by which the two properly oriented plates under comparison may be simultaneously rotated through a measured angle. As the plates rotate so the apparent "relief" of the proper motion star alters, the position of maximum relief giving the direction of the star's movement. It may be pardonable to add that the obvious experiment is very interesting.

PROF. GUIDO BACCELLI. 1832–1916

WE are indebted to the *British Medical Journal* for the following particulars of the career and work of Prof. G. Baccelli, whose death was announced in NATURE of January 13. Prof. Baccelli was born in Rome on November 25, 1832, and took his doctor's degree in the university of his native city in 1852. Four years later he was appointed to the chair of forensic medicine in the University of Rome, but resigned his position after two years, and devoted himself to the study of morbid anatomy. When a chair of that subject was founded in the University Baccelli was appointed the first professor. In that capacity he had a great influence in turning the minds of his pupils in the direction of modern scientific methods. In 1863 he was appointed lecturer on clinical medicine, and in 1870, when Rome became the capital of Italy, he was appointed professor of clinical medicine, a post which he continued to hold until the end of his life. In 1875 he entered the Italian Parliament as one of the deputies for Rome, and soon took a leading place as a politician. In 1881 he became Minister of Public Instruction, and held that portfolio four times in all, doing great service to his country by the promotion of far-reaching reforms, both of primary and university education. To him Rome chiefly owes the Policlinico, a magnificent pile of buildings, fully equipped for the study of disease. He was also once Minister of Agriculture, Industry, and Commerce. He was prominent as a sanitary reformer, and was at one time President of the Board of Health. He took an active part in the sanitary improvement of the Campagna; for his efforts in that direction he received the thanks of the Italian Parliament. He was a Senator of Italy. Prof. Baccelli was president of the eleventh International Congress of Medicine held in Rome in 1894, and at that congress he made a powerful appeal for the introduction of Latin as a universal spoken language which could be understood all over the world. A little modification in the teaching of Latin in schools as a spoken and not merely as a dead language would give all the advantage of the attempts which have been made to construct a universal language, while it would not disorganise the present curriculum and would render available for general use all the stores of wisdom and knowledge contained in Latin books and at present unavailable for common use. Besides a monograph on Roman malaria, published in 1878, in which his views on the sanitary improvement of the Campagna were embodied, Prof. Baccelli was the author of many

contributions to medical literature, among them being a treatise in four volumes on the pathology of the heart and aorta; clinical lectures on malaria; sub-continuous fevers, containing his earliest researches on malaria; and State medicine and clinical medicine in ancient and modern Rome.

RESEARCH IN TERRESTRIAL MAGNETISM.[1]

THE handsomely printed and illustrated volume before us records the activity of the Department of Terrestrial Magnetism by *land* from 1911 to 1913. In pp. 5–20 we have an account, illustrated in plates 2, 3, and 4, of instruments used in the world survey on which the department has been engaged since 1905. Pp. 21–182 deal with the land observations made during 1911 to 1913. The names of thirty-four observers are recorded on p. 23. Of the 983 stations occupied, 207 were in Africa, including 106 in Algeria and the Algerian Sahara, 52 in French West Africa, and 13 in Morocco. In Asia there were 83 stations, 59 being in China or Indo-China. There were 284 stations in Australasia, and 247 in South America, the latter distributed in eleven countries, 63 stations being in Peru and 52 in Brazil; 46 stations were occupied in islands in the Pacific, Atlantic, and Indian Oceans, and 30 in the Antarctic, by members of Sir Douglas Mawson's Expedition, trained and supplied with instruments by the department. The results are tabulated on pp. 26–64 of the volume. The following sixty-four pages are devoted to the observers' reports, illustrated by seventeen photographs in plates 5, 6, and 7.

One of the most interesting reports is Mr. D. W. Berky's account of his travels from Algiers to Timbuktu, which includes varied information as to camels and wild life in the Niger. On several occasions in the Sahara such heavy electrical charges from wind-driven sand appeared on the instruments that observation was impossible. On one occasion half-inch sparks were drawn when the instrument was touched. Another interesting narrative is that of Mr. H. M. W. Edmonds, who occupied thirty-eight stations, mostly in remote parts of Canada, travelling more than 2000 miles by canoe. One of the largest pieces of work was a magnetic survey of Australia carried out by Mr. E. Kidson and three assistants. During 1910 and the first half of 1911 Mr. W. H. Sligh travelled 22,000 miles, commencing observations at Constantinople and finishing up with Helwan. His eighty-four stations included Jerusalem, Jericho, Damascus, Smyrna, Bagdad, Bombay, Aden, and Suez. Particulars of the several stations occupied by all the observers occupy pp. 130 to 182.

Pp. 185–200 describe the new headquarters of the department in Washington, comprising a commodious main building, which cost, without equipment, 68,000 dollars, and a standardising observatory of wood. A high tower is in contemplation for atmospheric electricity. The buildings are shown in plates 1, 8, and 9. On pp. 201–209, and in plate 10, the director, Dr. Bauer, deals with a nine-months' trip which he made in 1911, when he travelled 47,000 miles, visited eighteen magnetic observatories, including Mauritius, Dehra Dun, Buitenzorg, Christchurch, N.Z., Tsingtau, and Tokio, and observed during a total solar eclipse in Samoa.

The final section, pp. 211–278, discusses the comparisons made since 1905 of the standard magnetic instruments at some thirty observatories, photographs of eighteen of which are shown in plates 11, 12, and 13. In the case of H (horizontal force) it is assumed that the correction to the value observed with a particular instrument is proportional to the local value of H. This is true when the sole cause is error in the calculated moment of inertia of the magnet. There are, however, other less universal causes of error which may follow different laws. Two ultimate standards are mainly referred to, entitled C.I.W. (Carnegie Institution, Washington) and I.M.S. (International Magnetic Standards). The C.I.W. standard is that to which all the department's land observations from 1905–13 have been reduced. It is embodied in a certain magnetometer and dip-inductor, with specific small corrections applied. The I.M.S. standards in D (declination) and H represent a mean from 42 magnetometers, 22 belonging to the department; while the I.M.S. standard for I (inclination) represents a mean from 25 dip circles, the majority by Dover, and 18 dip inductors. The differences between the C.I.W. and I.M.S. standards are given as 0·1′ in D, 0·5′ in I, and 0·00015 H in H. The authors think that if suitable precautions are observed the magnetic standards at an observatory should maintain for a period of five to ten years constancy to within 0·2′ in D and I, and 0·00015 H in H. The comparisons between the C.I.W. standards and those at Potsdam and Kew, "two observatories where . . . every care is bestowed upon instruments and constants," show, it is said, no changes not reasonably assignable to observational errors. The authors add:—"No undue significance is to be attached to the circumstance that the corrections for the Washington standards (on the I.M.S. scale) are apparently the smallest of the three observatories." The Washington standard magnetometer is, in fact, believed to give values for H exactly midway between those given by the Kew and Potsdam standards, which are supposed to differ by 16 parts in 100,000.

The work represents a large amount of accumulated experience and will doubtless be widely read by magneticians.

C. CHREE.

[1] Researches of the Department of Terrestrial Magnetism (Carnegie Institution of Washington). Vol. ii. Land Magnetic Observations, 1911–13, and Reports on Special Researches, by L. A. Bauer, Director, and J. A. Fleming, Chief Magnetician. Pp. 278+13 plates. (Washington, D.C.: Carnegie Institution, 1915.)

BIRD MIGRATION IN AMERICA.[1]

THE latest contribution by Mr. W. W. Cooke to the literature on bird migration deals with the general subject, especially in its American aspects, and is of an acceptable and interesting character. To condense into a brochure of forty-seven pages the main conclusions drawn from observations extending over more than twenty-five years, during which 500,000 records were communicated by some 2000 observers located in all parts of North America, is an achievement worthy of admiration.

Written in a lucid manner, it affords useful information on the many-sided subject on which it treats, among others on the causes of migration; weather relations; day and night migrants; distances travelled; routes; speed; how birds find their way; influence of temperature, etc. In treating of these the author has drawn his conclusions from the movements of a number of typical American migratory birds, and to exemplify them more effectually has introduced a series of maps and diagrams showing the summer and winter distribution of each species treated of, migration routes, isochronal migration lines, etc. These serve, among other purposes, to illustrate Mr. Cooke's conclusions with regard to the routes taken by the migrants when crossing the Gulf of Mexico, showing that by far the greatest number of migrants choose the shortest route

[1] "Bird Migration." By Wells W. Cooke, United States Department of Agriculture. Bulletin No. 185. (Washington, D.C., 1915.) Price 10 cents.

Review

Birds—Migration

migration of birds

across the Gulf. Some birds, as, for instance, the American redstart (*Setophaga ruticilla*), cross on a front of more than 2000 miles from east to west. Others again cross on a narrow front, as in the case of the red-breasted grosbeak (*Zamelodia ludoviciana*), which, although the breeding range has a width of 2500 miles from east to west, converge, until they leave the United States along a line of Gulf coast only 800 miles wide.

One of the most interesting of the species treated of in this work is the bobolink (*Dolichonyx oryzivorus*). Our author tells us that "in the case of the bobolink the evolution of a new extension of the migration route is now occurring before our very eyes. By nature a lover of damp meadows, the bobolink was formerly cut off from the western States by the intervening arid region. But with the advent of irrigation and the bringing of large areas under cultivation, little colonies of nesting bobolinks are beginning to appear here and there almost to the Pacific," an excellent demonstration of the intimate relation between ecological conditions and geographical distribution. These individuals are stated to "return over the old route and show no disposition to shorten the flight by direct trip across New Mexico to the Gulf coast of Texas." The author, however, like many other writers on this subject, seems too prone to believe that most birds that pass are necessarily recorded. This, however, is absolutely impossible, even on a small and confined space; how much more so on a great continent such as America? The remarks on the red-eyed vireo (*Vireosylva olivacea*) as an example of a recent extension of breeding range and consequent elongation of migration route are of much interest. The extraordinary overseas flight of the American golden plover (*Charadrius dominicus*) in autumn is also referred to, as well as the curious elliptical form its migration takes at that season, the spring route being quite different from that of the autumn. Another most interesting and less known example of an elliptical migration route is that of the white-winged scoter (*Oidemia deglandi*), of which a full description and map are given. Mr. Cooke also directs attention to relative speed of various species on northward migration; as an example of slow and uniform migration he instances the black and white warbler (*Mniotilta varia*), to which he assigns an average speed of twenty-five miles a day during its northward passage from Florida to its breeding places in south-eastern Canada. On the other hand, as an example of rapid migration, the grey-cheeked thrush (*Hylocichla aliciae*) is instanced, this bird being allotted a speed of 130 miles a day for its journey of approximately 4000 miles; in the last part of the route, however, the speed is much greater than in the Mississippi valley. Another point touched on is the condition in which birds arrive at the end of a long migration flight, and the conclusion arrived at is that birds are not exhausted by their aerial journeys. This is, no doubt, largely the case in the western hemisphere, where the migratory movements are mainly performed overland from the equator to the Arctic regions; but in the Old World, especially in the British Isles, the migrants arriving after overseas flights often suffer much from exhaustion, even when the journey has been accomplished under the most favourable weather conditions. In this and in other respects, Mr. Cooke's work affords interesting comparisons between migration phenomena as observed in North America and in the British Isles.

Our author believes that food supply is the primary cause of migration; he says the "conclusion is inevitable that the advantages of the United States and Canada as a summer home, and the superb conditions of climate and food for the successful rearing of a nestful of voracious young, far overbalance the hazards and disasters of the journey thither. For these periodical trips did not just happen in their present form; each migration route, however long and complex, is but the present stage in development of a flight that at first was short, easily accomplished, and free from danger. Each lengthening of the course was adopted permanently, only after experience through many generations had proved its advantages," a sound statement, and one that is often in danger of being forgotten. Many other important points are dealt with in Mr. Cooke's pamphlet, but enough has been said to indicate its comprehensive and valuable nature: it should be read by all who are interested in the subject.

W. E. C.

SOLVENTS AND SOLUTIONS.[1]

THE appearance of each volume published by the Carnegie Institution of Washington induces in us a feeling of envy towards our American *confrères* on account of the facilities thereby afforded to them for the publication in collected form of the results of investigations which otherwise would appear only in small instalments and scattered throughout the various volumes of scientific journals. Through the appearance in such a collected form of the results obtained in a series of investigations bearing on one main question, it becomes possible for other scientific workers to realise more clearly the actual extent of the advance made. For such publications as the present, therefore, all workers on solutions will be grateful.

The present monograph deals with a wide variety of subjects, nearly all of them, however, suggested by the solvate theory of solution so familiarly associated with the name of the chief author of this publication.

In the ten chapters into which the discussion is subdivided, we find the following subjects dealt with:—Viscosities of solutions of cæsium salts in mixed solvents; conductivities of formamide solutions; radiometric measurements of the ionisation constants of indicators; influence of salts on the velocity of saponification and on the hydration of acetic anhydride; conductivity of organic acids in ethyl alcohol; conductivities and dissociation of some rather unusual salts in aqueous solution; the dissociating powers of free and of combined water; the absorption of potassium from aqueous solutions of potassium chloride.

Of the different contributions, the most interesting are, perhaps, the two dealing with the radio-metric measurements of the ionisation constants of indicators. By means of a grating and a radio-micrometer, of which a description is given, the light transmitted by solutions of methyl-orange and of rosolic acid have been determined. From these determinations the ionisation constants of the indicators could be calculated. In view of the excellent apparatus which the authors possess, further valuable work on a difficult problem may be hopefully expected.

A. F.

THE FRUITS, PROSPECTS, AND LESSONS OF RECENT BIOLOGICAL RESEARCH.[2]

THE general welfare of mankind has been wonderfully promoted during the past 150 years by the rapid progress of chemical, physical, and biological science. In the early third of that period, physics and chemistry and their applications seem to have played the most active parts in promoting human welfare, although pure botany and zoology enlisted

[1] "Conductivities and Viscosities in Pure and in Mixed Solvents. Radiometric Measurements of the Ionisation Constants of Indicators." By H. C. Jones and Collaborators. Publication No. 230. (Washington D.C.: Carnegie Institution, 1915.)

[2] Presidential address delivered to the American Association for the Advancement of Science at Columbus, Ohio, on December 27, 1915, by Dr. Charles W. Eliot.

many devoted workers, and made great advances; but during the past one hundred years it is biological science that has contributed most to the well-being of humanity. The new methods of transportation and of manufacturing by the aid of machinery with steam as motive power were products of applied physics. So were the great works of civil and mechanical engineering. The improved agriculture of the last half of the nineteenth century was partly due to new tools and machinery, and partly to new applications of chemical knowledge. Latterly biological science has helped the farmer very much to raise better crops and animals, and to protect his products from vegetable and animal pests.

While the industrial and social changes which applied physics and chemistry made possible unquestionably improved the general condition of mankind as regards bodily comfort, security against natural catastrophes, longevity, and an increased sense of mutual support and community interest through the vast improvement in the means of communication, these changes have all been *indirect* influences on human well-being and happiness, and with the good they brought much evil was mixed. Thus, the factory system, the congestion of population, and the noise and turmoil of city life are grave evils accompanying the advantages which applied physics and chemistry have created and diffused. The fruits of the biological sciences—botany, zoology, physiology, and biochemistry, applied to curative medicine and surgery and to preventive medicine and sanitation—have been *direct* contributions to human welfare; because they have provided defences against disease, premature death, and individual and family distress and suffering. The beneficent applications of biological science, unlike most of the large results of applied chemistry and physics, take effect in the field of human affections and family experiences, make life less anxious and more enjoyable for multitudes of human beings, mitigate or abolish ancient agonies and dreads of the race, and promise for it a happier future.

The career of Pasteur illustrates admirably the passing of the centre of beneficent scientific research from chemistry and physics to biological science. Pasteur's first researches were crystallographic; whence he passed to the study of molecular dissymmetry, the material of his researches being, however, organic. He was first professor of physics and then professor of chemistry. His interest in certain tartrates led him naturally, though partly by accident, to a study of fermentation. His zealous discharge of his duties as dean of a faculty of sciences at Lille, a manufacturing centre, led to his study of beetroot juice, fermented in order to produce alcohol. Thereafter Pasteur's researches were biological, although he had had no training as either naturalist or physician. He began at the foundation by disproving the doctrine of spontaneous generation. One of his earliest conclusions was that "gases, fluids, electricity, magnetism, ozone, things known or things occult, there is nothing in the air that is conditional to life except the germs it carries." Of his earliest results from experiments on admitting pure air to flasks containing putrescible infusions he wrote: "It seems to me that it can be affirmed that the dusts suspended in atmospheric air are the exclusive origin, the necessary condition of life in infusions"; and in the same paper he made the pregnant remark, "What would be most desirable would be to push those studies far enough to prepare the road for serious research into the region of various diseases." He lived to push his studies into the causes of the silkworm disease, of a cholera which came from Egypt into France, of the plant diseases affecting the manufacture of wine and of beer, of the splenic fever, of the chicken-cholera, and of rabies; and he and his followers invented successful treatment for those diseases, and for the treatment of typhoid fever and diphtheria.

The germ and parasite theory of disease led the way in serum therapy, and established both the philosophy and the practice of the new medicine and surgery of the past thirty-five years. Starting with a sound knowledge of chemistry and physics, and having early acquired a habit of utmost accuracy in observing and reasoning, Pasteur passed over into biological science by the time he was thirty-two years of age, and became the most suggestive and productive inventor and promoter in applied biology that has ever lived. His career illustrates conspicuously the general truth that the sciences most serviceable to mankind during the past sixty years have been the biological sciences. In a letter to his father in 1860, when his inquiries were opening new vistas in physiology, Pasteur wrote:—"God grant that by my persevering labours I may bring a little stone to the frail and ill-assured edifice of our knowledge of those deep mysteries of life and death, where all our intellects have so lamentably failed." That prayer was granted.

Let us review in a summary way the fruits of applied biological science since the nineteenth century opened.

The first invention, vaccination against smallpox, long antedated the later studies of germs, parasites, the routes of disease from one human being to another through insects and other animals, and the theory and practice of immunity. Vaccination, the invention of a country doctor who practised in a dairy district, was a momentous discovery in immunity from a fatal and disfiguring disease, which was frequently epidemic, the immunity being procured by causing in the human body another disease very seldom fatal and not at all disfiguring. The favourable reception and rapid application of Jenner's discovery were due to the fact that many persons at that time protected themselves against the frequent and terrible epidemics of smallpox by being inoculated with smallpox itself. So soon as it was proved that cowpox gave immunity in almost all cases against smallpox, inoculation with cowpox came rapidly into use; because inoculated cowpox proved to be, as one of Jenner's contemporaries remarked, "a pleasanter, shorter, and infinitely more safe disease than inoculated smallpox." The relief of civilised mankind from the terrible recurrent epidemics of smallpox is one of the greatest benefits that the profession of medicine has conferred on the human race.

From biological studies largely on microscopic organisms—protozoa, bacteria, and parasitic growths—the means of communication from one human being to another, or from an animal to man, of dysentery, cholera, typhoid fever, typhus fever, puerperal fever, bubonic plague, diphtheria, tuberculosis, cerebro-spinal meningitis, syphilis, gonorrhœa, sleeping sickness, yellow fever, malaria, and hook-worm disease, have all been brought to light. Means of preventing or restricting the spread of these diseases—with the exception of cerebro-spinal meningitis—have been invented, and for most of them improved methods of treatment have been devised. Much has also been learnt about infantile paralysis, and something about cancer. The whole subject of toxins and antitoxins has been developed with wonderfully beneficent results.

It is really impossible to describe or appreciate the alleviations and preventions of human misery included in this list of the fruits of applied biological science. Some of the diseases mentioned were within a few years familiar household terrors in the most civilised countries, others from time to time destroyed in recurring epidemics large portions of the population in many parts of the world. They terrorised families and

nations, made innumerable homes desolate, and ruined for a time cities and States. The generations now on the stage can scarcely appreciate the formidable apprehensions from which their predecessors suffered, but they themselves have been relieved by the achievements of medical research and preventive medicine. This blessed preventive medicine may almost be said to have been created by the combination of bacteriological and pathological studies, which are all, of course, biological studies. Physiology has been wonderfully developed as a study of biological processes by the addition of bacteriological experimentation to its former chemical and physical methods of research.

Public health boards have been established and equipped to perform under new laws numerous functions which had no existence until applied biology, with aid from chemistry and physics, indicated the desirable modes of public action. The boards, or public health commissioners, prescribe, teach, and enforce rules and orders concerning personal, industrial, farm and dairy, and school hygiene, social hygiene, including venereal prophylaxis, for individuals and families, the preservation of foods and their protection from infection, the effects of various industries on the health of employees, the connection of syphilis with insanity and general paresis, and of gonorrhœa with blindness, procure vital statistics, establish registration of births and deaths, and of cases of disease, study epidemics and infant mortality, and contend against dangerous contagious diseases by quarantine, isolation, disinfection, and the destruction of the insect and vermin carriers of disease. All these activities have been completely dependent on applied biology for their methods and processes, and have changed and developed rapidly with the progress of that science. Taken together, they constitute an immense contribution to human welfare, present and future.

It is animal experimentation with the help of anæsthesia and asepticism which has given mankind by far the larger part of all the exact knowledge of medicine now possessed, and promises still greater serviceableness in the future. In the service of man new studies have been made, not only of microscopic plants and animals, but of many larger creatures which live with man—such as poultry, rabbits, guinea-pigs, cats, dogs, cattle, horses, mules, and monkeys; and of many insects—such as flies, ticks, mosquitoes, and lice, which infest the fauna and flora which surround man, or the bodies or clothes of men themselves. An immense mass of biological information on all these subjects has been accumulating during the past two generations, and is growing rapidly from year to year, as the good results of such studies become better known.

These results bear directly on the well-being and happiness of the human race, but also indirectly on the economic and commercial fortunes of the race. Through the well-directed efforts of the Rockefeller Sanitary Commission hundreds of thousands of persons in the southern States have, within the last five years, been made much more effective labourers, because relieved of the hook-worm disease; and this good work is now being extended by the International Health Commission—one of the departments of the Rockefeller Foundation—to the West Indies, Central America, Ceylon, and the Straits Settlements. The work of this commission has three divisions :—(1) The commission makes surveys of regions where hook-worm disease is prevalent; (2) then it cures multitudes of sufferers by active and persistent treatment; and (3) it teaches people by the thousand how to prevent the recurrence of the disease in farming communities by using privies and wearing shoes. In the last two processes it tries—often successfully—to enlist existing public authorities and the taxing power in the work, in order to give it permanence. All this beneficent action is fruit of biological research. It would have been impossible to dig the Panama Canal without the effective control over yellow fever and malaria which biological science has given to the race within a single generation. Two humane contributions to military efficiency during the great war are results of biological research applied to sanitation, one the prevention of epidemics of fever and cholera in the camps and trenches in western Europe, and the other the quick arrest of a terrible epidemic of typhus fever in Serbia.

Let us next take account of the prospects of applied biology in the coming years. May we anticipate for it an increasing or a decreasing influence?

The progress of medical and surgical research during the past twenty years is of great promise for the future. It goes on actively in every good medical school, in many hospitals and dispensaries, and in the new institutes exclusively devoted to research. It is strongly supported by the new tendency to maintain in medical schools professorships of comparative anatomy, physiology, and pathology. The importance of comparative psychology is just coming to be recognised. Inasmuch as animal experimentation, with the help of anæsthesia and asepticism, is nowadays the principal means of extending knowledge of the causes of disease and of the means of remedy and prevention, the importance of comparative studies on many species of animals, including man, has become obvious to all persons who think about the improvement of the human race and of its useful animal associates.

In regard to the treatment of contagious diseases, the story of the recent past cannot but suggest hopes of even more rapid progress in the future towards the effective control of some of the worst diseases that afflict humanity. Thus, in the ten years from 1903 to 1913, syphilis was transmitted artificially to certain lower animals; the characteristic bacillus of that disease was discovered; the Wasserman test was invented, a test which enables an expert in its use to detect those cases which have no external symptoms; the value of salvarsan, as a safe destroyer of the bacillus within the human body, was demonstrated; and the bacillus was grown in pure culture outside the body, whence resulted luetin, an important aid in the diagnosis of obscure cases; and finally the bacillus was detected in the brain of patients suffering from general paresis, and in the spinal cord of patients with locomotor-ataxy. This series of discoveries and inventions has given to man a much-improved control over this terrible scourge; but this control is not yet applied on an adequate scale. It remains for the future to cause this destructive disease to be early recognised, reported, and dealt with effectively. It is for State and municipal boards of health to invent and put into practice the means of contending against the spread of this horrible disease. This is a public health problem of the gravest sort. That public health authorities may succeed in the future against the horribly destructive effects of syphilis on every civilised race in the world is one of the hopes of the future—a hope inspired by the recent progress of biological science.

The progress of biochemistry and bacteriology has already enabled civilised Governments to do much for the protection of their people from injury by foods not fit for consumption and by adulterated drugs. This is a branch of the public health service which is capable of large extension hereafter. The efficiency of the methods now used will be greatly increased; and they will be used in new fields. It is only about forty years since the Massachusetts Board of Health gave effective

attention to the transportation and slaughtering of animals intended for food, an admirable piece of pioneering which brought about great improvements, and served as a basis for further measures of defence for the community. The common use of cold storage for meats, vegetables, and fruits has lately increased the need of protection against damaged foods; and this cold-storage process is likely to be more and more used in the future—quite legitimately—for the preservation of perishable foods produced in greater quantity than can be sold at or near the time of their production. A cold-storage plant performs as to foods the function of the reservoir in an irrigation plant. Both urban and rural communities have much to hope in the future from cold storage and irrigation; but to both these public utilities applied biological science must contribute indispensable precautions. There are climates in which extensive irrigation is liable to produce and perpetuate pestiferous insects.

One of the most favourable results of applied biology during the past fifty years is the great addition made to the means of detecting the true causes of abnormal conditions within the human body, and to the accuracy of diagnostic reasoning on both acute and chronic disorders. These new means of diagnosis and examination are in part chemical and physical, but chiefly biological. The theory and practice of asepsis are results of biological researches. Comparative anatomy, physiology, and pathology all contribute largely to modern sanitation and to all the practices of boards of health for the discovery and prevention of insanitary conditions in both urban and rural communities. Very promising examples of these useful practices are: the precautions nowadays taken against contagious disease in schools; the employment of school nurses; the inspection of school children's teeth, eyes, noses, ears, and skin; the discovery in the mass of school children of the defective, the feeble-minded, and of those suffering from glandular abnormalities, particularly in the nose, mouth, and throat. The effective treatment of school children following on the detection of their disorders or defects promises much towards the better health of the coming generations. The successful use of the Schick test, which enables the physician through a laboratory expert to separate the susceptible from the non-susceptible individuals who have been exposed to diphtheria, and therefore to avoid all unnecessary administrations of antitoxin, seems to open a wide prospect in the study of natural immunity. The process of improvement is not going to stop; on the contrary, it will advance at an accelerated pace.

Another great field for applied biological science in the future is the contest against alcoholism and sexual vice. This is an important part of the province of social hygiene, a province which includes the philanthropic and economic treatment of the feeble-minded, the insane, the paralysed, and the blind. The field is enormous; and its evils are intimately connected one with another; but in the whole field the means of cure and prevention have come in the main from biological research. There is every reason to expect that this great field for Christian effort will hereafter be more effectually cultivated than it has ever been.

In connection with the medical, surgical, and sanitary activities of the present day, new forms of educational effort have been instituted which are very promising for the future health and comfort of mankind. Thus, the institution of district nursing has already developed strong educational effects. The district nurse goes from house to house to treat and comfort individual patients suffering from various disorders; but in every house she also teaches the mother, sister, or some other attendant on the sick or injured person, how to perform herself the remedial operations, how to feed the patient, and how to prevent the communication of the disease to other persons; and this teaching function of the nurse is quite as important as her curative or comforting ministrations. The social worker who follows up the out-patients of a great hospital, sees them at their homes, studies their surroundings, and gives them sympathetic counsel, has a similar teaching function, which often takes strong effect on whole families and even larger groups. Like the district nurse, she also frequently obtains family histories which are of value to students of inheritance, good or bad, and of eugenics. The same is true of the school nurses and medical inspectors who are employed by American cities in which the health department is strong and well organised. These nurses and doctors not only detect defects and diseases in school children, but indicate to parents or friends the remedial measures that are demanded, and give much instruction to parents and guardians about keeping children well. The same educational function is performed by the dentists who are being employed in a few American cities to make periodical inspections of the teeth of school children. These large-scale examinations and teachings call for acquaintance with bacteriological information and methods only recently acquired, and for skill in the use of diagnostic tools and appliances only recently invented. These new applications of biological science promise great reduction of human suffering and distress, and significant additions to average longevity and average efficiency so soon as they come into general use.

Biological science has made possible several other kinds of widespread teaching which are certain to have beneficial effects on the productiveness of human labour, particularly in agriculture—the fundamental industry. Thus, the whole work of the International Health Commission is essentially educational. It teaches the people in hook-worm disease districts by demonstration, first, that they have the disease; secondly, that it can be cured in the individual and eradicated from the community; and, thirdly, that the embryos of the disease live by thousands in soil that has been befouled by an infected person, and are there ready to infect any person with whose bare, soft skin they come into contact. These demonstrations combined teach the people how the disease may be avoided in the future by an individual or by a community. As a result of this educational work, the common people and the health authorities co-operative effectively in both the work of treatment and that of prevention.

Another illustration of the broad educational processes now at work in consequence of the achievements of applied biology is to be found in the short courses given by many State universities to farmers and their grown-up sons on the principles of agriculture, the choice of seeds, and stock-raising, and in the itinerant teaching for adults now carried on by the U.S. Department of Agriculture throughout the southern States on similar subjects. This instruction is supplemented by the offer of prizes, and the setting-up of model farms, or model acres, in great number as lessons and incitements to neighbourhoods. The effects on the productiveness of American agriculture, especially in cotton and corn, are already remarkable; but the promise of these educational methods for the future is more precious still. Several colleges and universities of high standing now provide short courses which run from six to twelve weeks, some in winter and some in summer, expressly to prepare teachers or leaders for girls' canning clubs and home demonstration work. These courses cover cooking, canning, sewing, market gardening, poultry husbandry, plant propagation, and

rural sanitation. Their good effects have been quickly demonstrated on a large scale.

Boards of health in several American municipalities and States have lately undertaken a large work of public teaching by means of widely distributed posters and leaflets on contagia and the carriers of contagious disease. They have found themselves obliged to take this action, because they learnt by experience that the spread of contagious disease cannot be prevented by enacting laws and employing inspectors to procure the execution of those laws, unless the citizens themselves co-operate actively and with intelligence in the execution of the measures which applied biology prescribes. Thus, the public at large must be taught that if streets, yards, and vacant lots of a city are kept clean, garbage is removed promptly and kept covered until removed, and the privy vault and the manure-heap are abolished, the number of flies and vermin in and about dwellings will be much reduced. Reduction in the amount of sexual vice and venereal disease can be effected by teaching parents and young people about the dangers of syphilis and gonorrhœa for the individual, and their fatal effects on family happiness.

Thirdly, this immense development of biological knowledge and skill must have lessons to teach about the means of other progress, similar or contrasted.

The most important lesson which the great advance in applied biological science teaches is that the treatment of human evils and wrongs in the future should be preventive for the mass, as well as curative for the individual. This is the reason for the great change which is taking place in the profession of medicine. The main functions of that profession are to be, not the curing of individuals who are already suffering from disease, but the prevention of the spread of disease from individual to individual in the community, and the eradication or seclusion of the causes, sources, or carriers of communicable diseases. The same great change needs to be wrought in all the callings which deal with prevention of crimes and misdemeanours. Society must concern itself, not chiefly with the isolation, temporary or permanent, of the individual murderer, thief, or forger, but with the extermination or repair of the genetic, educational, or industrial defects which cause the production of criminals. Since it is often found through medical and psychological examination that the prostitute, forger, robber, or poisoner is physically as well as morally defective, it is probable that biological science will in the future contribute largely to the prevention as well as cure of such bodily defects, and hence of those moral defects which in an appreciable fraction of the population result in crimes. When humane persons learn, for example, that three-fifths of all the prostitutes in New York City are feeble-minded girls and women, they become interested at once in the better care and treatment under medical dirction of the feeble-minded, in the means of making a trustworthy diagnosis of feeble-mindedness in children, and in preventing the feeble-minded from reproducing their like. These are all biological problems; and the progress of biological inquiry during the past fifty years is sufficient to afford the means of solving on a large scale these fundamental social problems. It is to biological science in the departments of mental disease and psycho-therapy, as well as to educational theory and practice, that we must look for new methods of discipline and education in prisons, reformatories, and houses of correction. Preventive medicine and sanitary reform have shown the right way of dealing with these chronic sores in the body politic.

The interrelations of the sciences are vividly taught by the history of biology during the past eighty years. Biological science is deeply indebted to physical science for the new instruments of precision which the biologist uses in determining and recording his facts. The telephone, the X-ray, and all the electrical apparatus for recording fluent observations and making certain note of very minute portions of time and space have been invaluable additions to the resources of the biological investigator. Many of the instruments which are indispensable in botanical and zoological laboratories were not invented for biological uses, but for physical or chemical uses. The dental practice called orthodontia has profited greatly by the use of the X-rays, because the Röntgenograph exhibits the precise abnormalities in the jaws and the concealed teeth which need to be remedied. The art of photography has contributed much to biological research and biological teaching, although developed and improved more for commercial and astronomical purposes than for biological. The microscope itself and the immersion lens, tools indispensable in the study of micro-organisms of all sorts, were long used in pure botany and zoology, before they became the necessary tools of applied biological science.

Again, the long series of successful applications of biological science illustrates strikingly the impossibility of drawing any fixed line of demarcation between pure and applied science, or of establishing an invariable precedence for one over the other. Sometimes an application is suddenly made of one fragment of an accumulation of knowledge which men of science have made without thought of any application, and sometimes a bit of knowledge successfully applied stimulates purely scientific workers to enter and ransack the field from which the bit came. The latter process was strikingly illustrated when the large group of the mosquitoes were studied with ardour, because two species became famous, one as the carrier of malaria, and the other of yellow fever. The anatomy and habits of the typhus fever louse had been worked out many years before that insect became known as a carrier of typhus fever. Long before salvarsan was proved valuable for killing the syphilis micro-organism in the human body, a series of organic compounds derived from benzol and containing arsenic had been elaborately studied, and the means of producing them made known by chemists who had not the faintest suspicion that a safe remedy for the most destructive of contagious diseases in the human species was later to be found in a new member of the series having a reduced arsenical potency. The man of science often feels, and not infrequently expresses, contempt for applications of science and for the men that make them. Sometimes the seeker for valuable applications of scientific knowledge feels no interest whatever in researches of which no industrial application seems feasible or probable, and confesses publicly this lack of interest. The facts seem to be that all such feelings are narrow and irrational; that no mortal can tell how soon a practical application of a scientific truth, which seems pure in the sense that it has no present application, may be discovered; and that, on the other hand, innumerable applications are nowadays made of truths which five years or fifty years ago seemed as remote from all human interests as the observation attributed to Thales, that a bit of amber rubbed with a piece of silk would repel pith-balls suspended by fine filaments. Yet all magnetism and electricity with their infinite applications hark back to this experiment by Thales and to Galvani's observation of twitchings in a frog's legs.

The new physiological studies of the bodily changes accompanying or produced by pain, hunger, fear, and rage already promise a new interpretation of human behaviour, and therefore a new policy for human

society in regard to those emotions which, from primitive times to the present day, have been the source of enormous evils to mankind. The bodily changes which in man accompany these powerful emotions have only recently been in part made known; but it has already been made out with regard to a group of these alterations in the bodily economy that they may be regarded as responses adapted to preserve the individual, and to promote his bodily welfare or his efficiency. The emotions which man fighting experiences call into sudden and potent action the muscular and nervous forces which he needs for both offence and defence. Hunger is a highly protective sensation. Fear stimulates muscular and nervous exertion, so long as the frightened animal can flee; but, if the animal is cornered, fear turns to fury, which develops the extraordinary strength of desperation. The successful study to-day of these bodily changes and reactions prophesies a better understanding in the future of the moral forces which make for rational conduct, and of the public policies in regard to war and peace which, long pursued, may gradually affect the sum of human misery or of human happiness.

The present terrible condition of Europe, and the coincident sufferings of much of the rest of the world, give fresh significance to the following remarks of Louis Pasteur at the inauguration of the Pasteur Institute at Paris in 1888:—"Two contrary laws seem to be wrestling with each other nowadays—the one a law of blood and of death, ever imagining new means of destruction, and forcing nations to be constantly ready for the battlefield; the other a law of peace, work, and health, ever evolving new means of delivering man from the scourges which beset him. The one seeks violent conquests; the other the relief of humanity. The latter places one human life above any victory, while the former would sacrifice hundreds and thousands of lives to the ambition of one. . . . Which of these two laws will ultimately prevail, God alone knows."

The whole civilised world observes with delight that the profession of medicine, including surgery and the profession of public health and sanitation, stands out distinctly among all the intellectual callings as being steadily and universally devoted to curing the sanguinary ills of war, alleviating human sufferings from disease and folly, and extending for mankind the domain of health and happy life. These professions employ all the resources of physics, chemistry, and biology for merciful ends, both in peace and in war. The martial professions, on the other hand, employ many scientific discoveries and inventions, originally made for peaceful uses, as means of destruction and death. Biological science has great advantage in this respect over physical and chemical. It cannot so frequently or easily be applied to evil ends.

The development of public sanitation practice during the past fifty years has taught democratic communities important lessons on the just subordination of individual interests or rights to collective interests or rights, whenever the fulfilment of individual desires imperils the collective security. Sanitary regulations often interfere with family management, the schooling of children, the transportation and selling of perishable goods, the established practices of mining and manufacturing corporations and of small tradesmen, and even the personal habits of the private citizen. These interferences are sometimes abrupt and arbitrary. On the whole, however, this teaching has been wholesome in the freedom-loving nations, in which individualism is apt to be exaggerated, and the sense of neighbourliness and social unity needs to be quickened.

The rapid development of public sanitation has also given important lessons on promptly utilising so much as we know of applied science, but also modifying our practices rapidly whenever the subsidiary sciences effect an advance. Forty years ago the filth and fomites theory was the basis of sanitary practice. Municipal and household cleanliness are still inculcated, but the emphasis on them is no longer exclusive. Then, bacteria and other disease-producing organisms became the chief objects of interest for sanitarians, and sanitary practice was based on knowledge of these organisms, and study of the media through which they reached man, such as the air, water, the soil, dust, milk, and other uncooked foods. Isolation of all cases of contagious disease was much insisted on. Isolation is still useful in many cases; but it is not regarded to-day as the one effectual defence against epidemics and the diffusion of disease. Next, insect and vermin carriers were made known, and with them came in quite a new set of sanitary practices—not a replacement but a large addition. Lastly, the contact theory of contagion, with its demonstrations that living bacteria may be carried from one person to another in minute vesicles or droplets thrown off in coughing, sneezing, or any convulsive effort, and borne on the air, has gained general acceptance. At the same time, abundant proof has been given that pathogenic bacteria and protozoa develop in the bodies of many persons without causing any recognisable symptoms. Yet the virulence of the germs these persons carry may be extreme.

These recent discoveries have introduced serious difficulties into some departments of sanitary practice. The apparently healthy carrier cannot be isolated, for he remains unknown. If at any time such carriers and missed cases are numerous in a given community, isolation becomes useless, if not impossible. That is the ordinary condition of most American communities in regard to tuberculosis. Hence, bacteriologists have before them a very useful piece of work in the study of human carriers of disease who are not sick. Meantime sanitary practice is obtaining sound explanations of the occasional failure of its former methods of resisting epidemics, and preventing the spread of the ordinary contagious diseases.

The principal lesson to be drawn from the experiences of sanitarians during the past fifty years is that practitioners of any useful art must be prompt at every stage of progress to make use of knowledge just attained, even if it be empirical and incomplete, and must not linger content or satisfied at any stage. This lesson is applicable in every modern industry and educational or governmental agency during either peace or war.

Biologists are now realising that biochemistry must furnish the fundamental knowledge of the processes which incessantly go on in the healthy body, and must also provide the exact knowledge of those changes in the normal processes which lead to disease and death. The physician and the sanitarian have become accustomed to the beneficial use of remedies and defences which chemistry at present can neither analyse nor synthesise, such, for example, as diphtheria antitoxin; but they are aware that this condition of their art is unsatisfactory and ought not to be permanent. The animal body consists of well-known chemical substances, and its functions depend on chemical reactions. Digestion is largely a chemical process. The animal body consists of innumerable cells in great variety, each of which acts under chemical and physical laws. Hence the belief of the biologist of to-day that chemistry—analytical, structural, and physical—can and will come to the aid of the science and art of medicine in the large sense, and will ultimately enable biological science to comprehend the vital processes in health and disease, and to penetrate what are now the secrets of life and death.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The number of undergraduates in residence this term is 665, as against 1227 during the corresponding term last year, and about 3600 in a normal term. Amongst the 11,000 members of the University in the land, sea, and air services, 1723 casualties have been notified; 697 have been killed and 892 wounded. The Victoria Cross has been awarded to three Cambridge men, the D.S.O. to 52, and the Military Cross to 103; the services of 714 members of the University have been recognised. Owing to the small number of undergraduates in residence a considerable amount of distress prevails amongst the keepers of licensed lodgings, some 1500 in number, and it has been suggested that munition workers might be economically housed in the vacant quarters; several large empty buildings are available which might be converted into munition factories. The late Rev. Dr. Streame left the sum of 500*l.* to Corpus Christi College, to be used as the master and fellows shall determine.

LONDON.—Owing to circumstances arising out of the war, Mr. Kilburn Scott's course of lectures on "Electrical Production of Nitrates for Fertilisers and Explosives," announced to begin at University College yesterday, January 26, will not be held.

SIR G. H. MAKINS has been appointed to deliver the Hunterian oration of the Royal College of Surgeons of England in 1917.

DR. F. E. BRASCH contributes to *Science* (vol. xlii., No. 1091, p. 746) an interesting article on the teaching of the history of science in American universities and technical schools. The nineteenth century was too full of creative work in the various fields of science to give historical studies their full play. The new century, on the other hand, will offer a larger field for historical studies for the reason that the practical value of such work will be more clearly demonstrated. There is a growing tendency to depart from the extreme and powerful method of specialisation, and to teach science from an historical point of view. An interesting statistical study is made of the courses in the history of the different sciences offered in universities and technical schools. These courses are on the whole specific to the individual sciences, and general courses of science history are of late origin, and exist only in a few schools. There is, however, no doubt that there is a growing tendency to regard the historical development of the sciences from a broader point of view than was possible or practicable in earlier years.

A MEETING of delegates from London branches of the Workers' Educational Association and similar organisations in the London County Council area was held on January 22 at the Memorial Hall, Farringdon Street, to discuss the proposal of the L.C.C. Education Committee to save 300,000*l.* on the educational expenditure for the year. A resolution was carried declaring that the policy of "educational reaction" adopted by the London County Council was opposed to the true interests of the workers and the nation as a whole, and calling on the Workers' Educational Association to work continually for the improvement of the educational service of the County of London. The Rev. William Temple, president of the association, in his speech from the chair, said that the meeting had been called because of the fear that the example of London might be followed elsewhere. Members of their association were much more concerned about this action as a symptom than about the actual fact, and their primary concern must be to convince public authorities that if they desired to represent the people they must put education in the forefront and prevent the war from being used as an occasion for whittling away that small amount of education which years of struggle had secured for children who without it would never be able to take their proper place in the life of the nation.

SOCIETIES AND ACADEMIES.

LONDON.

Mineralogical Society, January 18.—W. Barlow, president, in the chair.—Prof. G. **Cesàro**: A simple demonstration of the law of Miller. In any spherical triangle the arc x joining the apex C to a pole dividing the base c into segments α and β is given by the equation $\cos x \cos c = \cos a \sin \beta + \cos b \sin \alpha$. Taking the apex as the pole of one of the axes and the base as the zone containing the four poles, the usual anharmonic ratio is obtained.—Dr. G. T. **Prior**: The meteorite of Daniels Kuil. The meteorite consists of nickeliferous iron in large amounts, troilite, oldhamite, felspar, and enstatite, free from iron, and thus belongs to the exceptional Hvittis and Pillistfer group of chondritic stones, to which also must be added the Khairpur meteorite, which contains notable amounts of oldhamite.—Dr. G. T. **Prior**: The relationship of meteorites. Meteorites may be arranged by their chemical and mineral composition into the following six groups: (1) Bustee and Hvittis group; (2) Siderolites; (3) Cronstad group, consisting of chondrites, containing more than 10 per cent. of nickeliferous iron; (4) Baroti group, consisting of chondrites containing less than 10 per cent. of nickeliferous iron; (5) Chladnite group, including Chladnites, Angrites, Chassignites, Amphoterites, some Rodites, and probably some chondrites containing little nickeliferous iron; (6) Eucrites, Nakhlites, Shergottites, Howardites, and some Rodites. It is suggested that from the first group the remaining stones have been derived by the interaction between oxidising nickeliferous iron and enstatite with consequent production of ferriferous olivine and bronzite, the formation of chondrules, and enrichment in nickel of the residual iron. The nickeliferous iron of the first three groups corresponds with the more common meteoric irons, such as the octahedrites and hexahedrites, containing less than 10 per cent. of nickel, and that of the last three to nickel-rich ataxites, containing more than 10 per cent. of nickel. The groups (2) to (6) contain progressively diminishing amounts of nickeliferous iron, which is increasingly rich in nickel, and have increasing amounts of ferrous oxide in the ferromagnesium silicates, in which the ratio of magnesium to iron atoms approximates in the case of group (2) to 7, of group (3) to 5, of group (4) to $3\frac{1}{2}$, of group (5) to 2, and of the last group to 1 or less.—Dr. J. W. **Evans**: The isolation of the directions-image of a section of a mineral in a rock-slice. In some optical investigations, *e.g.*, the observation of the interference figures of minerals in thin sections under the microscope, the determination of the angle of total reflection, and the measurement of crystal angles, the image studied is not that of the object, but is one in which every part corresponds to a direction in which light is transmitted, or, in other words, it is a directions-image. To prevent the effects of closely adjoining objects being blended, all light except that traversing the object under investigation must be screened by a diaphragm placed near it or in a position conjugate with it. In an ordinary petrological microscope this may often be conveniently effected by placing the diaphragm below the condenser so that the image of the aperture is seen in focus simultaneously with that

of the object. The best results are, however, obtained when the diaphragm is placed in the focus of the eye-piece, and, after it has been adjusted, the Becke lens placed above it. The same method may be employed with advantage in the other observations referred to, the instrument employed being constructed primarily as a microscope and converted into a telescope by the addition of a lens, instead of *vice versâ*, as is the usual procedure.—Dr. J. W. **Evans**: A new method of determining the angular direction represented by a point in the directions-image. A circular plate is ruled with concentric circles at distances from the centre equal to $r \tan \theta$, where θ stands for different angles at intervals of 5° up to the full aperture of the objective, and r as a constant length, say, 50 mm., and with radiating lines 5° apart; it may be placed on supports which fix its position above the stage. When the microscope is adjusted for observations of the directions-image of a mineral, the point the angular position of which is to be determined is identified by the end of an adjustable pointer, which is placed so as to be seen in focus. The microscope is then focused up until the objective is accurately at a distance r from the plate, which is now placed in position and is clearly seen. The angular position required is then shown by the position of the end of the pointer relatively to the scale on the plate.—L. J. **Spencer**: A new (seventh) list of mineral names.

Institution of Mining and Metallurgy, January 20.—Sir Thomas Kirke Rose, president, in the chair.—W. F. **Collins**: Chinese mining legislation. The important consequences that may result from the introduction of a more suitable code of laws regulating mining conditions than that now in force can be appreciated when it is realised that China claims sovereignty over 4¼ million square miles of territory, and that if her mining development were on a par with that of the United States, the mines should give employment to nearly fifteen million men, pay wages of nearly 200 million pounds per annum, and produce in State revenue on a royalty of 2½ per cent. a sum of at least ten million pounds annually, apart from further duties levied by the Maritime Customs. Apparently the awakening of China which is now in course of progress will affect its mining industry amongst others, and the provision of legislation to deal with the changed outlook on affairs cannot be long delayed. The author of this paper passes in review the gradual evolution of mining legislation in China from the earliest times up to the present day, and seeks to show where it has proved prejudicial to proper development, and he then proceeds to formulate such changes as in his opinion will tend to attract foreign capital for the carrying on of the industry. He points out that the existing regulations place a foreigner at a serious disadvantage in competition with Chinese mining companies, and that it may be taken as axiomatic that so long as foreign capital is unable to work mines in China under its own company law, it will prefer to interest itself elsewhere. His criticism is constructive to the extent that he enunciates the fundamental principles required to be drafted into new mining legislation before the desired influx of foreign capital can be converted into an accomplished fact.—W. H. **Trewartha-James**: Taylor's pulp sampler. In this paper the author describes briefly an automatic pulp sampler of simple design and construction which has already, he claims, accomplished much useful work in Cornish tin mines. The apparatus provides for cutting the stream of pulp automatically at fixed intervals, which can be adjusted over a wide range, so obtaining samples in desired proportion to the amount of material passing through the feed launder. The inventor of the device has presented his design to the mining industry through the medium of the institution, and it has the advantage that it can easily and cheaply be constructed out of materials found in nearly every mine store, by an ordinary workman.

MANCHESTER.

Literary and Philosophical Society, December 14, 1915.—Prof. S. J. Hickson, president, in the chair.—F. G. **Percival**: The punctuation of the Brachiopoda. The shells of the Terebratulaceæ are perforated by thousands of little pores, through which pass tube-like processes of the mantle. The number of these punctæ per sq. mm. varies in different species, and this variation has been used as a means of distinguishing between different species. Unfortunately, an examination of large numbers of individuals belonging to one species shows that the variation within a single species is so great as to render the character useless as a means of distinction, *e.g.* 166 individuals of *Terebratula biplicata,* Brocchi, were examined and found to range from 39 to 129 per sq. mm. Similarly, 367 specimens of *T. punctata,* Sow., showed a total range from 66 to 240 per sq. mm. All the readings were taken at approximately the same distance from the umbo, because the number per sq. mm. increases with the distance from the umbo. These two species alone cover the greater part of the total variation possible for the group, and the variation in number is therefore almost useless as a means of specific distinction.—J. W. **Jackson**: The money cowry as a sacred object among North American Indians. One of the chief objects of value used at religious ceremonies by the Ojibwa and Menonimi Indians is the money cowry, *Cypraea moneta.* The use of this particular species is of great interest by reason of it being alien to the American continent, and in view of its adoption for religious and other purposes in the Old World. In the cult of Venus cowries played an important part in ancient times in European countries. The tradition among the Indians is that the sacred shell came through a particular hero-god, who acted as intermediary between the Great Unknown and the Indians, and founded their medicine society. During initiation ceremonies the candidate is acquainted with the traditions pertaining to cosmogony and to the genius of the Indians; much dancing and smoking is indulged in, and the medicine bag containing the sacred shell is thrust towards the candidate, by which means the shell —the symbol of life—is supposed to enter the latter's breast.—J. W. **Jackson**: The Aztec moon-cult and its relation to the chank-cult of India. The similarity in the use of shells in Aztec and Hindu religious ceremonies is remarkable, and several striking instances occur on Aztec manuscripts, where large conch-shells are seen in use as trumpets and marine shells are figured as symbols of the moon. The adoption of a shell as the emblem of the Mexican moon-god recalls the association of the chank-shell with the Hindu god Vishnu. This parallel is even more striking when one considers that the Brahman in reciting his daily prayer begins by a reference to the god of the moon at the mouth of the chank which he holds. Shell trumpets are used in India in connection with temple-worship and with harvest rites, and a like procedure is to be seen on the old Mexican picture-writings. Further, the ancient Mexicans, like the Hindus, had the same myth regarding the presence of a rabbit in the moon.—Prof. G. Elliot **Smith**: Further evidence for the derivation of elements of early American civilisation from the Old World. Discussing the significance of pre-Columbian representatives of the elephant in American sculptures and codices (already summarised in NATURE, November 25, p. 340, and December 16, p. 425), and making use of the evidence supplied by truncated pyramids

and the winged-disc symbolism in substantiation of the influence of Egypt and Asia, attention was directed to the fact that a great part of the ancient Indian pantheon, centred around the god Indra, had been bodily adopted by the Maya people of Central America. Evidence was adduced to explain the details of the process of transmission (which probably began somewhere about 200 B.C., and continued for many centuries), and the confusion which was introduced during the migration. Particular attention was directed to the great influence exerted by the late conventionalised form of the Indian Makara, as a sea-elephant, in determining the design, not only of the Copan elephants in the far east, but also of the early Christian and pre-Christian representations of the elephant upon the sculptured stones of Scotland and Scandinavia in the far west. The fact was again emphasised that practically every element of the early civilisations of America was borrowed from the Old World. Small groups of immigrants from time to time brought to America certain of the customs, beliefs, and inventions of the Mediterranean area, Egypt, Ethiopia, Arabia, Babylonia, India, Indonesia, eastern Asia, and Oceania, and this confused jumble of practices became assimilated and "Americanised" in their new home across the Pacific, as the result of the domination of the great uncultured aboriginal populations by small bands of more cultured foreigners.

January 11.—Presidential address.—Prof. S. J. **Hickson**: Animal symmetry and the differentiation of species. The attempt made by Cuvier, at the beginning of the nineteenth century, to separate into one division of the animal kingdom—the Radiata—all those forms of animal life that show a radial symmetry from the other divisions that included animals with a bilateral symmetry never met with much success. The advance of knowledge has shown that these symmetries cannot be used as a basis of classification. But it is worth while to consider the conditions which led to the development of the radial symmetry of the organs in some animals, and the bilateral symmetry of the organs in others. Radially symmetrical animals are usually sedentary or floating in habit, and have a feebly developed muscular system. Bilaterally symmetrical animals, on the other hand, have usually the power of moving rapidly and powerfully from place to place, and are provided with a well-developed muscular system. Nearly all the radially symmetrical animals show considerable variability even as regards the number and disposition of important organs. In bilaterally symmetrical animals, on the other hand, there is far less variability in important organs. In consequence of this difference in variability of the two kinds of animals, the systematic zoologist finds greater difficulty in arranging the former into discontinuous specific groups than the latter; and it may be a question for consideration whether in radially symmetrical animals we find any such discontinuity as that indicated by the species of bilaterally symmetrical animals. In the Pennatulacea we have a group of animal colonies which show a series of stages from radial symmetry to bilateral symmetry. In the radially symmetrical forms there is very great variability in all the important features of the colony, and definite discontinuity between specific groups is difficult to find. In the bilaterally symmetrical Pennatulacea, however, variability in these features is greatly reduced, and definite species are more clearly disclosed.

PARIS.

Academy of Sciences, January 10.—M. Camille Jordan in the chair.—Gaston **Darboux**: An extension of Poncelet's theorems relating to polygons inscribed in, or circumscribed about, conics.—G. **Bigourdan**: The manuscripts of the works of Jean de Lignières. A continuation of a catalogue commenced in an earlier communication, including MSS. at Erfurt, Florence, London, Melk, Milan, Munich, Oxford, Padua, Paris, Prague, and Rome.—G. **Humbert**: The convergents of Hermite.—D. **Eginitis**: Observations of Mellish's comet (1915*a*) made at the Athens Observatory with the Doridis equatorial (Gautier 40 cm.) Positions given for September 17 and 18, November 13, 15, 16, and 17.—G. A. **Le Roy**: The preservation of solutions of sodium aluminate by cold. At ordinary temperatures solutions of sodium aluminate are unstable, depositing alumina. At a temperature of $-1°$ C. to $-2°$ C. no change in composition was found after one month.—MM. **Russo** and **Tussau**: Geological journeys through Central Morocco.—Alfred **Angot**: Value of the magnetic elements at the Observatory of Val-Joyeux on January 1, 1916.—O. **Lignier** and Adr. **Toison**: Ephedra possessing a closed ovary and an included ovule.—M. **Pontio**: The analysis of textiles. A modification of the Vétillard method of microscopical examination.—Robert **Lévy**: The toxins of Epeira and Tegenaria.—E. **Gley** and Alf. **Quinquaud**: The relations between the secretion of the suprarenals and the vasomotor function of the splanchnic nerve. Contrary to the generally accepted view, from the experiments described it would appear that the stimulation of the splanchnic vasomotor arises from a neuro-muscular action and does not produce its effect by the intermediary of the adrenalin secretion.—M. **Cazin** and Mlle. S. **Krongold**: The methodical use of antiseptics based on the bacteriological examination of the pus in the treatment of septic wounds. Regular bacteriological examination of the pus is necessary, with corresponding change in the antiseptic solution, for the successful treatment of infected wounds. Wounds containing the pyocyanic bacillus, or in which staphylococci predominate, are best treated with a 1 in 200,000 silver nitrate solution. Gangrenous wounds containing *Bacillus perfringens* or the septic vibrion are best treated with weak solutions of sodium hypochlorite. In very weak solutions its prolonged use does not cause irritation, and the bactericidal power is not greatly affected by high dilution. The serum of Leclainche and Vallée can be used with advantage when streptococci are present.—MM. **Santamaria** and **Salonne**: Apparatus for the reduction of simple or compound fractures of the eight segments of the limbs.—E. **Vasticar**: The terminations of the acoustic nerve. M. **Delphy**: A remarkable deformation of the mouth of a specimen of *Trigla gurnardus*.

BOOKS RECEIVED.

Board of Agriculture and Fisheries. Fishery Investigations. Series ii.: Sea Fisheries. Vol. ii., No. 2, pp. 79. Vol. ii., No. 4, pp. 18+8 plates. Vol. ii., No. 5, pp. 34. (London: H.M.S.O.: Wyman and Sons, Ltd.) 5*s*., 4*s*., and 1*s*. respectively.

An Elementary Manual of Radiotelegraphy and Radiotelephony for Students and Operators. By Prof. J. A. Fleming. Third edition. Pp. xiv+360. (London: Longmans and Co.) 7*s*. 6*d*. net.

Neolithic Dew-Ponds and Cattleways. By Dr. A. J. Hubbard and G. Hubbard. Third edition. Pp. xxiv+116. (London: Longmans and Co.) 4*s*. 6*d*. net.

Water Purification Plants and their Operation. By M. F. Stein. Pp. viii+258. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 10*s*. 6*d*. net.

Annuaire pour l'an 1916 publie par le Bureau des Longitudes. Pp. vi+502. (Paris: Gauthier-Villars et Cie.) 1.50 francs.

A Concordance to the Poems of Edmund Spenser. Compiled and edited by Prof. C. G. Osgood. Pp. xiii+997. (Washington: Carnegie Institution.)

History of Domestic and Foreign Commerce of the United States. By E. R. Johnson, T. W. van Metre, G. G. Huebner, and D. S. Hanchett. Vol. i., pp. xv+363. Vol. ii., pp. ix+398. (Washington: Carnegie Institution.)

The Physiology of the New-born Infant: Character and Amount of the Katabolism. By F. G. Benedict and F. B. Talbot. Pp. 126. (Washington: Carnegie Institution.)

The Feebly Inhibited, Nomdism, or the Wandering Impulse, with Special Reference to Heredity. Inheritance of Temperament. By C. B. Davenport. Pp. 158. (Washington: Carnegie Institution.)

The Vegetation of a Desert Mountain Range as conditioned by Climatic Factors. By F. Shreve. Pp. 112+36 plates. (Washington: Carnegie Institution.)

Experiments with Displacement Interferometer. By Prof. C. Barus. Pp. vi+113. (Washington: Carnegie Institution.)

Bartholomew's War Map of Central Africa. (Edinburgh: J. Bartholomew and Co.) 2*s*. 6*d*. net.

Sleeping Sickness: a Record of Four Years' War against it in the Island of Principe, Portuguese West Africa. By B. F. Bruto da Costa, J. F. Sant' Anna, A. C. dos Santos, and M. G. de Araujo Alvares. Translated by Lieut.-Col. J. A. Wyllie. Pp. xii+260. (London: Baillière, Tindall, and Cox.) 7*s*. 6*d*. net.

Transactions of the Royal Society of Victoria. Vol. vi., 1914. Dioptrographic Tracings in Three Normæ of Ninety Australian Aboriginal Crania. By Prof. J. A. Berry and Dr. A. W. D. Robertson. Pp. 6+270 plates. (Melbourne: A. J. Mullett.)

Civilization and Climate. By E. Huntington. Pp. xii+333. (New Haven: Yale University Press; London: Oxford University Press.) 10*s*. 6*d*. net.

Organic Chemistry, or Chemistry of the Carbon Compounds. By V. von Richter. Edited by Prof. R. Anschütz and Prof. G. Schroeter. Vol. i. Chemistry of the Aliphatic Series. Translated and revised by Prof. P. E. Spielmann. Pp. xvi+719. (London: Kegan Paul and Co., Ltd.) 21*s*. net.

Bitter Pit Investigation: The Experimental Results in their relation to Bitter Pit and a General Summary of the Investigation. Fourth Report, 1914–15. By D. McAlpine. Pp. 178+xl plates. (Melbourne: A. J. Mullett.)

Historia del Observatorio de Manila, 1865–1915. By R. P. M. S. Maso. Pp. 210. (Manila: E. C. McCullaugh and Co., Inc.)

Physical Chemistry for Schools. By Dr. H. J. H. Fenton. Pp. viii+215. (Cambridge: At the University Press.) 3*s*. 6*d*. net.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 27.

ROYAL SOCIETY, at 4.30.—A Collision Predictor: Prof. J. Joly.—Discussion of Kew Magnetic Data, especially the Diurnal Irregularities of Horizontal Force and Vertical Force, from ordinary days of the eleven years 1890 to 1900: Dr. C. Chree.—A Portable Variometer for Magnetic Surveying: G. W. Walker.—The Single Line Spectrum of Magnesium and other Metals and their Ionising Potentials: Prof. J. C. McLennan.—The Microscopic Structure of Semipermeable Membranes, and the Part Played by Surface Forces in Osmosis: F. Tinker.—The Reduction of Metallic Oxides with Hydrogen at High Pressures: E. Newbery and J. N. Pring.—Discontinuous Fluid Motion Past a Curved Boundary: H. Levy.

ROYAL INSTITUTION, at 3.—Fuel Economy from a National Standpoint: Prof. W. A. Bone.

FRIDAY, JANUARY 28.

ROYAL INSTITUTION, at 5.30.—The Science of Clothing and the Prevention of Trench Feet: Dr. Leonard Hill.

PHYSICAL SOCIETY, at 5.—Guthrie Lecture: Some Problems of Living Matter: W. B. Hardy.

SATURDAY, JANUARY 29.

ESSEX FIELD CLUB (at the Essex Museum, Stratford), at 3.—Fresh-water Polyzoa, Illustrated by Specimens: J. Wilson.—Recent Roman Discoveries in London: F. Lambert.

TUESDAY, FEBRUARY 1.

ROYAL INSTITUTION, at 3.—The Physiology of Anger and Fear: Prof. C. S. Sherrington.

RÖNTGEN SOCIETY, at 8.15.

WEDNESDAY, FEBRUARY 2.

SOCIETY OF PUBLIC ANALYSTS, at 8.—Annual General Meeting.—Note on Human Milk: G. D. Elsdon.—Notes on Common Processes used in Water Analysis: W. T. Burgess.—Poli Oil—A New Adulterant of Ghee: J. H. Barnes and Arjan Singh.

GEOLOGICAL SOCIETY, at 5.30.

ROYAL SOCIETY OF ARTS, at 4.30.—Women's Work During and After the War: Hon. Lady Parsons.

ENTOMOLOGICAL SOCIETY, at 8.—The Pairing of the Plebeiid Blue Butterflies: Dr. T. A. Chapman.

THURSDAY, FEBRUARY 3.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Note on an Orderly Dissimilarity in Inheritance from Different Parts of a Plant: Prof. W. Bateson and C. Pellew.—Observations on Coprozoic Flagellates, together with a Suggestion as to the Significance of the Kinetonucleus in the Pinucleata: H. M. Woodcock.—Investigations dealing with the Phenomena of Clot Formations. III. Further Investigations of the Cholate Gel: S. B. Schryver.—The Mechanism of Chemical Temperature Regulation: J. M. O'Connor.

ROYAL INSTITUTION, at 3.—Industrial Applications of Gaseous Fuels derived from Coal: Prof. W. A. Bone.

FRIDAY, FEBRUARY 4.

ROYAL INSTITUTION, at 5.30.—Fifteen Years of Mendelism: Prof. W. Bateson.

GEOLOGISTS' ASSOCIATION, at 8.—Presidential Address: The Geological History of Flying Invertebrates: G. W. Young.

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Editorial Communications to the Editor.

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