Nature

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

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

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

THURSDAY, SEPTEMBER 6, 1917.

THE PSYCHOPATHY OF THE BARBED WIRE.

Shell-shock and Its Lessons. By Prof. G. Elliot Smith and T. H. Pear. Pp. xi+135. (Manchester: At the University Press; London: Longmans, Green, and Co., 1917.) Price 2*s.* 6*d.* net.

THE conditions of modern warfare, with its trench life, its sudden gas and bomb attacks, the extraordinary intensity of newly discovered explosives, their variety, and also their long-continued effects when directed against human beings in a life-and-death struggle, have created among our men at the front such an amount of nervous and mental tension that the war has disclosed manifestations never previously anticipated, and the appellation to some of these states of the term "psycho-neuroses" is amply justified. These conditions are, however, rare in the trenches, although far from uncommon behind the lines, in the field hospitals, at the base, and especially at home. They occur also in labour battalions, and even among those who have never crossed the Channel. Nevertheless, we owe an inexpressible debt to all our menfolk in the line; they have suffered long and endured many things with the dogged determination to win victory for liberty, social justice, and human brotherhood. The price we pay for deathless courage and for records of supreme self-sacrifice on the part of officers and men, who lay down their lives to guard our homes and to protect our and their own flesh and blood, implies an intense stress and strain, resulting in many instances in a complete breakdown of mind and body; yet the proportion of mental cases is not so large as might have been expected, although their number in the aggregate with so great an army is naturally high.

This little treatise of five short chapters, designated "Shell-shock"—it would have been more accurate, we think, to have called it "War-shock," for the conditions described have been witnessed in cases that have not been to the front—purposes to give an account of some of the nervous and mental states associated with the war, and it has several lessons to teach. Most noticeable is the changed relationship here accepted between the mind and the body, for in place of the usual psycho-physical parallelism (of which Wundt was the chief pre-war exponent), which affirms that there is no causal relation between the processes in the one series and those in the other, we now have the view put forward that there exists a reciprocal causal relation between the two—but with stress laid upon the psychical series. It is assumed by the authors that a cerebral disturbance (physical) is caused by an object through the organs of sense, which gives rise to a sensation (psychic), and this, when cognised, causes a feeling or an emotion with a conative tendency (psychic), resulting in some further cerebral disturbance (physical), which eventually results in a motor reaction. This, in short—if the reviewer rightly interprets the meaning implied—is the view taken by the joint authors, one of whom is a distinguished anatomist and the other a student of psychology, both being guided in their new field of experience by the able psychiatrist to whom the volume is dedicated.

The essay is characterised by three main features: first, as stated, the tendency throughout to magnify as the predominant partner the first element in the psycho-physical relationship and therefore tending to dwell, we think unduly, upon the value of suggestion, dream analysis,[1] hypnotism, "psycho-analysis," and personal magnetism, nothing being said of massage, electricity, or baths; secondly, the great stress laid upon nurture rather than nature, which shows the authors to be out-and-out environmentalists; and thirdly—which does not appear to follow as a corollary from a disquisition upon "shell-shock"—the constant effort made to convince the public of the necessity for reform in the treatment of the insane, the urgent need for reconstructing the administra-

[1] See also "Dream Psychology." By Maurice Nicoll. (London: H. Frowde, and Hodder and Stoughton.)

tion of English asylums for this purpose, and the compelling want that exists for relaxing the Law of Lunacy, so that cases of insanity may be treated in the unconfirmed stages without the legal certificate—the latter certainly an example of preaching to the converted, as there were two Bills before Parliament for this purpose at the commencement of the war, and the London County Council has since obtained the sanction of law for the treatment of mental illness during its early stages in the Maudsley Hospital, now employed for military mental cases.

It may be stated here that the authors show a lack of practical knowledge of the law as applied to the insane poor—in whose interests the book pleads—when they state that the granting of the reception order is conditional upon the friends of the insane poor visiting from the outside world. This reception order really only applies to private patients—the richer of the community—and the long experience of the reviewer recalls regulations to limit the number and frequency of visits to asylums for the insane poor rather than the reverse. Nearly one-half of the essay is devoted to the third feature, and, as stated in the introduction, the object of the volume is to rouse a feeling against "the British attitude towards the treatment of mental disorder." Naturally, therefore, and also avowedly, the work is written for the general reader, and not for the medical practitioner,[2] and so far as the experience of the authors is concerned it is an exceedingly interesting essay; but we cannot subscribe to its views, especially in regard to heredity. We find this statement: "The war . . . has warned us that the pessimistic, helpless appeal to heredity so common in the case of insanity must go the same way as its lugubrious homologue which formerly did duty in the case of tuberculosis. In the causation of the psycho-neuroses heredity undoubtedly counts, but social and material environment count infinitely more."

In the reviewer's experience, which has been considerable with this class, a family history of insanity, epilepsy, paralysis, neurasthenia, or parental alcoholism has been obtained in 33 per cent. of all cases of shell-shock, and probably the correct proportion is much higher. As those who investigate in this field of inquiry know, the admission of insanity occurring in the family is not readily made, owing to the stigma attaching to it, and pedigrees ascertained are of the briefest kind. In order to be of value the family history should not only enumerate all the members, but also embrace at least three generations. In the absence of this information it would be incorrect to state that shell-shock cases presented no neurotic family history. In regard to heredity we know that the interaction of any two sets of characters may be conditional upon the presence of some third one, such as sex, as in hæmophilia, and in certain other diseases which appear in first-cousin marriages, and the character upon which these depend being recessive, the diseases would not appear, therefore, until two similar hybrids, each possessing this character, had intermarried. If the disease be rare, two such hybrids are not likely to meet unless they are of the same family, yet there exists a deeply seated defect which is highly hereditary. We have no definite knowledge of what is inherited; it may be the faulty nutrition of some ancestor, some "inborn error of metabolism"; at any rate, it is some deeply ingrained defect only curable by extinction of the stock or by its repeated crossing with other more stable stocks.

We think, therefore, that the authors assert too dogmatically that "there is no anatomical, pathological, or chemical evidence of inheritance in the cases of psycho-neuroses" which they had treated. Surely this evidence would not be necessary in order to prove the inheritance of disease, which is not ascertained by microscopic or chemical evidence. These conditions are known much more by perverted nervous action than by coarse structural lesions or chemical reaction, and we know that melancholia, epilepsy, paranoia, hysteria, and neurasthenia are not only interchangeable among themselves, but also definitely inherited, which indicates some deep underlying nervous defect. The reviewer is of the school which regards heredity as a great factor, and he believes there are few cases of shell-shock which do not inherit in their nervous system some *locus resistentiae minoris*, which has tended towards a breakdown at some age or other under the necessary stress. The comparison made by the authors between the heredity of tuberculosis and that of insanity is scarcely to the point, for in one instance the disease is of microbic origin, whilst in the other it is not. However, the authors are men of science who deny that there can be a true inheritance of any microbic disease, but observation and experience can best supply the test answer in regard to this, and there are few practical physicians who are not prepared to admit that the body in which the germinal plasm is lodged, if deeply affected by exhausting disease, may produce far-reaching effects upon this plasm, and consequently upon the offspring, so that a lower resistance to disease, or a greater proclivity or susceptibility, is probably transmitted, and the reviewer thinks it is not too much to affirm that this lowered resistance may be perpetuated—a thesis which cannot to-day be denied.

The reviewer is scarcely in agreement with the authors, who adopt so wholeheartedly the exclusively emotional origin of shell-shock as against the physical origin. That shell-shock is entirely of psychic origin and can be overcome by psycho-therapeutics is too sweeping a statement. In many, if not in most, of these cases there are physical weariness, fatigue, exposure, insomnia, exhaustion, and irregular meals—possibly also on occasion malaria and venereal disease; the reviewer has known these. Moreover, the state of the vital organs—the heart with its peripheral extensions, the lungs, and the alimentary system,

[2] See also "Psycho-névroses de Guerre." By Drs. Roussy and Hermitte. (Paris: Masson et Cie.)

together with the condition of the great eliminating organs, the liver, kidneys, skin, and bowels—are abnormally affected by life at the front—factors which must control the psycho-physical connections.

We know that intellectual and emotional manifestations depend greatly upon changes in the blood, in the internal secretions, and in the vital organs, but the authors seem not to recognise fully the implications connected with such physical changes, or they appear to underrate them, yet we have daily proof of their importance; witness the influence upon the emotions of visceral derangements, of changes in the circulation, or in the supply and distribution of blood to the great depurating organs. The brain must depend for its normal action upon the healthy co-operation of all the vital functions, and although the biological response of fear is of far-reaching importance, mental influences are not always the predominating factors in the causation of shell-shock, which may be more the result or the consequence of physical changes. The highest intellectual and emotional powers by which well-balanced adjustments are reached and well-balanced feelings are maintained require a full flow of nervous energy from all the bodily organs acting with unimpaired harmony, and whilst mental influences, positive and negative—exultations and agonies—count for much in the soldier's life at the front, the bodily state must not be neglected if the partnership is to prove effective. ROBERT ARMSTRONG-JONES.

SCIENTIFIC HOME-MAKING.

(1) *The Mothercraft Manual.* By Mary L. Read. Pp. xviii+440. (London: George G. Harrap and Co.) Price 5*s.* net.

(2) *The Home and the Family: An Elementary Text-book of Home-making.* ("The Home-making Series.") By Prof. Helen Kinne and Anna M. Cooley. Pp. vi+292. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) Price 3*s.* 6*d.* net.

(3) *Food Gardening for Beginners and Experts.* By H. Valentine Davis. Pp. vii+44. (London: G. Bell and Sons, Ltd., 1917.) Price 6*d.* net.

(4) *One Hundred Points in Food Economy.* By J. Grant Ramsay. Preface by Prof. W. D. Halliburton. Unpaged. (London: G. Bell and Sons, Ltd., 1917.) Price 1*s.* net.

(1) THE author of "The Mothercraft Manual," who is a director of the School of Mothercraft in New York, complains that the word mothercraft is coming into general use, especially in England, in a much narrower sense than it was intended to bear. Certainly the aim of her book is a wide one. It is, briefly, to make available to "home-makers, present and prospective," some of the wealth of knowledge gained by students of biology, hygiene, child-psychology, and other sciences by translating it into the language of everyday life.

The early chapters deal with the evolution of marriage, the duties of the State and of parents so that reasonably early marriage may be possible, the establishing of the home on small means—a sense of humour is named as one of the chief essentials—preparation for parenthood, and the present state of knowledge of heredity and eugenics.

The last sections are too much compressed to be of value in themselves, but a bibliography to each chapter is appended, and one of the avowed objects of the book is to enable the student to follow out in more technical works any of the subjects touched upon. The most advantageous age for parenthood is stated to be twenty-five to forty for the mother and "over twenty-five" for the father; "two or three years" should elapse between births; four children are required on an average to maintain the family, but ethical control on the part of the parents is the only method of limitation consonant with the highest ideal of matrimony and with the welfare of the child.

The keynote to the section on growth and development is, that to live fully the life normal to any particular stage is the best preparation for the succeeding one. Many charts and tables of normal physical and mental acquirement at different stages are given, and these will be useful as a guide to fresh observation.

The practical part of the book begins with a discussion of the health, habits, and general well-being of the mother and the influence of these on pre-natal life. Much space is devoted to the actual care of the infant, and its daily, indeed hourly, *régime* from birth onwards is mapped out with meticulous care. In regard to the food tables our chief impression is that the stomach of the American infant must be very different from that of the kind of baby we are accustomed to if, at eighteen months, it is advisable to add to its dietary a *purée* of fresh or dried peas, celery, onions, or corn, or if the following is a "typical" midday meal for a child of six: Half portion macaroni, one tablespoonful cooked cheese, four tablespoonfuls string beans, lettuce with oil and lemon-juice, bread and butter, and a raw apple! The tables of food composition, however, are very clear and of general applicability.

The succeeding chapters deal with the education of the child in the home, and they follow in the main the now familiar principles laid down by Froebel, Stanley Hall, Prof. Dewey, and Mme. Montessori. The value of play as a factor in education is recognised, and we are glad to see that no great regulation of play, as distinct from games, is recommended. Abundant playthings suited to the visual capacity and muscular development at each stage are enumerated, highly finished toys which leave nothing to the resource and imagination of the children being ruled out. Organised games should begin at about four years old, and can be used as a training in group-action, in competition, loyalty to a leader—in short, to lay the foundations of nearly all the civic virtues.

The place of story-telling, of music, and of the arts in home education is considered, and the book closes with a section on home nursing and first aid. Some of the illustrations are useful and interesting; others, such as a tableful of labelled bottles of unwholesome sweets, have rather an irritating effect.

(2) It is open to question whether it is well that the attention of young women should be concentrated too closely and continuously on the problems of home-making and child-rearing unless they have a definite prospect of marriage, or of putting the training to practical account in some other way. But a basis of general knowledge of the home-making arts is necessary to every woman. This, and the perception that there is a high standard to be reached, can be gained comparatively early in school life, perhaps best between the eleventh and fourteenth years. Therefore we welcome very warmly an "Elementary Text-book of Home-making" by Prof. Helen Kinne and Anna M. Cooley, both teachers of the subject in Columbia University. The book, which is American in its setting, is written in story form, and is intended for use as a supplementary reader in elementary schools. The directions for the sanitary arrangement of the house, the furnishing and cleaning of rooms, the care of the baby, and the preparation of food are clear and simple. Emphasis is laid throughout on the duty—and the means—of simplifying life and economising labour that a higher degree of mental health and physical efficiency may be reached by the maker of the home, as well as by its other inmates. The "typhoid" fly has a chapter to itself, and an optimistic picture, published by permission of the Louisiana State Board of Health, shows a child, in the year 1920, gazing at a fly on the edge of its plate and asking interestedly, "What's 'at?" If anything could bring about so desirable a state of things in so short a time, it would surely be the dissemination of the terrifying figure on the next page of a fly the legs of which are festooned all over with germs "greatly magnified."

(3) Vegetable culture has become a very important homecraft in these days, and this little book, "Food Gardening for Beginners and Experts," will be found a useful guide. It gives very simple directions and diagrams for arranging a plot or garden in three sections, so that each is heavily manured and limed once in three years. Tables show the proper rotation of vegetables for each section, and brief instructions are given for the culture of each kind. A calendar of garden operations is appended, but no guidance is given as to the probable differences of time for seed-sowing in various parts of the country.

(4) "One Hundred Points in Food Economy" is stamped with the approval of Prof. Halliburton, and in these days of tabloids it may make some appeal. We quote one "point": "Food substitutes are not to be despised. *Why?* Because many of them are equal, or better, than the food they are intended to substitute, but, on account of ignorance, prejudice, or habit, they may not be so popular." *Why* should anybody write English like that? M. R. T.

SPECULATIVE ANTHROPOLOGY.

Modern Man and His Forerunners: A Short Study of the Human Species, Living and Extinct. By H. G. F. Spurrell. Pp. xi + 192 + illustrations v. (London: G. Bell and Sons, Ltd., 1917.) Price 7*s.* 6*d.* net.

IT may be at once admitted that the author of this book is a daring and original thinker, who has used man, ancient and modern, as a stalking-horse to cover a series of essays dealing with the origin and fate of man and of man's highest form of modern civilisation. The author, had he so chosen, is well qualified to write a book on modern man and his forerunners; he has made notable contributions both to anatomical and to medical literature; as a physician he has resided in South America and West Africa. Indeed, the very best parts of his book are those in which he records his studies of the habits and psychology of apes and monkeys. His interests, however, are centred, not on the anatomical features of species of man and ape, but rather on those mental characters which come into action when individuals become grouped in herds and communities.

Dr. Spurrell pictures three selective phases in modern man's evolution. In the first and earliest phase man's struggle was with his environment, the fittest individuals surviving. In the second, that of primitive communities, the struggle was with other communities. "The object of such a community," says Dr. Spurrell, "is not to promote the survival of the fittest, but to fit as many as possible to survive." In the second phase selection was no longer individualistic. In the third phase, when primitive communities have become welded into nationalities by the introduction of those conditions of life to which the author would restrict the term "civilisation," the form of selection again changed. "At the beginning of civilisation the individual method of selection again came into play. Individuals with a greater capacity for civilisation had a greater chance of surviving and leaving children to carry on their qualities." Civilisation tends to favour the survival of the rapacious, selfish individual. "The basic weakness in civilisation," writes Dr. Spurrell, "lies in the deeply rooted predatory instinct in human nature."

From such quotations it will be seen that Dr. Spurrell is not optimistic about our future. "The ultimate extinction of man is, of course, as inevitable as was that of the innumerable species with whose remains geological strata are packed," is a sentence from the last page but one. Yet the author has many clever and mordant statements to make. "It is the fittest armies which survive war, not the fittest individuals." "Civilisation is essentially a slavery, the need of money being its whip." "What the masses want when

they profess themselves socialists is ease without effort." "The advertisement of cheap and painless substitutes for war has been a recurring feature in the cycles of civilisation." We suspect that the author has a sense of humour hidden away somewhere and that perhaps he does not really mean all he says.

IDENTIFICATION OF PLANTS.

Name this Flower: A Simple Way of Finding out the Names of Common Plants without any Previous Knowledge of Botany. By Prof. Gaston Bonnier. Pp. xii + 331 + plates 64. (London and Toronto: J. M. Dent and Sons, Ltd.; New York: E. P. Dutton and Co., 1917.) Price 6*s.* net.

THE desire to know the names of wild flowers is very widespread and by no means confined to those who take any particular interest in botanical science. For such as these there has been no easy book of reference. The simple books have all been written on botanical principles, and the science of plant classification underlies almost every so-called popular treatise.

Prof. Gaston Bonnier has fully realised this, and in producing his book, "Name this Flower," has achieved a really useful purpose. At first the botanist may be tempted to scoff and consider it a wasted effort, for the construction of the admirable keys must have been a most laborious work. But a little study reveals its great value, and a test with such difficult plants as sea holly or teazel shows how thoroughly the work has been done.

In writing the book Prof. Bonnier was largely influenced by the philosopher Ernest Bersot's "Letter on Botany," published among his "Reflections of a Moralist." "Botany," he says, "is one of the most deceitful of sciences. As flowers are so charming one imagines that it also must be charming; but how soon one is disillusioned! And why? Ah, why? Because the *savants* have thought about themselves and not about us. They have wished for a science complete in itself; and they have put each thing in its place without troubling to ascertain whether it would be easy for other people to find it there. How many times have I tried to become a botanist, and each time I have been vanquished."

Prof. Bonnier, by his exhaustive keys, well illustrated by line drawings, enables anyone to find out the names of plants without knowing anything of botany or of the principles of classification. The value of the book is enhanced by sixty-four plates of coloured illustrations, which represent the plants sufficiently adequately. A good deal of botanical and general information is also packed into the book, and it is very well indexed. Anyone using Prof. Bonnier's book carefully could scarcely fail to find that in so doing he had not only learnt the names of plants, but was also being impelled on the high road to become a botanist.

English students should be grateful to Prof. Boulger for this translation of Prof. Bonnier's excellent book.

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.]*

Unusual Rainbows.

THE very interesting diagram sent to NATURE for August 30 (p. 525) by Mr. Allan Low seems to exhibit a complete system of direct and reflected rainbows. The falling raindrops would be flooded with the direct light of the sun, forming the usual pair of bows. They would also be flooded with the light reflected from the surface of the sea; if the sea is not ruffled this latter light would be directed from a fairly concentrated image of the sun, below the horizon. Thus it should show another pair of bows, the common axis of which is the prolongation of the line from the observer to this image of the sun; as that line points above the horizon, these bows should be more than a semicircle in extent. When the surface of the sea is ruffled, the blurred image of the sun will be so large that the colours in the bows will overlap, and only a broad white bow will appear, which would not be noticed. Fog bows are white for a different reason. The two systems of bows meet at points which must be equidistant from the sun and its image; for bows of the same radius these points must be on the horizon. The altitude of the anti-sun, the radius of the bow drawn to the horizon, and the horizon form a right-angled spherical triangle; thus the sine of half the angle between two bows where they intersect on the horizon is equal to the sine of the sun's altitude divided by the sine of the radius of the bow. With Mr. Low's estimated figures this would bring out the radius rather too small. J. L.

Cambridge, August 31.

THE arcs of the third and fourth bows, so well described by Mr. Low in NATURE of August 30, are, I think, undoubtedly due to the sun reflected from the ocean behind the ship.

Around a centre O describe two circles with radii of 42 mm. and 52 mm. respectively. Then 7 mm. above O draw a horizontal line. This will represent the horizon, and the portions of the circles above this will be the primary and secondary bows due to the direct light of the sun. On a line from O, perpendicular to the horizontal line, take another point P, distant 14 mm. above O, and describe circles about P with radii as before. The portions of these circles above the horizontal line will be the primary and secondary bows due to the reflected sun. It will be found that the figure thus obtained is very similar to that given by Mr. Low, except that he saw only small portions of the third and fourth bows. But I believe the sun's altitude must have been greater than 7°, for with that height only about one-sixth of the vertical radius of the primary bow would be below the horizon, and in his diagram about one-third is cut off. I have taken the radii of the primary and secondary bows as about 42° and 52°, in round numbers.

Invermay, Hyde Park, Leeds, August 31.

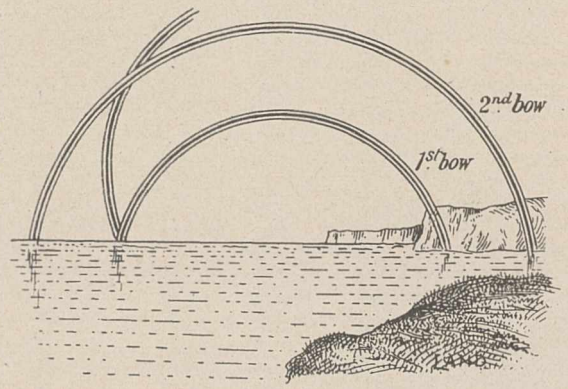
C. T. WHITMELL.

THERE seems to be a simple explanation of "An Unusual Rainbow" described by Mr. Low in NATURE of August 30. If the sea was sufficiently calm there would be, from the point of view of the raindrops causing the rainbow, a real sun 7° above the horizon

and also a mock sun 7° below it, caused by reflection. The primary and secondary bows caused by the latter as source would occupy exactly the positions indicated in the sketch with the appropriate colour arrangement. As the intensity and definition of the mock sun, good at grazing incidence, would fall off rapidly as the angle increased, only the lower part of the bows would be distinctly visible; this also is suggested in the sketch. The calmness of the sea is not specifically mentioned, but seems to be implied by the other weather conditions stated. F. W. ASTON.

South Farnborough, August 31.

THERE was observed over the Medway estuary on August 18 (7.15 p.m., B.S.T.) an extremely brilliant rainbow. In addition to secondary bows concentric with the primary (all less than a semicircle), there was seen a bow of considerable brightness having an arc greater than a semicircle. This "anomalous bow" appeared to be of the same radius as the primary bow, had its colours in the same order (*i.e.* red outer-



most), and cut the horizon at the same point. It was, in fact, the remainder of the circle of which the primary arc formed a part.

The bow in question presumably originated from the image of the sun reflected in the still water of the foreground, and thus the right-hand end of the primary bow, which stretched overland, was unaccompanied by the eccentric arc. The phenomenon should not be an uncommon one, yet I do not remember to have observed it previously. W. NEILSON JONES.

Grain, Kent, August 18.

The Sounds of Gunfire.

THE recent correspondence in the *Times* referring to the audibility of the reports at great distances induces me to record my experiences here. I have a garage, built of corrugated iron and lined with match-board. It stands on a concrete base, and the floor is cemented. Its dimensions are 20 ft. by 10 ft., by 15 ft. to the ridge. I can hear the sounds of the guns inside the building on days when they are inaudible outside. When audible outside they are considerably accentuated within.

The same thing occurs in the case of a smaller shed, of similar construction, about 100 yards away.

A structure of corrugated iron and wood upon a concrete base appears to act as a resonator, collecting and intensifying the sounds. It might be possible to record the sounds on wax cylinders (phonographically) by using an abnormally large megaphonic trumpet directed towards the source of the disturbance.

C. CARUS-WILSON.

Strawberry Hill, Middlesex, August 27.

EDUCATION AND INDUSTRY.

DURING the early part of 1916 the Higher Education Sub-Committee of the Education Committee of the London County Council devoted a great deal of time to interviewing representative employers with the view of obtaining their views on the efficiency of the work done in the various types of educational institutions under its control, and a frank discussion of the relations which should exist between the education given in them and industrial and commercial life. The results of these interviews are summarised in a report recently presented to the Council, which has roused a good deal of comment in the Press, much of it of a very superficial character.

Most of those interviewed were concerned with the distribution and transport of goods or with financial undertakings, but, in addition to these, three groups of employers dealing with what may be said to be the three main London manufacturing industries, engineering, printing, and the chemical trades, were also interviewed.

While the inquiry was generally directed to the possibility of establishing a closer relationship between education and industry than at present exists, the main lines on which it proceeded may be summarised under four heads:—

(1) The methods adopted by business men for recruiting their staffs and the qualifications demanded from applicants.

(2) General defects in the education given by the schools as revealed by the experience of business men.

(3) The possibility of greater assistance being given to employers in making a suitable selection and in providing better material.

(4) The encouragement given by business men to further education of their staffs, and the desirability or otherwise of compulsory further education.

With the criticisms of the representatives of commerce we do not propose to deal beyond remarking that they are largely criticisms of the character and *moral* produced by the schools, and the most sweeping of them have been shown by the events of the last three years to have very slight foundation. For many of the others the conditions of employment, and particularly of the methods used for selecting employees, which in too many cases pay far too little attention to the selection of the really able and intelligent boy and far too much to personal influence, are much to blame. If a boy in his last years at school feels that someone whom he knows will get him into a post and that it matters very little whether he does his school work well or badly, he has little encouragement to put forth the best that is in him.

The engineering group of trades forms the most important group of manufacturing industries in the London area: few people realise that nearly three-quarters of a million persons are dependent upon it.

The representatives of this group showed a refreshing belief in continued education; they all

felt that elementary-school education is insufficient, and that education and workshop practice should go hand in hand; they expressed a decided opinion that to be effective any scheme of continued education for the ordinary boy must be compulsory, so as to protect the good employer. In this group of trades the provision for technical education hitherto made has been more complete than in any other, and it is in this group that the country has best held its own against foreign competition.

As regards the curriculum of the technical schools, recommendations were made to widen the scope of the training to include the colloquial teaching of foreign languages and some economics. The question of costs and estimates also needed attention.

It was stated that the ever-increasing demands of the industry called for a larger supply of suitably trained men, and that every chance should be given for the best men to reach the highest institutions, which should be well equipped and well staffed.

The representatives of chemical industries were not so completely in accord with each other. The practical man was inclined to think that works experience, aided by technical classes, was sufficient; the university-trained man believed that nothing short of a full university training was of much use. The industry was said to need three distinct classes of workers: the research assistant, the foreman and technical chemist who supervises the manufacturing operations, and the semi-skilled or unskilled labourer who does the routine work. The first class has found less employment in England than in Germany or America, and this was said to be due to several causes. In Germany research is subsidised and encouraged by the State to an extent quite unknown in England, and the chemical industry is in the hands of large firms, who are willing and can afford to incur expenditure upon research. In England, on one hand, teachers are said to be too little in contact with industry, and, on the other, manufacturers expect too much from the young chemist, and do not realise that until he has had some business experience he cannot be reasonably expected to produce startling improvements.

The printing trade group of employers also are believers in technical education, and they referred to the value of the research work in connection with the photo process industry which has been carried out at the Photo-Engraving School at Bolt Court.

As a result of these conferences two important proposals are made by the sub-committee—(1) to create an Appointments Sub-Committee, which shall do for the secondary and elementary schools what the Appointments Boards are now doing for the universities; and (2) to form consultative committees of experts chosen by the Council for various branches of commerce and industry to advise the Council upon the equipment of institutions and upon the distribution, development, and modification of courses of instruction relating to the industry concerned. Such a committee is already in existence for the printing trades, and committees are to be formed for the engineering and chemical trades. If only the right persons are chosen, and if the Council pays proper attention to their recommendations, this step should prove fruitful of good results.

There is an uneasy feeling abroad that the present Council is not really in earnest in regard to this matter of technical education, and that many of its influential members do not look upon education as a profitable investment which will make large returns, but rather as something which they must perforce appear to attend to in order to keep faddists from troubling. The old Technical Education Board, which had a somewhat independent existence and did a great work for technical and scientific education in London, came to an end when the Council became the Education Authority in 1904. Since then the claims of technical and scientific education have been much in the background; the able officer who advised the Board in such matters was quietly shunted; and there has been a tendency to restrict unduly expenditure on equipment and, under the plea of concentration, to hinder the development of institutions doing good work.

When the Technical Education Board went out of existence plans had been prepared for an institute of technical optics, and these were left in a forward state to be carried out by the new authority, but under one plea or another their execution was repeatedly postponed. What this postponement has meant will only be known in years to come, when the full story of the present world-conflict can be told. Now, under the stress of national need, steps have been taken, but it will yet be some time before they can produce their full effect.

Similar remarks apply to provision that was contemplated for the erection and maintenance of technical institutes to serve North-East and South-East London. Both these much-needed schemes, providing for important industrial areas, have been under discussion for more than ten years, and we believe that plans have actually been prepared for the necessary buildings and equipment, but from one cause or another nothing has as yet been done in either case to carry them out. It is to be hoped that the new consultative committees will not be used as an excuse for further delay.

The root of the whole difficulty lies in the fact that the average member of the Council has little belief in education, and, if anything, less belief in the value of science; and until this attitude of mind is altered no amount of new machinery is likely to bring about improvements of any value.

There are indications that the necessity for encouraging research is likely to be more appreciated in the future than it has been in the past. It is to be hoped that in making important staff appointments, especially appointments to principalships of large technical schools, more attention will be

paid than hitherto to proved ability of this character; that the staffs of technical institutions should be not merely allowed, but expected, to undertake original research; and that they should not be so overburdened with other duties as to leave them little time and energy for such work.

NATIONAL WORTH OF CHEMICAL LABORATORIES.

WE have on several occasions during the past few months directed attention in these columns to the strenuous efforts America is now making to take the fullest advantage of the opportunity afforded by the present condition of things in Europe to improve and enlarge such of her industries as are directly dependent upon chemistry. On all sides we see the evidence of her determination to render herself independent of the hold which Germany, by means fair or foul, has sought to obtain over her, to the detriment of her commercial development. But energetic and far-sighted American manufacturers have even a wider outlook than the supply of their home markets. They are out for wresting from Germany the pre-eminence she has hitherto been able to secure by combinations and financial arrangements of a shady complexion in the markets of the world, and there is no question that the industrial magnates of Germany are now seriously alarmed at the prospect. The recent political crisis in Germany is a sure sign of this fact, and the industrial and military autocracies have still further cemented their union in the effort to meet it. The present struggle will inevitably develop into an economic warfare of the most bitter and relentless character. All this is clearly foreseen by all the more important industrial communities. The very method by which Germany is conducting her share of the war is an indication of what she intends her economic policy to be in the immediate future.

In an address delivered at the dedication of the chemical laboratory of the University of Oklahoma, reproduced in our contemporary, *Science* (July 6), Prof. W. A. Noyes, of the University of Illinois, has admirably defined the relation of the research laboratories of the American universities to the coming struggle. They are the training schools in which the prospective combatants must receive the equipment upon which success alone depends. Economic warfare, in the long run, is a far more complicated business than a military campaign, and its ultimate and permanent triumph rests upon many factors. But, under modern conditions, it fundamentally depends upon the efficient application of scientific principles and upon the aptitude to turn the knowledge gained by scientific research to practical account.

Prof. Noyes illustrates these facts by examples, familiar enough to all who are cognisant of the course of industrial development during the past six or seven decades, but which cannot be too often dwelt upon. They are lessons to be instilled into each succeeding generation, and which they must never be allowed to forget. He begins with the creation of the Giessen laboratory, and traces its influence upon the growth of scientific chemistry all the world over, and its special influence upon the development of applied chemistry in Germany. Incidentally he contrasts the difference in the trend of events in England. We had an enthusiastic and inspiring teacher in Hofmann, actuated by the spirit and example of Liebig, who had unquestionably a powerful stimulating effect here; but much of the good seed fell upon stony ground so far as it permanently affected the character of our chemical industries, and the stimulus of Hofmann died with his recall to Berlin. The manner in which we threw away our opportunity in discarding the new industry which Hofmann and the associates he gathered round him created is one of the saddest stories in our economic history. We are now realising only too bitterly what the loss of that industry has meant, not only to our manufacturing supremacy, but also to the rapid and successful prosecution of the war. The moral of this lesson will, we may hope, not be lost upon the young community to which it is addressed.

Prof. Noyes then rapidly deals with these questions as they affect his own countrymen. He points to the extraordinary development in the means of instruction in chemistry which the United States has witnessed in the course of a generation, to the spread of admirably equipped schools for higher instruction and research, and to the growing recognition on the part of the industrial community of the importance of scientific training in the conduct of manufacturing operations. But the full fruition of such efforts is, as with us, occasionally impeded by unwise legislative action, and Prof. Noyes gives examples of such action on the part of Congress, apparently at the instigation of persons acting in the interests of foreign firms. The practices of these firms are in direct contravention of the principles of the Sherman law, which forbids combinations intended to prevent real competition in the manufacture of staple products. But these combinations are deliberately fostered by the German Government, and branch establishments of powerful German firms settled in America are avowedly working against the spirit of the law in the effort to strangle the rapidly growing development of American chemical industry. There is an amusing story of how a characteristic instance of Teutonic bullying was effectually checked by a manufacturer who was largely concerned in the production of American bromine. The proverbial astuteness of our American cousins is frequently more than a match for the somewhat clumsy blundering of their German competitors. Show a firm front to the bully and he speedily collapses. But America wisely learns what she can from her enemies, assimilating the good and rejecting the bad, in her determination to organise the world on the basis of justice instead of force.

SOME RECENT DANISH MEDICO-HISTORICAL WRITINGS.[1]

DURING the last few years there has been a widespread revival of the study of medical history in many countries, and a considerable number of professorships have been founded to teach a branch of the curriculum which is considered by many to be invaluable from an educational point of view. Some medico-historical societies have also arisen in France, America, and England, and, judging by their literary output, work is going on very actively. The small but highly intellectual country of Denmark is not behind the others, as is seen in the issue, under the direction of Prof. Vilhelm Maar, of the University of Copenhagen, of an important series of small monographs which we have before us. Up to the present fourteen of these have been published and cover a wide field of medical historical research. They are the work mostly of Danes, chiefly of the University of Copenhagen.

Thus Finnur Jónsson (1), professor of Northern philology, gives an interesting account of various diseases in northern Scandinavia and Iceland in ancient times, of particular importance being his statements as to the wide geographical distribution of leprosy, small-pox, pulmonary and mental diseases. There would appear to be no records of syphilis, and, indeed, venereal diseases generally were but little known.

Kristian Carøe (2) has written a short account of the relation of the medieval bedell to medicine, and in particular to the practice of surgery. The exposition of the doctrines on the origin of mental diseases in the classical period has been ably carried out by Dr. J. L. Heiberg (3). Dr. Ernest Wickersheimer (4), the well-known librarian of the Academy of Medicine in Paris, continues the studies on the treatment of hydrophobia by sea-water which he had published some years previously. A very exhaustive account of trephining in primitive times comes from the pen of Dr. Søren Hansen (5), and is well illustrated. Ample justice is done to the fairly extensive literature extant on the subject. Dr. K. K. K. Lundsgaard (6) deals with the well-worn theme of the history of spectacles and eye-glasses, and brings the facts well up to date. In the seventh brochure Dr. J. W. S. Johnsson writes with knowledge and humour on medieval quacks and their advertisements.

Chr. Barfoed (8), in the compass of eighty-eight pages, has managed to dig deeply into the question of the laying on of hands in its religious and therapeutic aspects from ancient to modern times. The practice of the royal touch in England from Edward the Confessor to Queen Anne is dealt with at some length. Charles II. seems to have carried out this royal duty with great assiduity, for, at the rate of 3700 a year, he touched 92,102 sick persons between 1660 and 1682. After George I. the practice fell into disrepute in England. The relationship of "laying on" to Christian Science and its extraordinary modern dissemination is also dealt with.

Carl Jul. Salomonsen (9), the eminent professor of general pathology in Copenhagen, deals in his own characteristic way with the island of Cos and the home of Hippocrates, basing his work on the remarkably successful excavations carried out by Rudolf Herzog in 1902, which have added immensely to our knowledge of this insular home of the medical art.

One of the largest of Prof. Maar's series is a translation of Felix Platter's autobiographical reminiscences of his youth (10 and 11). Platter, as is well known, was one of a medical family of the name who added great lustre to the town of Basel in the Middle Ages. He himself was in practice there for a large part of the sixteenth century, and after his return from Montpellier was one of the first to dissect the human body and to teach the Vesalian anatomy. His autobiography, including as it does his journey to Montpellier and his study there, is an important contribution to the history of the time of the Reformation.

Of less purely medical interest is Axel Garboe's (12) work on unicorns and their relation to existing animals like the narwhal. Dr. Julius Wiberg (13) gives an elaborate account of the doctrines held among the ancients as to the causes, onset, and termination of crises and critical days in diseases—a subject which modern medicine has not yet unravelled in its entirety. The series closes with a small book by the late Prof. Ingerslev (14) on Dr. Ambrose Rode, a German doctor who practised first in Copenhagen and then in Christiania in the seventeenth century.

Prof. Maar is to be congratulated on having gathered together such an interesting amount of original material, and when more peaceful times come again it is to be hoped that he will be able to keep the historical flame burning in that small Scandinavian country to which we are bound by so many ties over so many centuries. W. B.

[1] "Medicinsk-historiske Smaaskrifter." Ved Vilhelm Maar. (København: Vilhelm Trydes Forlag.) (1) Finnur Jónsson: "Lægekunsten i den nordiske Oldtid"; 1912. (2) Kristian Carøe: "Bøddel og Kirurg"; 1912. (3) J. L. Heiberg: "Sindssygdom i den classiske Oldtid"; 1913. (4) Ernest Wickersheimer: "Hundegalskab og Strandbade"; 1913. (5) Søren Hansen: "Primitiv Trepanation"; 1913. (6) K. K. K. Lundsgaard: "Brillernes Historie"; 1913. (7) J. W. S. Johnsson: "Lidt om landefarernes og laegernes Reklame i Ældretid"; 1914. (8) Chr. Barfoed: "Haandspaalaeggelse"; 1914. (9) Carl Jul. Salomonsen: "Asklepios' Helligdom på Kos"; 1914. (10 and 11) "Felix Platters Ungdomserindringer, skildringer fra Basel og Montpellier i Reformationstiden, oversatte og udgivne af Thora Gertz"; 1915. (12) Axel Garboe: "Enhjørningen"; 1915. (13) Jul. Wiberg: "Kriselaeren i oldtidens Medicin": 1916. (14) E. Ingerslev: "Ambrosius Rhodius og hans Hustru": 1916.

NOTES.

ACCORDING to the *Chemist and Druggist*, Prof. E. Buchner, director of the Chemical Institute of Würzburg University, and Nobel Laureate in chemistry for 1907, has been killed in action on the Western front.

SENOR AUGUSTO VILLANUEVA, Banco de Chile, Santiago de Chile, has accepted the position of representative and corresponding member of the Ramsay Memorial Committee for Chile, and is taking steps to promote the objects of the memorial in Chile by the formation of a local committee and in other ways. The Ramsay Memorial Fund now amounts to

21,428*l.* 11*s.* 6*d.* Further donations can be sent to the honorary treasurers, Lord Glenconner and Prof. Collie, at University College, London (Gower Street, W.C.1).

THE Martell scholarship of the Institution of Naval Architects, which is of the annual value of 100*l.* and, subject to the regulations, tenable for three years, has been awarded to Mr. H. C. Carey, of Chatham Dockyard. The Earl of Durham prize of the same institution has been awarded to Mr. H. D. Leggett, of Portsmouth Dockyard.

WE learn from the *Scientific American* that a series of handbooks is to be published by the U.S. Geological Survey giving for the various military divisions of the country, in a compact form, information relating to their physical features, leading industries, transportation lines, and other matters of interest to the Army. The preparation and editing of the volumes have been entrusted to the committee on physiography of the U.S. Geological Survey.

ACCORDING to a report in *L'Echo du Commerce* for August 18, certain tests which were made some time ago with a view to the use of fuel made from olive residues gave such satisfactory results that the Tunisian Government, which has already commenced manufacturing the fuel in the form of briquettes, is about to increase its production. A tramway company and other important firms will use this fuel in their electric power stations.

WE regret to learn that 2nd Lieut. H. L. Foster, of the Royal West Kent Regiment, was killed on June 7. Mr. Foster was the son of the most distinguished horticulturist of his time, the late Mr. Charles Foster, who was for some years the head of the Horticultural Department of University College, Reading. He was educated at the Reading Collegiate School, and underwent the horticultural training at the Royal Horticultural Society School at Wisley. He was appointed assistant horticultural instructor under the Kent Education Committee, 1913, an appointment which he held until September, 1914, when he joined his Majesty's Forces. He obtained a commission in 1916, after having been severely wounded at the battle of Loos. Although still young, Mr. Foster proved himself one of the most promising of the younger horticulturists, and his death is a severe loss to the world of horticulture.

DR. J. R. TOSH, lately assistant professor and lecturer on zoology in St. Andrews University, has fallen (July) in Mesopotamia from "heat-stroke," when gallantly doing his duty. Dr. Tosh was a distinguished student, and after graduating in arts devoted himself, as became one in touch with the Dundee Museum from boyhood, to zoology. He carried out, very early in his career, fisheries' work at the old St. Andrews Marine Laboratory, and further developed a great aptitude for teaching. He then became a science teacher in schools, and carried out various researches, such as the investigation on the salmon of the Tweed, for the Fishery Board, making at the same time a collection of its parasites for a subsequent notice. He also studied the development, life-history, and economic aspects of the pearl shells. Later he was appointed marine zoologist to the Queensland Government, with special reference to the pearling industry, and he did much good work on Thursday Island. When he returned in 1905 he was made assistant professor and lecturer in his *alma mater*, and ably performed for nine years the duties as a popular demonstrator, skilled in all the modern technique and a great favourite with the students. He returned again to Australia to develop the pearling industry on lines of his own, coming home just as the war broke out to form a company on the basis he had outlined, but the absorbing interest in the war arrested progress. He then joined the field forces, and was suddenly cut off as mentioned, to the loss of science and the pearling industry.

MR. DONALD MACLENNAN, whose death was announced in NATURE of August 30, laid the foundation of a very profound knowledge of the shorthorn and other breeds in the Black Isle district of Ross-shire. Failing to make both ends meet in his native land, he emigrated in 1871 to the Argentine. Having made a small fortune as a stockman, he decided in 1881 to return to Scotland, with the view of paying off his debts and thereafter devoting his life to improving the hitherto neglected native Argentine cattle. About 1867 steps were taken to raise the standard of the scrub cattle of Texas, Colorado, and other North American States, with the result that for some twenty years the breeding of improved types of cattle was a great industry in the south-western and western States of the Union. But in course of time cattle ranges practically disappeared in North America. Thanks largely to Maclennan, as cattle ranges disappeared in the United States, improved breeds of cattle made their appearance in the Argentine. But for this the supply of sufficient meat for the Army in France and for home consumption would have been extremely difficult. In July the wholesale price of the best class of Argentine beef was 3½*d.* per lb., *i.e.* 1½*d.* less than in New South Wales. Maclennan thoroughly realised the kind of animals required to improve the descendants of the cattle originally introduced into South America by the Spaniards. He trusted more to make and performance than pedigree, and being extremely conscientious, he was trusted by the Argentine breeders, and so completely gained the respect and admiration of British stockmen and others he had dealings with that at a memorable gathering at Perth in 1914 Lord Lovat, in the name of his many friends, presented him with his portrait.

FEW Augusts of recent years have been so unsummer-like as the month which has just closed, and the weather conditions were almost continuously rainy and cool, whilst the winds have been stormy, amounting at times to the full force of a gale. During the latter half of the month cyclonic disturbances traversed Great Britain almost daily, the wind incessantly backing and veering through south and west. At South Kensington, the observing station of the Meteorological Office, the highest temperatures observed throughout the month were 77° on August 23 and 75° on August 7. On some days towards the close of the month the thermometer at the health resorts failed to touch 60°, even at Hastings, Falmouth, and Bournemouth. The *Times* of August 31 and September 3 gives an account of a dull and wet August. It states that the month had an excessive rainfall over the whole country, the rain measurements being almost as heavy as in 1912, the wettest August on record. In many parts of England and Ireland the aggregate rainfall for the month amounted to more than double, and at some places in the west to nearly three times, the average. At the headquarters of the British Rainfall Organisation in Camden Square the total of 3·99 in. was not so large as in the August of last year, but at Kew Observatory the total of 4·08 in. was larger than in any August since 1912, or, with that exception, since 1881. At Wandsworth Common the total of 4·66 in. was more than double the average, and was larger than anything recorded since 1912, although it was not quite so large as in the August of 1903. The highest temperatures are said to have occurred in Scotland and the north of England, where at the close of the first week the ther-

mometer exceeded 80°, registering 84° at Nairn. At Kew the highest temperature was 75°, and at Hampstead 73°. Temperature is said to have been much more favourable than in August, 1912, when the thermometer failed to rise above 70° at any but a few scattered places in England, and at many places in the northern and western districts it failed to exceed 65°.

Symons's Meteorological Magazine for August contains a short account of the unusually heavy and persistent rain in the south-east of England between July 29 and August 4. In London the rainfall for the six days amounted to 3·78 in. More than 7 in. fell at a number of places: at Canterbury (St. Thomas Hill) the measurement was 10·31 in.; at Maidstone 8·09 in.; at Kingston Rectory 7·51 in.; at Teynham, Kent, 7·32 in.; and at Margate 7·05 in. These amounts are in many cases said to have been quite unprecedented. In the three days, from July 30 to August 1, the rainfall measured 6·18 in. at Maidstone, 5·82 in. at Canterbury, and 5·58 in. at Meopham. A more detailed account is promised in "British Rainfall, 1917." In July the rainfall over the whole of the British Isles was only 69 per cent. of the average; in England and Wales it was 76 per cent. Correlations of the several meteorological elements are being studied with the view of securing long-period forecasts, and the magazine contains a short account of correlations between the temperature at South Orkneys and the rainfall in the Argentine Republic, by N. A. Hessling. With two years' interval between the temperature and the rainfall the correlation is negative, whilst with three and a half years' interval the correlation is positive. It is suggested that the negative correlation may be explained by the annual ice, and the positive correlation by ice which has broken away from the permanent ice-barrier, the greater thickness of this ice explaining the longer interval. Similar reasoning is followed for correlations between temperature at Stykkisholm in Iceland and Jacobshavn in Greenland and the rainfall at Albany, N.Y., with two years' interval; there are also similar correlations for Paris, Greenwich, and Ponta Delgada.

IN the *Times* for August 27 Dr. Andrade continues the discussion on the sound of gunfire introduced by Mr. Sleggs's letter (see NATURE for August 23, p. 513). Referring to the work of Prof. Mach and more recent writers, he remarks that "the sound produced by a high-velocity gun, as heard in front of the piece, is double, consisting of a sharp crack, which is very distressing to the ear, followed at an interval (which for the 60-pounder may be two or three seconds if the listener is in the line of fire) by a dull boom, which is the true sound of the firing of the piece. This boom is a much duller and heavier sound, which shakes buildings, but does not hurt the ear. The sharp crack is not produced by the gun directly, but by the shell during its flight, and then only if the initial velocity of the shell exceeds that of sound, as is the case with all modern guns. . . . The interval between the two sounds is greatest in the line of fire; as one walks to a flank it becomes less and less, until finally only one sound, that of the gun itself, is heard, the same sound that is heard behind the gun. The zone within which the double sound is heard is bounded by lines from the gun, making an angle of somewhere about 45°–65° on either side the line of fire, varying with the initial velocity of the shell and also with the angle of elevation at which it is fired." Dr. Andrade points out that this shell-wave accounts for the fact that for an observer some distance in front of the batteries taking part in a bombardment the noise is much more trying to the ear than for one an equal distance to the rear of the batteries, quite apart from the noise of the enemies' guns. Owing to the shell-wave being directed, and also originated, in the air well above such obstacles as trees and houses, it carries farther than the gun-wave, and is often the only sound heard of the enemies' guns, the true noise of the discharge of the piece being lost if the gun is far back behind the enemies' lines.

IN his paper on "Masks and Acting," published as No. 7 of Occasional Publications of the Classical Association, Dr. F. B. Jevons remarks that while of late years classical scholars, both of Oxford and Cambridge, have paid increasing attention to anthropology as well as to the classics, it is surprising how little discussion has been devoted to the possibility that there may be some connection between the use of masks in the performance of savage mysteries and in the performance of the Greek drama. Outside Europe masks and acting are part of the commemoration of the dead, and also form an element in the worship both of vegetation spirits and of theriomorphic spirits. A presumption is thus raised that similar rites were used in Greece, and that these three types of observances eventually gave rise to tragedy, comedy, and the satyric drama. This is corroborated by the mummers' plays of England and modern Greece, and if the conjecture be accepted, these mummers' plays spring from the same source as did Greek comedy, and, like it, inherit their masks and acting from prehistoric times.

THE Journal of the Gypsy Lore Society now appears (vol. viii., part 3) after unavoidable delay caused by the war. The chief contribution to this number is a paper on "English Gypsy Folk-tales and other Traditional Stories," collected by Mr. T. W. Thompson, who by long intercourse with branches of the tribe has acquired a remarkable familiarity with their manners and customs. Many gipsy folk-tales have already been collected by Campbell, Groome, Sampson, Leland, Hall, and others, and the material seemed to have been fully gathered. Mr. Thompson has now discovered some old gipsies who possess a hitherto unknown stock of traditions, and during six months he recorded no fewer than sixty märchen, drolls, and lying tales hitherto unknown. From the instalment of his collection now published he is perhaps inclined to over-estimate the value of this new material, many of the tales being little more than trivial anecdotes. But there is much of substantial value, such as the fine tragical story of "The Robber and the Housekeeper" and a gipsy version of "Jack and the Beanstalk." Mr. Thompson appeals to students of folk-tales for assistance in collecting parallels to the incidents with a view to the publication of the entire collection at a future time.

IN the *Veterinary Review* for August (vol. i., No. 3) Capt. Frank Chambers, A.V.C., states that evidence has been obtained that animal trypanosomiasis can be and is spread in tsetse-free areas by the agency of biting flies, of which the Tabanidæ are the worst offenders. This number also contains a further series of abstracts of papers, which is such a valuable feature of this journal.

AN address to nurses delivered by Dr. Mercier to the nursing staff of The Retreat at York in 1909 has been issued in booklet form ("The Ideal Nurse," The Mental Culture Enterprise, 329 High Holborn, W.C.1, price 1*s.* 3*d.* net.). While written primarily for the mental nurse, it contains a number of hints and suggestions which would be of value to any nurse, and these are presented to the reader in an attractive form.

THE *Brooklyn Museum Quarterly* for April, which has just reached us, contains a brief but interesting

account of the nesting habits of the Sooty albatross of South Georgia by Mr. R. C. Murphy. During a four months' stay in South Georgia Mr. Murphy found plenty of nests of these birds, though all but three were inaccessible, being placed on the ledges of unscalable cliffs, sometimes as much as 700 ft. up. In one nest which he examined he found a male brooding a downy chick, and succeeded in photographing both. The coloration of the head of the latter is conspicuously different from that of the adult, and recalls that of the Emperor penguin. This particular family was brought back, and is now mounted in the Brooklyn Museum. Judging from the photograph given of this group, it does not excel as an example of the taxidermist's art.

THE forty-eighth annual report of the trustees of the American Museum of Natural History for 1916 has just been issued. Beautifully illustrated and admirably compiled, it is certain to arouse considerable interest among those concerned with the management of museums all the world over. In spite of the war, we are glad to note, the trustees have decided to proceed with their scheme for the addition of a new wing, which is to be called the Court of Ocean Life, and it is to be "the most complete and beautiful museum unit in the world." It is to include a "Hall of Fishes," a great whale gallery, a gallery for the reptiles of the world, and above this a "Hall of Dinosaurs." The building is planned, in short, on the lines of the famous Oceanographic Museum at Monaco. Since, owing to the war, public funds are not available for this great work, the trustees have appealed to the generosity of the public, who, as usual, have responded promptly and liberally. But a sum of 400,000 dollars yet remains to be collected to complete the 1,000,000 dollars which must be raised to complete the work.

A BRIEF but most admirable memoir of the gorilla which died lately in the Dublin Zoological Gardens is given by Prof. G. H. Carpenter in the *Irish Naturalist* for August. This animal, a female, lived in the gardens three years and four months, the longest period through which a gorilla has survived in captivity in the United Kingdom. Though less interesting and friendly than most of the chimpanzees which have lived in Phœnix Park, "Empress" was always docile, but she resented any attempt at nursing or being carried about, even by her keeper. But she showed a great affection for a young male chimpanzee, which was her constant companion. For a brief space, while the chimpanzee was unwell, she displayed great anxiety, and tried to nurse him as though he were a sick child, pillowing his head on her body. During her games with "Charlie" she was in the habit of drumming with her fists on her breast, as a kind of challenge. She not only rarely lost her temper with him, but indeed showed towards him something like subservience, even giving up, without protest, food that he was greedy enough to covet. But she was always less active than her fellow-captive, and could never be induced to leave her cage with him for a ramble, though all kinds of inducements were held out to her to do so. The length of life in captivity attained by the Dublin specimen seems to have been exceeded only by the female which lived in the Zoological Gardens at Breslau nearly seven years. Three most excellent photographs add greatly to the value of this history.

AFTER five months' suspension, we are glad to receive the second number of the *Kew Bulletin* for this year. This number is mainly occupied by a careful revision of the difficult fungus genus Phomopsis, which has long been imperfectly known, and the present account, by Mr. W. B. Grove, which deals with the British species, will be of great value to mycologists, both in this country and in the United States. A second article, on "Tree Labels at Kew," gives a detailed description of the treatment of the descriptive card labels, by celluloid varnish, for the purpose of resisting exposure to weather and also of avoiding the use of glass.

IN his address on the social, educational, and scientific value of botanic gardens, delivered at the dedication of the laboratory building and plant-houses of the Brooklyn Botanic Garden on April 19, 1917, Prof. J. M. Coulter made some interesting remarks on fundamental and practical science, the two phases sometimes referred to as pure and applied science. With reference to the general impression that pure science holds no relation to public welfare, and that applied science serves our needs, Prof. Coulter points out that only by pure science is applied science kept alive and progress made possible. To neglect the former would be like wanting children and eliminating parents, or like some "practical" men who would praise the practical electric light and forget the unpractical, because unseen, power-house. To this power-house may be likened scientific research, which generates the energy we apply in developing what may be called the machinery of our civilisation.

IN a report on the work of the Imperial Institute presented to the new Executive Council, some account is given of the investigations that have been completed into the composition value and commercial prospects of a variety of raw materials derived from some twenty-four countries in the Overseas Empire. In Egypt flax-growing is being extended, and a sample of flax straw has been valued in Belfast at from 200*l*.–220*l*. per ton. In normal times such flax would be worth 60*l*. per ton. In Seychelles, ajowan, *Carum copticum*, and the mosquito plant are being cultivated with success as sources of antiseptic thymol, which used to be imported into this country from Germany. Another matter of interest relates to the important clove industry of Zanzibar and Pemba, whence last year a record crop of cloves was obtained. In recent years the trees have been attacked by a disease which could not be traced to any fungus or insect pest; and it has now been found, as a result of an examination at the Imperial Institute, that the soils in which the affected trees were growing have become acid and deficient in lime and phosphates, through neglect of proper cultivation, and appropriate remedial measures have been suggested for trial.

OF modern contributors to Italian scientific and general literature, probably few have shown so much versatility as Aldo Mieli. A list of Mieli's writings, dealing with the period 1906–16, has now been published (Florence: Libreria della Voce, 1917, pp. 64). Born at Leghorn on December 4, 1879, Mieli graduated at Pisa in chemistry in 1904. He afterwards studied under Ostwald, and assisted in the department of chemistry at the University of Rome, obtaining the rank of *privatdozent* in 1908. He acted as chief editor of the *Rivista scientifico-industriale* of Florence during part of the years 1907–9, and was also editor of the Italian section of the Belgian periodical, *Isis*, suspended at the outbreak of war. In addition, he edited the natural science section of the *Rivista per la storia critica delle scienze mediche e naturali*, as well as a series of "Classics of Science and Philosophy," published at Bari (Società tipografica editrice barese). He also wrote a large number of papers, as well as book reviews, for the leading Italian scientific journals, and a list of these is included in the pamphlet before

us. Among the subjects dealt with are chemistry, physics, history of science, including Roman and Greek history, politics, philosophy, and music.

METEOROLOGISTS and physicists who are interested in the subject of globular lightning will find two papers by Prof. Ignazio Galli, published by the Pontificia Accademia Romana dei Nuovi Lincei in 1916 and during the present year, of great value. The phenomena present themselves under such varied guise that some physicists are inclined to doubt altogether their actual existence, preferring to regard what is seen as the result of an optical illusion produced by the light of the discharge. Prof. Galli, in addition to an historical account of older references to the subject, going back to classical times, has collected from the appropriate scientific literature a large number of modern observations. These are well classified according to the various appearances presented and will form a very convenient source for comparison and reference. The writer of this note may, perhaps, be allowed to put on record an observation of his own. Some years ago, when driving with a friend, he was overtaken by a violent thunderstorm accompanied by torrents of rain. When the storm was at its worst a vivid flash of lightning was immediately followed by a terrific clap of thunder; on looking up against the driving rain each of us saw, on a small hill about half a mile in advance, a luminous globe the angular diameter of which was rather less than that of the moon, and the colour of which was that of the positive glow in a carbon dioxide vacuum tube. This persisted for nearly five seconds and then suddenly disappeared.

MR. LEO WALLERSTEIN is the author of an interesting and comprehensive paper entitled "Enzymes in the Fermentation Industries" in the Journal of the Franklin Institute for May and June. A general outline is given of the wide field over which enzyme activity ranges, from the decomposition of urea by urease to the coagulation of the blood by thrombase on exposure to air. Stress is laid on the conditions characteristic of optimum enzyme activity, viz. the specificity of enzymes, the importance of temperature and reaction of the solutions in which they act, and their colloidal nature. It is pointed out that enzymes, although of importance industrially mainly as decomposing agents, are naturally of equal importance synthetically, as they serve to build up the tissues of the animal body and of plants. Mr. Wallerstein gives a detailed account of the brewing process from the point of view of the enzymes concerned. In the malting of the barley grain the reserve food material of the endosperm is rendered available by the oxydase, amylase, protease, etc., secreted by the embryo. In the mash-tun the starch is degraded to maltose and dextrin by the action of the amylase, whilst the proteases effect changes in the proteins present. Finally, in the fermentation of the sterile wort with yeast the chief enzyme action is the decomposition of the sugar into alcohol and carbon dioxide by means of zymase. It was discovered by the author that beer can be made chill-proof (when kept on ice beer becomes cloudy, owing to separation of protein matter) by addition of a very small proportion of pepsin to the sterilised wort. The power of the yeast cell when provided with sugar, ammonium sulphate, and inorganic salts to synthesise albumen has been employed in Germany, where large quantities of yeast are so prepared and used as a cattle food.

IT is more than seven years since the date of the last disastrous flood which inundated Paris and left a record in height surpassing anything since the year 1658. Although the intervals between the graver visitations of this kind seem to be increasing, yet the Parisians have not failed to recognise the inevitability of their recurrence and the necessity of preparation for them. Shortly after the floods of January, 1910, a commission was appointed for the purpose, under the presidency of the late M. Picard, and a few months later a report was issued containing its recommendations. Some of these have already been carried into effect, but the more important are still under consideration, partly on account of their magnitude and cost, and partly on account of the war. In January last year the French Government brought forward legislative proposals, which included the widening of La Monnaie channel in Paris itself and the deepening of the Seine between Suresnes and Bougival, at a total estimated cost of 67,346,000 francs, or nearly 2,700,000*l*. A deviation of the Marne, by means of a canal from Annet to Epinay, though recommended by the commission, is not regarded at the moment as a feasible proposition. It is calculated that the works proposed to be carried out will effect a lowering in flood height of rather less than half a metre, say 18 in. The period required for their execution is at least seven years. Operations will involve the moving of a section of the Paris-Orleans Railway and the building of a new quay wall opposite the Cathedral of Notre Dame. We are indebted for these particulars to an article in the *Engineer* of July 6.

THE *Times Engineering Supplement* for August 31 contains an account of the Australian Transcontinental Railway, which is now practically completed. This railway runs from west to east, and for the first time puts Western Australia in direct railway communication with the other States in the Commonwealth. It will reduce by two or three days the time required by passengers and mails to travel between Great Britain and the eastern States of Australia. Among other advantages, it will tap the resources of a stretch of country having great productive possibilities, and it also possesses strategic importance. The line runs from Kalgoorlie, in Western Australia, to Port Augusta, in South Australia—a distance of about 1051 miles, and its course is roughly parallel to the coast of the Great Australian Bight, but always well away from it. The highest elevation attained is 1354 ft. The standard gauge of 4 ft. 8½ in. is adopted. The railway is designed for high-speed running, and when the ballasting is complete the journey between Kalgoorlie and Port Augusta should be made in about twenty-four hours.

UNTIL quite recently the semi-Diesel, or hot-bulb, type of oil engine for marine purposes was considered to be suitable for comparatively small powers per cylinder. Recent modifications in design have brought this type into favour for powers up to 130 brake-horse-power per cylinder. The Beardmore engine—described in *Engineering* for August 24—has four cylinders, each 11 in. diameter by 15-in. stroke; working on the two-stroke cycle, it develops 160 brake-horse-power at 280 revs. per min. It is particularly suited to consume fuels ranging from 0·8 to 0·9 specific gravity, but can be adjusted to use either slightly lighter or heavier oils. The low speed of revolution is conducive to high propeller efficiency. The engine is directly reversible by means of compressed air, and requires no disconnecting clutch between the engine and the propeller. For a typical British coaster, 75 ft. long, the 160 brake-horse-power engine weighs 145 cwt.; the weight of the complete installation, including fuel tanks, floor plates, pipes, etc., is 14 tons, and the engine-room bulkheads are 15 ft. apart. One thousand gallons of fuel can be carried, and this quantity gives the vessel an acting radius of 750 nautical miles.

OUR ASTRONOMICAL COLUMN.

SOLAR RADIATION AND TERRESTRIAL METEOROLOGY.—In view of the evidence obtained by Abbot as to short-period changes in the intensity of solar radiation, Mr. H. Helm Clayton, of the Argentine Meteorological Service, has investigated the possible coincidence of these variations with atmospheric changes on the earth (Smithsonian Miscellaneous Collections, vol. lxviii., No. 3). Comparison was first made with temperature observations at Pilar, in Central Argentina, and afterwards, as regards both temperature and pressure, at a number of widely distributed stations. The pressure correlation was found to be the reverse of that of the temperature. In the tropical regions the temperature rises and falls in unison with the changes of solar radiation, but follows the solar changes by about two days; following a rise of temperature, the pressure falls, reaching a minimum between the second and third day after the solar change. On the succeeding day the pressure attains a maximum in the temperate region and the temperature a minimum. Four to five days after the solar changes there is a minimum of pressure in the Arctic Circle near the 60th parallel in both hemispheres, and a maximum of temperature in the oceanic centres of low pressure like that near Iceland. These results are interpreted as indicating a transference of air from the tropics to high latitudes, probably in the upper layers. Analysis of the solar variation suggests a period of about twenty-two days, which was also shown by the fluctuations of temperature at Buenos Aires during the same period. Continued observations of solar radiation are regarded as being of great importance for meteorology.

PROPER MOTION OF THE GREAT ANDROMEDA NEBULA.—Prof. Barnard has recently given an account of his attempts to detect proper motion of the great nebula in Andromeda (*Astronomical Journal*, vol. xxx., No. 20). The nucleus of the nebula is about 2″ to 3″ in diameter, but it is so strongly condensed that under good conditions it can be bisected with almost the same accuracy as the comparison stars. In 1898, in the hope of ultimately detecting motion of the nebula, Prof. Barnard began a series of measurements with respect to three small stars which seemed to have no connection with the nebula. The observations were repeated in 1909, and again in 1915–16, but notwithstanding the lapse of eighteen years, no displacement could be detected. Previous measurements by other observers are somewhat discordant, but appear to show that no considerable motion has occurred during the past eighty years. The individual measures by Prof. Barnard show that the parallax must be beyond the reach of ordinary micrometer work. In the course of these observations the place of the nova of 1885 was carefully examined, but nothing was seen in this position.

THE LUNAR ECLIPSE OF JULY 4.—During the total phase of the eclipse of the moon on July 4–5, 1917, it was remarked by several observers that the brightness of the disc was sensibly greater near the limb than towards the centre. It has been suggested by M. A. Nodon that this appearance may possibly indicate a feeble luminosity of the surface of the moon (*L'Astronomie*, August). An experiment which appears to support this view is described by M. Nodon. A brass ball about 10 cm. in diameter was placed in a dark box, of which only one side was open, and was viewed in a feeble light; the appearance observed was that of a disc brightest at the centre. On the other hand, in the case of a sphere which was uniformly coated with a slightly phosphorescent substance, the luminosity was greater at the edges than at the centre. Phosphorescence of some of the materials composing the lunar surface is accordingly suggested as a possible explanation of the distribution of luminosity observed during the eclipse.

Range-finders

xx Gunnery

THE MODERN RANGE-FINDER.

THE War Office has published a pamphlet on the modern range-finder, written by Prof. Cheshire, and, as is to be expected from an author of such technical knowledge, it is a clear and thorough exposition of a difficult and attractive subject When it is considered that all that a range-finder has to do is to enable the observer to utilise the angle of convergence upon a distant object of the widely spaced eyes of the instrument in order to find the distance of the object the problem of range-finding may appear to be very simple, and so in principle it is. This is not the difficulty. The real difficulty is to make an instrument which shall be portable, handy, and quick in use, and also shall attain the ultimate possible limit of accuracy. That which is not only attainable, but attained every day is something so perfect as to exceed the utmost that an inventor might have dared to hope for. Some form of reflecting device is needed at each end to bring the two sets of optical beams together into a single eyepiece. Any structure that supports the mirrors or prisms is liable to bend under its own weight or on account of differential heating. Simple reflectors at the ends would double any such angular displacement, and the kind of accuracy required would be unattainable. Double-reflection prisms, however, may be tilted without affecting the apparent direction of the object, as may be noticed when using the ordinary camera lucida. However, such oblique reflection would require prisms of inconvenient size; accordingly pentagonal prisms are used, which, however, require to have their reflecting faces silvered, as they are within the critical angle. As these prisms turn the beam through an invariable angle, slight flexure such as is here contemplated does not matter. The prismatic devices near the eyepiece designed to bring the two beams in two parts of the field into view together and into perfect alignment, where the object is at a very great distance, must not only do this, but the line of demarcation between the fields should be sharp throughout its extent. This is essential to accuracy. These fields may both appear erect, or one may appear inverted either laterally or vertically. Where there is convergence of the beams the alignment is disturbed, and the optical means by which it is corrected, as by a sliding prism, are connected up with a scale, so that the distance may be read directly. In the Barr and Stroud range-finder, which is more particularly described and illustrated, this scale is seen by the other eye through a separate eyepiece. It is satisfactory to find that in the essential of sharpness of the line of demarcation the Barr and Stroud instrument is superior to two German forms.

It is quite impossible in the limits of space here available even to indicate the nature of the highly ingenious three-dimension reflecting devices which serve to bring the two converging beams into sharply separated parts of the field, and in the Barr and Stroud instrument at the same time to throw them up at an angle of 60°, so that the observer lying on the ground or in other comfortable position may look down at a convenient angle instead of wearing out his neck by looking horizontally. In one form of instrument made by Zeiss the telescopic magnification of the two beams is different, so that the images seen in juxtaposition are of different

dimensions. In that case there is no necessity to employ sliding prisms and scale, or equivalent, as the part of the field where the coincidence occurs depends upon the distance of the object, and thus a scale of distance at the focus of the eyepiece is all that is needed. Of all methods of using the angle of parallax to find the distance, the most attractive is one proposed by a workman in the Zeiss works, and which, after much difficulty in its elaboration had been overcome, was shown to the present writer by the late Dr. Czapski at the Paris Exhibition of 1900. In this instrument the right and left beams are received by the right and left eyes respectively of the observer, and owing to the distance between the two beams entering the instrument a superstereoscopic view of the object is seen. At the same time each eye sees in the field of view a scale of distance, but the two scales are differently ruled in such manner that the eyes combine them stereoscopically and the scale of distance appears projected away into space. It was fascinating to sweep this scale past more or less distant buildings and see the divisions of the distance scale pass behind or in front of the different objects, or to look up the Eiffel Tower and tickle the members of the framework with the nearer divisions. For the purpose of aircraft range-finding this method, on account of its speed, would appear to have great advantages, and even if it does not equal in accuracy the more deliberate methods of other range-finders, this cannot be of consequence when the range is changing at so high a rate. Some discussion of this type of range-finder by Prof. Cheshire would have been very valuable. The number of the German patent is 82,571, and the date July, 1895. A description is to be found in the second volume of the collected papers of Ernst Abbe, published by Gustav Fischer in the year 1906.

Returning now to the question of the limitation of accuracy, the figures quoted as having been obtained on a Barr and Stroud instrument are important and surprising. The base of the instrument was three yards, but the diameter of the object glasses is not stated. Using an optically prepared artificial object, the accuracy of setting obtained by an experienced and highly skilled observer was such that the mean error was about one-fifth of a second of arc, *i.e.* an angle with a circular measure of one divided by a million. When it is remembered that the defining power of a telescope as measured by the diameter of the star image is about 4·5 seconds of arc divided by the aperture in inches, this is equivalent to saying that the aligning power of this range-finder is equal to the separating power of a perfect telescope of about 22-in. aperture, and that irrespective of the length of its base. Or if, as is likely, the aperture is about 2 in., the aligning power is more than ten times the possible separating power. Similarly, on multiplying by the magnifying power, it appears that the aligning power of the unaided eye is in the neighbourhood of 3 seconds of arc, which is still more surprising when it is remembered that the separating power is certainly insufficient to divide 60 seconds. It would be interesting to ascertain what is the aiming power of a good billiard player when, for instance, the object ball is near the striking ball and far from the pocket, but when, nevertheless, with this coefficient against him, he can time after time drive the ball clean into the pocket. That, whatever it is, must be very great, but it must be exceeded by the aligning power of the eye in the comfortable use of a good range-finder. Figures such as are here given must be realised before the skill and marvellous attainment of the designer and constructor of the modern range-finder can be appreciated. There is much more in this pamphlet that it would be interesting to follow if space were available.

C. V. BOYS.

THE RELATIONS OF MATHEMATICS TO THE NATURAL SCIENCES.

BY a happy coincidence, the addresses of the retiring presidents of two leading mathematical societies, delivered almost simultaneously, follow similar lines, although from somewhat different angles of view, and are of unusual interest for the man of science whose surmises regarding natural phenomena receive their ultimate justification from mathematical reasoning. Such a man has had cause more and more in recent years to deplore the divorce between the more striking mathematical developments of the present time and those which are urgently necessary as an inspiration to progress in his own work. For, as the two presidents point out, the insistent call for help to the pure mathematician has now begun, though perhaps reluctantly, to take shape even from the biological sciences.

Prof. E. W. Brown, in his address to the twenty-third annual meeting of the American Mathematical Society, selected the subject the title of which we have borrowed, and indicated somewhat precisely the types of work really needed from the pure mathematician in this regard, and their capacity for furnishing a fruitful field of research of great interest to any willing investigator. Sir Joseph Larmor, in his address to the London Mathematical Society in November, 1916, limited his detailed remarks more especially to the scope and limitations of the harmonic analysis associated with the name of Fourier. The problems connected with periodic phenomena were evidently predominant also in the mind of Prof. Brown during the preparation of his address, and the necessity for a Fourier type of treatment of such problems renders the two addresses complementary in the regions in which they are not closely parallel.

We may turn, in the first place, to the more general point of view present in both addresses, and outlined in greater detail in Prof. Brown's. Pure mathematics is a science or an art which is self-contained, and requires for its development no external inspiration. Applied mathematics is an aid towards the development of the natural sciences, and in fact of all investigations which depend on deduction from exact statements. Such statements are, of course, founded not on axioms, but on physical laws which sum up the results of series of experiments, and these laws no longer, as in the past, serve to suggest suitable axioms and profitable lines of development of pure mathematics as an art. So large a body of doctrine, in fact, has pure mathematics become that isolation is marked among its many branches, and one mind can no longer be fully conversant with each of them. The task of our presidents, in attempting a fusion between pure and applied mathematics, becomes more and more difficult.

Prof. Brown points out one fundamental difficulty in the lack of standardisation of mathematical symbols. In spite of the fixed character of the underlying principles, such a symbol as (1) may still denote a number, operator, group, function, axiom, or convention, and any of these may have special limitations for the purpose in view. He suggests that the task of a reader of several members should be facilitated by extending the principle now used in the case of the special type adopted to represent vectors. Such a prearranged system would have special advantages in the subsequent compilation of any future mathematical encyclopædia. Prof. Brown pleads also for an extension of the growing practice, even at the cost of artistic appearance, of printing a summary at the end of each published paper.

These and other purely mechanical aids to the

student of science are, of course, only side-issues, and do not touch the main problem of evoking, on the part of the pure mathematician, an interest in the applications. The pure mathematician has not the leisure necessary for familiarity with the history and essentials of a proposed problem, but he could assist by turning the thoughts of his better students into such a direction. When he does become interested in an application, he usually studies only the mathematical methods tried more crudely by others. His interest, in fact, lies more in the logic of the matter than in any co-ordination of new phenomena which may be obtained. Yet at the same time he must not be blamed, for the physicist and engineer rarely present their problems in such a form that the mathematician can even begin to seek a solution. He does not know what approximations he may make and yet retain a solution of value. The proper function of a treatise on applied mathematics is to give strict formulations of problems and an account also of the principles which underlie good physical approximations. The applied mathematician who can fulfil this function, and intervene between the mathematician and the experimenter, is now lamentably rare. The temptation to go to one of the extremes is too strong under the present system, though Prof. Brown suggests various ways in which such men could be encouraged to steer the middle course.

The fundamental subjects which, from the present point of view, demand systematic examination, and, more especially, simple exposition from the mathematician, are: the numerical solution of classes of differential equations, symbolic forms adapted for rapid numerical calculation, reduction of a series of numbers to the best formula, and Fourier and other representations of periodic phenomena. Under this last heading a considerable contribution is made by Sir Joseph Larmor's address, which cannot in this respect be noticed at all adequately in our present space. But it is readily accessible, and this fact somewhat precludes the necessity. In so far as it is general the views expressed are essentially similar to those outlined above, and it includes, moreover, an instructive account of the history and present state of the society, with suggestions towards its future adaptation to changing conditions.

In his critical analysis of the Fourier harmonic method Sir Joseph sketches the history of its development, and afterwards points to an insistent question: What is to be done with the accumulated observational data such as are being piled up by meteorologists and statisticians, and to what extent should they be continued? Such questions are of the essence of pure mathematics and not strictly of its technical application. It is a curious fact that progress in such directions was practically stopped by difficulties in running the Kelvin integrating machine. Sir Joseph Larmor makes a powerful appeal to the pure mathematician to revive his former interest in such problems, and cites the work of Schuster as a striking illustration of the success which could be obtained by an organised attack. We may cite, as another illustration, Sir Joseph's own discussion of some of the problems of radiation, which forms the remainder of his address, for it presents many sides of the question which have been only too imperfectly considered by those who work with any aspect of the Fourier analysis.

We can only repeat that it is a fortunate event, and perhaps a sign of the times, that the presidents of the two leading mathematical societies in the English-speaking world should have chosen the same ground so closely, and independently expressed concordant opinions even in points of detail. This fact must surely stimulate workers to an interest in these questions, the elucidation of which, even if only partial, would be a fundamental gain to the whole range of work in the province of natural science.

J. W. NICHOLSON.

PRECISE LEVELLING IN THE WEST OF ENGLAND.[1]

THIS recently published Professional Paper of the Ordnance Survey gives an interesting account of the revision of a line of precise levelling which had been carried out under the direction of a committee of the British Association in the years 1837 and 1838. The line was run from Axmouth, on the coast of the English Channel, to three points on the southern coast of the Bristol Channel, and the terminal points were marked with metal bolts "to afford a basis for a comparison with the position of the lines then determined, at present, and at any future period." When the revision of the primary levelling network of Great Britain was undertaken the revision of this particular line was included in order to see whether there was any indication of earth movement, and in the course of the last three years it has been found practicable to carry out this work by the reserve levelling staff which has to be maintained at Southampton. The earlier levelling was carried out by Mr. T. G. Bunt, and full details are given by Dr. W. Whewell and him in the report of the British Association for 1838.

He used a level by Simms which had a telescope 14 in. in length and a magnification of 26. The bubble is said to have been affected by a movement of 1/100,000 in. of either end. The staff used was at first of brass, but this being found unsatisfactory, it was replaced by one of seasoned oak 9 ft. long and having scales on both sides. Nothing is stated about the verification of the staff divisions. The staff was read with the aid of a vane or target, of which the position was read by a vernier to 1/500 ft., and it is stated that the average error of a single reading was 1/250 in. Lines were levelled in both directions from beginning to end, then from end to beginning, and the discrepancies found are recorded. Mr. Bunt mentions a systematic error which he experienced, viz. that "the heights of all points came out less by the levels returning than by the levels going," and from Portishead to Axmouth, a distance of seventy-four miles, the discrepancy between forward and backward levelling was 1·029 ft. The old levelling books are not now to be found, so that the comparison with modern work could only be made over the distances between Axmouth, Axmouth Church, Stolford, and Perry Farm, where the old marks are still existing.

The discrepancy between the older and the new levelling from Axmouth to Perry Farm, a distance of fifty-seven miles, is but 0·92 in., though at Stolford, fifty-five miles, it reached 2·11 in. The amount of the accidental and systematic errors of Bunt's levelling computed by the formulæ adopted by the International Geodetic Commission is 1·0 mm. and 0·9 mm. per kilometre respectively, against the limits of 1 mm. and 0·2 mm. per kilometre, as laid down by international agreement for precise levelling.

The conclusion arrived at is that there is no evidence of any change in the relative levels of the marks near the shores of the English Channel and the Bristol Channel.

The Ordnance Survey levelling was executed with a Zeiss No. 3 pattern 14-in. level with a parallel plate object-glass micrometer, and invar levelling staves. The operation is one of much interest as affording a comparison between the best class of levelling work in this country at the two periods. H. G. L.

[1] Report on the Re-levelling in 1915–17 of a Line from the English Channel to the Bristol Channel. Ordnance Survey Professional Papers. New Series, No. 4, 1917. Price 6d.

SCIENTIFIC AND INDUSTRIAL RESEARCH.

THE second annual report of the Committee of the Privy Council for Scientific and Industrial Research for the year 1916–17 was published last week (Cd. 8718; price 3*d.* net). It consists of an introductory statement by Lord Curzon, as Lord President of the Privy Council, the report of the Advisory Council, signed by Sir William McCormick and Sir Frank Heath, and appendices giving Orders in Council, terms of the Imperial Trust, documents relating to research associations, and names of members of committees attached to the Department of Scientific and Industrial Research. Lord Curzon points out in his introduction that the foundation of the department led to the creation of the Imperial Trust for the encouragement of scientific and industrial research.

The trust holds on behalf of the department the sum of one million sterling which Parliament has voted for the purposes of the department. The negotiations of the Advisory Council with the leading manufacturers in the various industries showed that it would not be possible to develop systematic research on a large scale unless the Government were in the position to assist financially over an agreed period of years. These considerations led the Government to place a fund at the disposal of the Privy Council Committee to be spent over a period of five or six years afforded the best means of dealing with the problem. During the past year negotiations have been concluded with the Royal Society for the transfer of the property of the National Physical Laboratory, together with the responsibility for its maintenance and development, to the Department of Scientific and Industrial Research. The scientific management of the laboratory will remain in the hands of the Executive Committee under the chairmanship of Lord Rayleigh, a member of the Advisory Council.

The committee reported last year that grants had been approved to a number of individual students and research workers for the year 1916–17 to an amount not exceeding 6000*l.* The amount actually expended under this head, however, was not more than 3550*l.* upon thirty-six workers. Throughout the work has suffered in amount owing to the war, and the committee was unable to expend more than 14,524*l.* out of the 40,000*l.* placed at its disposal by Parliament for the financial year 1916–17. During the current year a sum of 38,050*l.* was taken in the estimates, in addition to the fund of a million referred to already. The annual vote is intended to cover (*a*) the cost of those researches which will not be undertaken by the proposed research associations; (*b*) the grants to individual research workers, both students and others; and (*c*) the cost of administration.

The second annual report of the Advisory Council records the considerable progress made during the past year, and some of the matters referred to in it are summarised below.

In our report of last year, covering the period from July 28, 1915, to July 31, 1916, we attempted to describe the nature of the problems by which we were faced, and the conditions which appeared to us necessary for their solution. We discussed the vital need of research at the universities, especially in pure science, and the urgency of prompt measures for increasing the number of their students. We referred to the beginnings of association among manufacturers, and expressed our belief in co-operation between capital, management, science, and labour, as the best means of financing and directing the extended laboratory investigations and the large-scale experimentation required for industrial research. Above all, we emphasised the necessity for patient effort, cautious preparation, and co-ordinated attack upon the problem from all sides.

The experience of another year of work has confirmed our first estimate of the position. We have made progress. The establishment in December last of a separate Department of State entrusted with the organisation of scientific and industrial research has brought encouragement to our efforts and the necessary financial support.

We have addressed ourselves during this year in the main to the organisation of industrial research, first, because we felt the paramount importance of arousing and securing the interest of manufacturers in the application of science to industry, and, secondly, because the influence of the war has created in industry an atmosphere conducive to the growth of new ideas, whereas it has unfortunately made the prosecution of work in pure science and in its organisation a matter of extreme difficulty.

THE MILLION FUND FOR TRADE RESEARCH ASSOCIATIONS.

The one question of policy, to which throughout the year we have continuously devoted our attention, is the working out, with all the care and advice we have been able to command, of the policy of co-operative industrial research foreshadowed in our last report. Lord Crewe, who was at that time Lord President of the Privy Council, received a deputation of the Board of Scientific Societies on December 1 last, at which he outlined the policy of the Government in regard to industrial research. He announced their intention to ask Parliament to place a large fund—a million sterling—at the disposal of the department to enable it to co-operate with the industries of the country in the foundation and maintenance of approved associations for research during the next five years or so. After these initial years it is expected that the larger industries, at any rate, will be able and willing to carry on the work of the associations without assistance. The intention of the Government is to make a contribution to the assured income of such associations from the subscriptions of their members, varying in amount according to circumstances, and with a normal maximum of pound for pound, though in very exceptional cases this limit may be exceeded. Lord Crewe also announced that the Board of Inland Revenue would be prepared to instruct surveyors of taxes to allow as a working expense for income-tax purposes the contributions by traders to industrial associations formed for the purpose of scientific research for the benefit of the various trades. The allowance would be subject to certain conditions; that is to say, the association must be under Government supervision and the trader's contribution must be "an out and out payment, made from his trade profits and giving him no proprietary interest in the property of the association." Since this decision includes war profits and excess profits taxes, it offers a considerable inducement to firms affected by these taxes to act promptly.

RESEARCH ASSOCIATION FOR COTTON.

Substantial progress has already been made towards the establishment of a National Research Association by the great staple industry of cotton.

In view of the establishment of the Cotton Committee we have postponed the consideration of several applications for aid to researches bearing on the cotton industry, some of considerable importance and interest. But in one case we have taken immediate action of an interim kind, because there was a risk that useful research work actually in progress might be interrupted. With the approval of the Secretary of State for the Colonies, we have asked the Government of

the Island of St. Vincent to second one of their officers, who has been making an investigation into sea island cotton, for work under Sir Francis Watts, the Imperial Commissioner for Agriculture in the West Indies. We have offered the Commissioner a grant of money to meet the cost of labour and necessary apparatus, and we have offered to pay the research worker an adequate salary on a rising scale. We hope that this arrangement may enable the new Research Association to take over the investigation in due course. Incidentally we shall have put a research which was in danger of coming to an end upon a more satisfactory basis.

Associations in Prospect.

We are glad to report that the woollen and worsted manufacturers of Great Britain have already appointed a Provisional Committee to draft the constitution of a Research Association. The Irish flax spinners and weavers have decided to take the same step; the textile industries are therefore well to the fore. The Scottish shale oil industry and the photographic manufacturers have decided to establish associations immediately, the electrical engineering firms and the British Society of Aircraft Constructors, in conjunction with the Aeronautical Society, have the matter under consideration, the Scottish shipbuilding and steel industries are moving, and we have hopes that it may be possible to establish an association for research into the non-ferrous alloys in the near future. We understand that the British iron puddlers and the Diesel engine manufacturers have independently established research organisations for the benefit of their respective industries. The coal-mining industry is interested, but it will necessarily take time to organise this huge industry on a national basis. Several other industries, among them the pianoforte manufacturers, the master printers, and the cocoa industry, have approached us. But there is a number of industries which for one reason or another are not so circumstanced that their firms are able to combine in this manner. In some cases the leading firms realise to the full the value of science and of a combined attack, but they cannot as yet carry the industry with them. This is the position, for instance, of the papermakers, who are urging us to establish a State laboratory to the initial and maintenance cost of which they are anxious to contribute.

Other Cases.

In other cases the industry may be prosperous and the leading firms possessed of what they believe to be valuable and exclusive information, which they fear might be endangered by co-operative research. We have remarked that those industries which call for the most complex organisation and are most in need of scientific guidance, if they are to meet modern conditions successfully, are for the most part those in which the smallest progress has been made towards research on a co-operative basis. We refer to that large group of what may be called the chemical industries. At one end of this group we find a growing movement towards financial combination, *e.g.* among the highly developed heavy chemical and allied industries. Financial combines or fusions of scientific industries on the scale we are witnessing will certainly render co-operation for research alone less attractive, if not unnecessary. At the other end of the scale are industries, like those of pottery and glass, which have been driven by adversity to seek the aid of science, and have only been able to meet the cost by operating together. Between the two extremes is a large number of industries, some of them wealthy, which appear to be uncertain in which direction to move, and would probably prefer to move in neither.

Researches Unsuited for Co-operative Action.

There will remain, however, important fields for industrial research which we can never hope to cover by means of research associations. Research into fuel is one of these. Every home in the land, as well as almost every industry, is directly concerned in the economy of fuel, and for that reason it is simpler and more just that all should contribute through the taxes to the cost of the research. The Committee of Council have accordingly established the Fuel Research Board as a part of the department. Similarly, we think the argument for a national board of research in timber will prove overwhelming; in both cases, however, we may hope to receive assistance, if not contributions, from some of the industries more immediately interested. The researches we are conducting through the British Fire Prevention Committee and the Concrete Institute respectively into the fire-resisting properties and into the general physical properties of different kinds of concrete, are also cases which call for national action. We have been assured that the same considerations hold good for the scientific problems underlying illuminating engineering and cold storage.

The National Physical Laboratory.

There is still another class of scientific problems of great importance to industry, not susceptible of treatment by associations for research. We refer to the determination of constants and standards, whether physical, chemical, or bacteriological, and the accurate testing of manufactured products in the interest both of manufacturer and consumer. The range and importance of this work and of the research which it entails are certain to grow rapidly in the future. The experience of other countries goes to show that it is work which the State must itself undertake, or at least control, if it is to be adequately served. We welcome accordingly the arrangement recently made by the Committee of Council with the Royal Society under which the department will become financially responsible for the maintenance of the National Physical Laboratory.

Three Methods of Financing Research.

It will be noticed, from what we have said above, that there seems to be room in the industrial world for three methods of financing research. There is research which the individual firm finds it remunerative to undertake at its own expense. Secondly, there is research which is financed on a co-operative basis, and lastly, there is research which must be financed by the State if it is to be done at all.

Is any distinction in kind to be drawn between these three classes of research which would justify this difference of treatment? If there is, and if it can be clearly stated, it should greatly assist the sound administration of public funds and be a useful guide to our own policy. We suggest that the distinction is to be sought in the probable nature of the results to be obtained from an investigation. If the research is one which a single firm can finance and which, if successful, will yield results that a single firm can exploit to the full, there is no case in normal circumstances either for co-operation with other firms or for assistance from the State. The more powerful the firm and the greater the variety of its activities the more far-reaching will be the nature of the research it will be justified in undertaking. But as we pointed out in our last report, British manufacturing firms are not as a rule at the same time both large and complex. In the great cotton industry, where some of the firms have capital funds to be reckoned in millions, the organisation is "horizontal," not "vertical," and manufacturing success has been obtained by specialisation in a narrow range of processes. Far-

reaching scientific investigations which are likely to affect several sections of the industry are accordingly more suitable for co-operative than for single-handed attack. There will still be ample room for private research by individual firms on the lines of their own special work. Indeed, they may be expected to gather many suggestions for this from the results of the co-operative investigations.

On the other hand, the German chemical industry with its powerful firms engaged in handling the primary raw materials through all their intermediate stages up to the manifold but closely related final products, explosives, dyes, essences, drugs, antiseptics, would not be suited for co-operative research, though it may be prepared to go far in the direction of financial fusion—a mere continuation of the previous line of development.

If, as in this country, conditions are in many respects specially favourable to co-operation in the conduct of research, the State is, we think, justified in encouraging development along these lines by means of monetary and other assistance. We find the justification for our proposals for research associations in these considerations. But when the firms have done all that it will pay them to do in the way of both private and co-operative research, there still remain lines of investigation which will either be sufficiently fundamental to affect a range of interests wider than any single trade, however large, or else they will clearly have a direct bearing on the health, the well-being, or the safety of the whole population. The two types are not mutually exclusive, but research of either kind falls, we think, into the third class, and must be undertaken by the State itself.

Glass, Optical and Other.

We indicated last year, and the public have learnt to recognise the fact from constant reference to it, that the study of glass in many of its forms is one of serious importance for the national safety. For a short period there was grave anxiety, now happily removed, but we have not relaxed our efforts to deal with this many-sided industry in as comprehensive a manner as possible. The important research at the National Physical Laboratory, carried on at the cost of the department since 1915, has dealt with the fundamental problems of optical glass manufacture. Attention during the past year has been concentrated on the question of refractories. The superintendent of the metallurgical department reports that "important and encouraging results were obtained, both with pots made of the same material throughout and with others in which a more expensive and highly refractory material was employed as a lining only. Further progress was also made with investigations into methods of stirring and of melting which shall protect the glass from furnace gases and other sources of contamination in such a way as to leave the molten material freely accessible to stirring and other manipulation. The development of the electric furnace, particularly for the purpose of burning refractories at very high temperatures, proceeded satisfactorily. A new type of resistance furnace was evolved. Heat is generated by contact resistance between specially shaped graphite parts, and an endeavour is being made to substitute pressed carbon similar to that used in arc-lamp electrodes, as the latter can be obtained in this country."[1] While the National Physical Laboratory has been dealing with the fundamental problems of manufacture, Prof. Jackson has been investigating the composition of certain optical glasses for the department with the assistance of the Glass Research Committee of the Institute of Chemistry. He has succeeded in defining the composition of the bath mixtures necessary for the production of several glasses hitherto manufactured exclusively in Jena, including the famous fluor-crown glass. He has also discovered three completely new glasses with properties hitherto unobtainable. His work upon laboratory and other glasses during the past year has been chiefly devoted to assisting the manufacturers to perfect their processes and to remove difficulties which have arisen in the factories. Prof. Jackson's intimate acquaintance with manufacturing conditions has been of the greatest value for this purpose, and has, we are glad to learn, completely won the confidence of the makers. The dangerous position which existed when this council was first established having now been removed, thanks to the energy and initiative of the Institute of Chemistry, their Research Committee is now free to give its attention to other less urgent but not less important problems.

An investigation into abrasives and polishing powders, primarily in relation to their use in the grinding and polishing of glass, is about to be started under the direction of a committee of the department, and the Standing Committee on Glass and Optical Instruments has conducted, or is conducting, a number of inquiries with the view of ascertaining whether further research is required on the following subjects:—The annealing of glass; anti-glare glasses; the testing of, and the formulation of standards for, laboratory glassware; the permissible variations in the optical properties of glasses used by optical instrument-makers; improvements in refractometry; the silvering of glass surfaces; the standardisation of parts of optical instruments; the supplies of fluorite and of Iceland spar; and the plastic properties of materials. In some of these inquiries the department has already been able to give some assistance to the Optical and Glassware Department of the Ministry of Munitions and to the industries concerned.

The Research Institute for Glass at the University of Sheffield, in contemplation when we reported last year,[2] has now been established with the assistance of grants from this department and from two associations of glass manufacturers. The buildings have been erected and equipped on a larger scale than we then anticipated under an arrangement made by the Ministry of Munitions in consultation with the Committee of Council. Progress has already been made with several systematic investigations on glass problems and the results of one of them, concerned with the influence of small amounts of chlorides and sulphates in producing opalescence in glass, have appeared in the Journal of the Society of Glass Technology. The work to be undertaken will not duplicate the other researches into glass carried on elsewhere. On the other hand, it will be kept in close touch with them. This co-ordination has been greatly facilitated by the establishment of the Society of Glass Technologists, founded by a few of the active and enthusiastic workers at the technology of glass in and near Sheffield. It now includes all the progressive manufacturers as well as the men of science interested in the subject.

New Institute of Technical Optics.

Closely related to problems of glass are those of optics and optical instruments. For that reason we established a single Standing Committee to deal with both subjects. But here, as in every direction, we have found that no sound progress in research is possible without strengthening the bases of our national education. We therefore welcomed the untiring perseverance of the London County Council, which has during

[1] Report of National Physical Laboratory, 1916–17 p 63."

[2] Report of the Committee of the Privy Council for Scientific and Industrial Research, 1915–16, p. 34. [Cd. 8336.]

many years pressed for the establishment of a National Institute of Technical Optics. In the spring of 1916 the Higher Education Sub-Committee of the London County Council put a scheme before the Board of Education, which included the establishment of a new department for post-graduate education and research at the Imperial College, the strengthening of the existing department of technical optics at the Northampton Polytechnic Institute, and the appointment of a single director with a specially constituted committee to supervise the work, both at South Kensington and Clerkenwell. The London County Council offered to defray one-quarter of the capital and maintenance charges of the new department at the Imperial College, and has accordingly contributed 1000*l.* a year for maintenance, with a special capital sum of 2500*l.* for alterations and equipment. The scheme appeared to us to be promising, and after conference with the Board of Education, the London County Council, and the Imperial College, we recommended your lordships to make a grant of 750*l.* for special apparatus and an annual maintenance grant of 1000*l.* a year for five years provided the scheme agreed upon at the joint conference was put in force. The governors of the Imperial College offered the necessary accommodation for the proposed department, and later voted a sum of 2000*l.* for equipment. After further negotiation with the governors of the Northampton Polytechnic Institute and with the Board of Scientific Societies, which had interested itself in the project, the scheme was adopted by all the bodies immediately concerned.

NEW SERIES OF OPTICAL TEXT-BOOKS.

With a due regard to the needs of the industry and of research students in technical optics, our Glass and Optical Instruments Committee have directed our attention to the deficiency of books in the English language on geometrical and technical optics. They recommend that a series of foreign works on these subjects should be translated and published, with corrections and additions, a proposal strongly supported by the Ministry of Munitions. We have endorsed this recommendation, and the Committee of Council have accordingly authorised the issue by the department of revised versions in English of the following standard works at cost price:—

Von Rohr: "Die Theorie der optischen Instrumente," vol. i., "Die Bilderzeugung in optischen Instrumenten."

Gleichen: "Die Theorie der modernen optischen Instrumente."

Ferraris (Tr. by Lippich): "Die Fundamental-Eigenschaften der dioptrischen Instrumente."

At the close of our report last year we remarked that "if it is supposed that modern industry can be developed or even maintained by a process of detailed investigations, a series of particular inquiries, however careful, the time, trouble, and expense will be largely wasted." We are not likely, therefore, to suppose that the considerable number of inquiries we have initiated or aided and have referred to in this part of our report are any adequate measure of the progress made in dealing with the difficult situation with which British industry is faced. Whatever has been accomplished would be better understood by comparing the general attitude of manufacturers to-day with their attitude before the war, or even eighteen months ago; by noticing the rapidity with which men of science at long last are coming to their own; by listening to the altered tone of all classes, and not least the men of business, towards the claims of education. May we add that if our labours are helping to prepare one of the roads for the coming advance, it will be due in the main to our conviction that roads can only be built in country that has been adequately surveyed?

BOOKS RECEIVED.

Chile. Pp. 301. (Santiago: Chilian Government.)

Hygrometric Tables for Use with Rotating Dry and Wet Bulb Thermometers. By Dr. W. Doberck. Pp. 17. (London: Williams and Norgate.) 2*s.* 6*d.* net.

Introduction to the Calculus of Variations. By Prof. W. E. Byerly. Pp. 48. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press.) 3*s.* 6*d.* net.

Health in Camp. By Dr. A. T. Nankivell. Pp. ix+84. (London: Constable and Co., Ltd.) 1*s.* net.

Papers from the Geological Department, Glasgow University. Vol. iii., 1916. (Glasgow: J. Maclehose and Sons.)

Introduction to the Physiology and Psychology of Sex. By Dr. S. Herbert. Pp. xii+136. (London: A. and C. Black, Ltd.) 3*s.* 6*d.* net.

Technical Handbook of Oils, Fats, and Waxes. By P. J. Fryer and F. E. Weston. Vol. i., Chemical and General. Pp. x+279+plates xxxvi. (Cambridge: At the University Press.) 9*s.* net.

Bedfordshire. By C. G. Chambers. Pp. x+195. (Cambridge: At the University Press.) 1*s.* 6*d.* net.

The Theory of the Submarine Telegraph and Telephone Cable. By Dr. H. W. Malcolm. Pp. xi+565. (London: *Electrician* Printing and Publishing Co., Ltd.) 18*s.* net.

The Jewish Child: Its History, Folklore, Biology, and Sociology. By W. M. Feldman. Pp. xxvi+451+plates ii. (London: Baillière and Co.) 10*s.* 6*d.* net.

Zur Auffassung der Verwandtschafts-Verhältnisse der Tiere. By J. E. V. Boas. Pp. 61. (Kopenhagen: A. Bays.) 3 kroner.

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