in French. There is, however, nothing to be said in favour of publishing lists of new species with no description or reference to such, as is done, for example, in the case of a number of Spruce's specimens from tropical South America. The fascicles are separately paged, and an index to each would facilitate reference.

SCIENTIFIC RESEARCH AND NATIONAL PROSPERITY.[1]

MANY, no doubt, do not comprehend what functions the research chemist can exercise in South Africa, and what scope the country can offer for his labours. Following the United States principle of the best men in the best posts, where, they ask, can we place him so that the country may, through his instrumentality, reap the greatest advantage? To answer such questions one needs, first of all, to consider how scientific research—and therefore, inferentially, chemical research—may be distributed. As a matter of convenience a threefold grouping is adopted—university research, industrial research, and national research. Adopting the definitions given by Mr. C. E. Skinner a few months ago at a meeting of the American Institute of Electrical Engineers, we may say that university research includes the pure scientific research, which naturally finds its home in the university, and all other research done there for the purpose of training men. Industrial research comprises all that done by or for industrial concerns with the purpose of advancing industry. National research is that carried on by the Government for the purpose of benefiting the people as a whole. Now it is plain that between these three types of research there can be no sharp lines of demarcation, but university research is often the stepping-stone to industrial advancement, while national research is repeatedly industrial in its objects.

Mr. Skinner rightly holds that the primary function of the university in research should be the training of research men, and that universities should be equipped to turn out research men just as they are now equipped to turn out men with academic and engineering degrees. Prof. G. G. Henderson has laid down the principle that the training of the chemist, so far as that training can be given in a teaching institution, must be regarded as incomplete unless it includes some research work.[2]

The demand for research in almost every field is growing with a rapidity wholly unprecedented, and to the universities alone can we look for men able and ready to take their places in the strenuous effort that is bound to be put forth on every side. We have just inaugurated a triple university system: Prof. Crawford, in his presidential address to this association at Maritzburg, asked, and sought to answer, what South Africa expects from its universities, and referred, in particular, to the need of encouraging the study of science and of furthering research. In developing this theme he asked us to remember that the highest form of research is not made to order, and that there is more in genius than industry and opportunity. It would benefit us to bear this in mind and, in juxtaposition with Prof. Crawford's words, to place a sentence from Mr. Skinner's address:—

"If it takes a genius to recognise a genius yet undeveloped, and properly to stimulate and direct that genius, how necessary it is that we place men of genius at the head of the research departments of our universities!"

It comes to this, then, that we should see to it that our universities are well equipped with scientific research workers, and it is pre-eminently desirable that a system of research professorships should be instituted, the chairs to be occupied by men of enthusiasm, men who will inspire a like zeal and devotion amongst those of the younger generation whom they gather around them, men of personality and character, who will kindle in the breasts of the research students feelings of admiration and respect for them and their work.

"In training research men," says Mr. Skinner again, "the university will naturally become the custodian and the promoter of pure scientific research." Here is the fountain-head whence we shall ultimately draw our men for industrial research and for national research; how important is it, then, that the source of all our supplies should be of crystal purity! Whatever more utilitarian form of research one may afterwards take up, research in pure science is invaluable in the earlier part of the research student's career, for it will give him a zest and a stimulus that will remain with him throughout, enrich his scientific imagination, and adorn all his later work.

At the same time, university research may lead to the most utilitarian results; some of the most important dyes, artificial alizarin, the phthaleins, indigo, and such drugs as phenacetin, antipyrin, and aspirin, were all discovered in university chemical laboratories.

Now why have we so few persons doing research work in South Africa? Is it in part because no research geniuses are born, or is it that we fail to recognise them, and neglect to provide them with the essential facilities?—youths, maybe, on whose humble birth fair Science frowned not, flowers born to blush unseen and waste their sweetness on the desert air, mute, inglorious Miltons whose genius remained latent because we took no trouble to draw it out?

Dr. P. G. Nutting about a year ago said that some writers have spoken of the investigator as a rare individual, to be sifted out from educational institutions with great care for a particular line of work. My personal opinion is that a large percentage of the men students are fitted for research work if properly started along the right line.

What we in South Africa lack—next to the facilities for research—is not so much the research students as the men to start them on right lines. I think that Principal Beattie, at the inauguration of the University of Cape Town three months ago, sounded the correct note in observing that the youth of South Africa did not lack enthusiasm or ability for research, but they lacked opportunity, and, he added, much depended on the men they had as professors. That is the secret of it all. In this dread war South Africans have more than once exhibited a physical courage and a pertinacity equal to anything that Australia or New Zealand could show; why should not South Africa, then, produce a Bragg or a Rutherford as well as Australia and New Zealand, seeing that intellectual courage and pertinacity are two indispensable qualities in a successful research worker? The position is analogous to that which war has developed in Europe and America: there the opportunity has made the man. An American chemist said that "the German General Staff has learned, if others have not, that German chemical achievement, which is great indeed, is no sign that equal ability does not exist elsewhere. The Allies and America improvised a munitions industry in two years to match their machine of forty years' preparation"; and then he

[1] From the presidential address delivered by Dr. C. F. Juritz before the South African Association for the Advancement of Science at Johannesburg on July 8.

[2] Report British Association, Newcastle-upon-Tyne, 1916, p. 374.

went on to make a remark which we may well take to heart:—"War could force us to do nothing we did not possess capacity for before."

"The potential research worker," says the editor of the United States *Experiment Station Record*, "is probably less born than made"; and Dr. Nutting thus clothes the same thought in different language:—"Fertility of mind is not so much an inborn quality of the mind itself as of the training and association which that mind has had."[3]

Hence it is our solemn duty as a young nation to provide abundant facilities at each of our three universities for the making of our future research workers.

We pass on to speak of industrial research, which always has some utilitarian end in view, whereas the purpose of pure scientific research is more exclusively philosophic—the discovery of truth. The investigator in pure science has been likened to the explorer who discovers new continents, or islands, or lands before unknown; the investigator in industrial research to the pioneer who surveys the newly discovered land in order to locate its mineral resources, to determine its forest areas, and to ascertain the position of its arable land.

I quote these remarks with all circumspection, for, after all, there are no sharp boundaries between research in pure science and in applied or industrial science, and Huxley was right when he wrote that "what people called 'applied science' is nothing but the application of pure science to particular problems." The fact is that applied science is impossible until a foundation of pure science has been laid to build it on. You cannot apply a science which is not there to apply, and, as Sir William Tinney has said, until men began to interrogate Nature for the sake of learning her ways, and without concentrating their attention on the expectation of useful applications of such knowledge, little or no progress was made.

Industrial chemistry has been defined as that branch of chemical science which uses all the rest of chemistry and much engineering for the furtherance of production of chemical substances, or the use of chemical means or methods for manufacturing any material of commerce; and hence industrial research for the most part differs widely from university research. True, there are instances to the contrary; thus Michigan University has at Ann Arbor a tank for testing ship resistance, and Illinois University has a laboratory for investigations on a full-size locomotive engine; but industrial research is, for the most part, impracticable for universities, and, as often as not, needs to be carried out under large-scale conditions, as it were *in situ*, and by persons already possessing practical experience in the various phases of the problem under investigation. At the same time there should be much closer co-operation between the university and industrial research. Industry should recognise that it must depend primarily upon the universities for its trained research men, and co-operate to the fullest possible extent to the end that properly trained men be turned out.

Do you realise what this last sentence involves—you who are connected with the big industries? It involves that industry should recognise that, from a purely selfish motive, if from no other, its interest lies in endowing research chairs at the universities, and in seeing that they are occupied by men of genius. The very nature of industrial research implies that there must be a constant accession to the ranks of its workers of persons trained in pure scientific research. If such accession be intermitted, or if the increase of knowledge by means of pure scientific research be hampered, industrial research will inevitably be limited in corresponding degree.

The Government has acted wisely and well in endeavouring to establish a system of industries in this country; do we want these industries to fizzle out, or to go through years of laborious struggling? If we wish to minimise preventable disadvantages of that kind, let us do without delay whatever we can to foster research, so that the men to conduct it may become available as soon as they are needed.

National research approaches more nearly to the industrial than to the university type. It is often undertaken for the advantage of industry in general, but its outlook is considerably broader than that above embraced within the scope of industrial research, restricted, as the latter is, to the requirements of individual industries. In South Africa the cry for industrial research has become more imperative of late, and the Industries Advisory Board, as well as the Scientific and Technical Committee appointed on the initiative of the Minister of Mines and Industries, has gone some distance both in educating the public to the need of this type of research and in giving an impetus in the required direction. Mainly, however, the agencies used were of two classes: the laboratories of the university colleges, and those of certain Government Departments, together with the respective officers of those institutions.

There are two fundamental principles on which I must now lay stress; they are expressed in the words co-operation and co-ordination—co-operation between workers in different branches of science, co-ordination amongst those who work in the same branch in order that the maximum of benefit may be attained. So interdependent, in fact, so interlaced are the three types of research to which I have briefly alluded that it should be patent as the sun at noon that the closest co-operation between them all is essential. It is to be feared that this is not yet so clearly realised as it should be. The waste of time and energy that has risen from overlapping, which in turn has resulted from lack of collaboration, is incredibly great. It has stifled work of value in the past to an extent that is certainly not realised; it has thrown back for many years branches of investigation in which ere now incalculable progress might have been made and untold pecuniary advantages reaped. Would that the dire necessity of this searching war could stir up the South African nation to a correct appreciation of the facts!

About a year ago the president of the Society of Chemical Industry, in his address at Birmingham, insisted on the absolute necessity for the engineer and the chemist to "get into double harness as quickly as possible" and work sympathetically together for the progress of chemical industry. In South Africa, too, this necessity has been manifested, but I am glad to say that we have had more than manifestation; we have had realisation and we have had operation. For example, when, some months ago, the fertiliser scarcity arose, I was deputed to investigate the potentialities of unutilised raw materials in the Union, and found, amongst other things, that there were several thousand tons of good material going to waste in various places in connection with such institutions as slaughterhouses and crayfish canneries for lack of by-products plant to deal with it. When I had completed my tour of inspection and furnished my report, the engineers were charged to follow on, and set to work to make good the deficiency in plant, with the result that a respectable quantity of fertilisers will now be produced from the refuse that hitherto has been going to waste.

[3] NATURE, vol. c., p. 157, 1917.
[4] Col. I. J. Carty: Presidential address, Proc. Amer. Inst. Elec. Engineers, vol. xxxv. [10], p. 1415, 1916.

May I just repeat here—because they are still applicable to-day—a few remarks which I made in my presidential address to the Cape Chemical Society six years ago?—

"As an industrial science chemistry never operates in isolation. When we concern ourselves with the chemistry of the country's vegetable products it is the science of botany that has to afford additional aid; if it is general agriculture that we are dealing with, the chemist may also have to work in co-operation with the zoologist, entomologist, or mycologist. Often, in connection with the investigation of the country's mineral products and of its agricultural soils, consultation with the geologist is required. In any case, there is this one outstanding fact that these various scientific offices need to be in closest touch with each other in order to promote the smoothest working of the entire machine of investigation as an organised whole.

"This close contact between science and science is of great importance, but it is still more important that contact between the various workers *in one and the same science* should be as intimate as proper co-ordination and organisation can make it. During its annual convention, towards the close of 1910, the American Society of Agronomy was very largely occupied with the standardising of methods for conducting experiments. It was then shown again and again that a large amount of experimental work done in the United States had led to results which could not be compared with each other, were difficult to interpret in a trustworthy way, and were liable to lead to wrong conclusions because there had been no agreement as to method amongst the various institutions involved in the work. We do not wish to have these mistakes repeated in South Africa; our desire is rather to profit by the experience of other lands, but unless we look well to our steps we stand to repeat some of those very mistakes in an aggravated form. Therefore, lest we should go on a wrong track with regard to this matter of investigation and research, two principles should remain deeply graven on our minds: these are co-ordination of effort and unity of plan."

Some of us have read what Mr. H. G. Wells describes as ideal in his "Modern Utopia":—

"In Utopia a great multitude of selected men, chosen volunteers, will be collaborating on this new step in man's struggle with the elements. . . . Every university in the world will be urgently working for priority in this aspect of the problem or that. Reports of experiments, as full and as prompt as the telegraphic reports of cricket in our more sportive atmosphere, will go about the world."

Clearly, co-operation and co-ordination cannot become effective without efficient organisation. We were afforded a splendid illustration of what may thus be effected in the case of a private corporation on the occasion of the Stellenbosch meeting a year ago, when we visited the dynamite factory at Somerset West, and listened to the historical account given by the general manager. Established at the beginning of the present century for the purpose of supplying dynamite to the Kimberley mines, the sphere of operations had so extended that during the twelve months immediately preceding our visit the works had exported to the Commonwealth of Australia more than 100,000*l.* worth of explosive manufactured in South Africa, in addition to supplying our own needs. From that manufacture other industries developed one by one, and the works now include plant for the manufacture of sulphuric, hydrochloric, and nitric acids and of copper sulphate and the nitrates of barium and lead, while others are under consideration. Farmers have been supplied with the sulphur which they need for sheep-dipping and vine-spraying, while 20,000 gallons monthly of a lime-sulphur solution for sheep-dipping have been turned out. The works bid fair to develop into a general chemical factory after the war. Thus far the private concern; what we need in the way of a Government establishment is an institute for research in pure and applied chemistry—such a national chemical laboratory as Prof. Henderson has been longing to see established in England, but England is not yet sufficiently responsive. "We don't conduct research," says Mr. H. G. Wells; "we simply let it happen." Ah, that is where England differs from South Africa; we *don't* let it happen. Sometimes we make ourselves believe that we do, and then we let other things happen to interfere with it. Why, I have been pleading these twenty-four years for a properly organised system of chemical, physical, and biological research with respect to our agricultural soils, and it has not come yet.

The way in which a nation can organise itself and its resources for war has impressed a world. Other nations are talking about organising themselves for the commercial struggle that will ensue upon the termination of the present strife, but mere talking about reconstruction will not enable us to face the future serenely. "We all talk about the weather," said Mark Twain, "but nothing is done!" Why is it that England, France, Australia, New Zealand, and Canada are mobilising their scientific men for research? Dr. G. E. Hale, chairman of the Department of Science and Research of the United States Council of National Defence, says that it is because, "looking ahead, it was seen that the conclusion of peace would be followed by a trade war with Germany, in which no industry not perfected by scientific research could hope to succeed."

Can South Africa compete industrially with a country that has shown us what organisation can achieve, if we starve the very soul of industrial prosperity—pure and applied scientific research carried out in the laboratory?

Mr. W. C. Dampier Whetham, in his recently published book on "The War and the Nation," devoted a section to the organisation of British industry and commerce, in regard to which a reviewer says that "three years of war have done more than a century of peace to impress upon the public mind the indispensability of scientific research to national prosperity." The result has been that the Imperial Government has called into being a department for the express purpose of organising and directing research, and has placed considerable sums of money at this Department's disposal. But perhaps the most important outcome is that "the leaders of British industries have begun to acquire the habit of working together in order to conduct associated researches."[5]

Now let me emphasise the point that there is not one of these industries for which the chemist is not essential at one stage or another. An interesting address given some months ago by the president of the American Cyanamide Company[6] shows how universal the need of the chemist is. Two thousand grades of glassware are required for a vast variety of purposes; for this the skilled glass-maker must work under chemical control. The iron and steel of our cutlery, the extraction of silver, gold, and, in fact, of all metals from the ores, need the chemist at every step; the clothing we wear, the dyes that colour it, and more particularly synthetic dyes, the host of other uses to which cotton is put, the use of cellulose in the form of artificial silk as a new textile material, all are interwoven with the resources of the chemist. The

[5] Journ. Roy. Soc. Arts, vol. lxv., p. 755, 1917.
[6] *Chem. News*, vol. cxvi., pp. 157–59, 1917.

preparation and preservation of our foods, and the securing of their purity, both depend on chemical control. The manufacture of synthetic drugs, such as antipyrin, phenacetin, sulphonal, veronal, novocaine, aspirin, and salvarsan; the introduction of synthetic perfumes like heliotropin; of synthetic flavours like vanillin; of synthetic rubber and synthetic camphor; the quality of the fuel we use; the efficiency of the fertilisers we put into the soil; the extraction and utilisation of the various animal and vegetable oils, and the conversion of some of them into solid fats by catalytic agency, and so into soaps or candles, with glycerin as a by-product; the production of liquid fuels—every one of these would be impossible without chemical aid.

There are a few facts regarding the chemist which I want every South African, and particularly those in high positions, to realise. First of all, get rid of the idea that he is a druggist or pharmacist, any more than he is a baker or plumber, or belongs to any other avocation in which chemistry takes a share. And then grasp the fact that there is scarcely an avocation on the face of this earth into which chemistry does not enter, or wherein the chemist would not be of some use. One does not need to tell Johannesburg that it has to thank the chemist for its prosperity, for without him many of the mines would long have ceased to work. The other great industry of South Africa, agriculture, is at the mercy of the chemist in respect of the manufacture of fertilisers, and many agricultural products owe to him the processes employed in their preparation. Chemical operations are fundamental to every branch of the dairy industry; the making of jam, the drying of fruit, the tinned vessels in which many of these articles are preserved, are all subservient to the chemist. Without him the economical production of metals of any kind could not take place; there would be no locomotive engines, no assurance that the water which these engines need will not corrode their boiler-tubes, no testing of the coal which converts that water into steam, no provision of steel rails to run the locomotives on, or, to go further, no steel armour for our battleships, and no alloys for shrapnel, aeroplanes, or submarines. It is also the chemist's work to control the driving-power of ships of war and merchandise alike, whether that driving-power be coal, oil, or electricity, for the materials employed by the electrician must all, in the first place, be scrutinised by the chemist.

All explosives are essentially chemical in their make-up, and, in fact, the whole Army, as well as the Navy, is dependent on the chemist all along the line, inasmuch as he has to vouch for the purity of all their supplies of food and drink, even well-water; and not only their natural purity, but also their freedom from fraudulent adulteration or deliberate poisoning. The various gases so much used in the present war are all the productions of the chemist, and so are the means adopted to secure immunity from those gases. It is the chemist who controls the Army's drugs, disinfectants, and anæsthetics. The colouring of the material used for clothing not only the military and naval Services, but the whole civil population as well, is subject to the careful scrutiny of the chemist. His functions also include the manufacture of the leather which provides an army with boots; without him that leather cannot be tanned, as the entire wattle and other tanning industries are conducted under his advice. The finished leather, too, is investigated by him lest fraudulent practices should have participated in its manufacture.

Without the chemist there could be no books, for chemical processes are fundamental to the making of paper, of printing and writing ink, not to mention again the materials wherewith books are bound and the colouring of the binding. The production of illustrations in those books, by whatever means, and also the whole art of photography, must stand or fall with the ability of chemistry to assist them. And then, as I have already said, there is the increasingly large subject of fine and synthetic chemicals, beginning with manufactures like those of starch, glucose, and dextrin, the synthetic dyes which surpass natural products in brilliance and permanence, the synthetic perfumes which far transcend natural odours in potency, the synthetic drugs which have done much to afford relief to the suffering; artificial products—I do not say imitations, for they are often better suited to their applications than the natural products which they replace—artificial products in substitution of rubies, of bone, horn, and ivory, of resins, and of leather, are all the result of chemical research. Again and again the chemist has shown us how to produce the most valuable commodities out of waste and refuse. The refuse of the Bessemer steel-works gave rise to one of our most efficient fertilisers; the refuse of the gas-works provided the world with dyes, drugs, and a marvellously long list of other useful articles; the waste of wool-washeries furnishes us with lanoline. Waste wood, if destructively distilled, and, amongst others, waste wattle-wood, of which large quantities are annually available in Natal, is capable of producing acetone, whereof enormous quantities are now being used for the manufacture of propellants.

So we may rightly claim that the present age is the age of the chemist. The chemist has never before had such opportunity for the application of his knowledge to the betterment of material conditions upon earth, and never has he more effectively applied it to the attainment of this aim. It is also sadly true that never before has he applied his knowledge with such damaging effect as during the present war, but when the war shall have run its course all the chemist's resourcefulness, all his energy, all his persistence will be needed to repair the damage done, and to start exhausted nations upon new lines of industry. On the chemist, more than on anyone else, will this task devolve, and in South Africa in particular he will find abundant work awaiting him. Is he to be there to respond to the call? Then it is for us to educate and train him to the necessary standard; it is for us to provide the means whereby his purpose may be accomplished; it is for us to accord him sympathetic treatment. Do not let us regard him as useful only so long as he is bound down to routine work, and as academic when he is occupied with investigations bevond our limited capacity to understand.

We have heard much during the past four years of the difficulties under which the chemist has been labouring in Britain and America—of the apathetic attitude adopted towards him by Governments, public institutions, and industrial concerns; of the sparing hand wherewith the essentials for the pursuit of his investigations have been doled out to him. I have deemed it very desirable to place before you this evening some of the opinions which have been expressed on these topics north of the Equator, because I am convinced that many of our administrators, politicians, educationists, and commercial men are wholly unaware of the strong remonstrances which have grown to quite a literature during these four years, and are probably under the illusion that in South Africa the chemist has now the opportunity, if he cares to make use of it, to help the Union, with *éclat* to himself, safely through some of the difficulties resulting from the war. I have, in fact, heard such a view seriously expressed; the idea is, of course, perfectly absurd. At the same time it falls to the chemist in particular

to do all that in him lies to aid production during this time of crisis, and to assist those directly engaged in the work of production, whether it be the manufactures or agriculture. And those who have it in their power to strengthen the chemist's hands in such a work will themselves be not only aiding the State, but also assisting to bear up the lofty principles for the maintenance of which amongst men Britain and her Allies are contending.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

AN effort is being made by the New York University to raise a fund to meet the war emergency conditions. Part of the plan is to secure an endowment of 100,000*l.* for the engineering school in connection with a co-operative scheme of education between the industries and the University. So far the sum of 50,000*l.* has been received.

THE new session of the Sir John Cass Technical Institute, Aldgate, London, commences on September 23. The courses of instruction which have been arranged are directed especially to the technical training of those engaged in trades connected with the chemical, metallurgical, and electrical industries. Full facilities are available for qualified persons who desire to undertake special investigations in connection with these branches of industry. Among the special courses of higher technological instruction which form a distinctive feature of the work of the institute may be mentioned analytical work in fuel and gas analysis, courses on brewing and malting and on the micro-biology of the fermentation industries, and, in the department of metallurgy, courses of an advanced character on gold, silver, and allied metals, on iron and steel, on metallography and pyrometry, and on the heat treatment and mechanical testing of metals and alloys. Detailed information concerning the work of the institute is given in the new syllabus, a copy of which may be obtained on application.

THE summer school of civics and eugenics, which was organised conjointly by the Civic and Moral Education League and the Eugenics Education Society, and held at Oxford from August 10 to 31, was very successful, the programme being comprehensive and attractive, and the courses and meetings well attended. A prominent feature of the school was a civics and eugenics exhibition. The exhibits showed on the civic side the possibilities of regional study with a view to civic service as a part of the school and college work, and on the eugenic side gave illustrations of recent work in heredity and the study of family histories. An exhibit from the National Council of Venereal Diseases was also shown. The following public lectures were delivered :—"The Principles of Co-education," Miss A. Woods; "The Three Voices of Nature," Prof. J. Arthur Thomson; "The Sociological Bearing of Race-study," Prof. H. J. Fleure; "The Influence of Finance on Social Reconstruction," W. Schooling; "The Eugenic and Social Influence of the War," Prof. Lindsay; "The Training College of the Future," Dr. M. W. Keatinge; "Emigration and Eugenics," C. S. Stock; "The Forward Outlook of Eugenics and Civics," Major L. Darwin and A. Farquharson.

THE Indian Bureau of Education at Delhi has issued the first two of a series of short pamphlets in which it proposes to give some account of developments in Indian education which may suggest themselves as worthy of notice. Both pamphlets deal in the main with the sphere of elementary education. The first treats of drawing and manual instruction in Punjab schools. It shows that the same movement is proceeding in India as at home towards providing facilities for the young to learn by *doing* as by talking, listening, reading, and writing. The schemes of instruction follow those adopted of recent date in this country, and several of our own early mistakes are being avoided. Tools and benches are of European pattern. The problem of training teachers is being attacked with some vigour. The second pamphlet is of more general interest. It tells of the humble beginnings of the education of factory children in India, and also children working in tea plantations and on the colliery estate of the East Indian Railway. Descriptions are given of the work going on in all three classes of schools, ranging from the *crèche* to what in England is now called the junior technical school. Above the stage of the *crèche* and the infant school the instruction is that of the part-timer, as a rule, but there are arrangements for evening continuation schooling for older children and adolescents. The vernacular has, as it should have, a more important place than the teaching of English, and the vital importance of manual instruction is recognised. The value of this enterprise can scarcely be exaggerated, for, apart from the fact that the individual is given the opportunity of rising as clerk or, preferably, as skilled workman, there is the likelihood of greater confidence between employer and employed when direct communication is possible, terms of engagement can be clearly understood, and rates of pay calculated. Difficulties abound, and one's sympathy must go out to the pioneers in an uphill task. Mill-owners in Madras, planters in Darjeeling, the railway company, who have actually introduced compulsory education, and officials deserve encouragement.

A PAMPHLET (price 3*d.*) has been issued by the Association for the Scientific Development of Industry, containing the terms of a remarkable address on "The Place and Importance of Science in Education," delivered before the society at Manchester on February 21 last by Mr. Edw. C. Reed. Mr. Reed alludes with satisfaction to the awakened interest of all classes towards science and scientific questions, largely induced, however, by the events of the war, and warmly pleads, with a variety of vivid illustrations, the claims of scientific knowledge and of scientific methods of imparting it as a fundamental part of our educational system. "The result of our neglect of science," he states, "has revealed itself to us in waste, muddle, and inefficiency in practically every department of our national life," whilst, on the other hand, "wherever we have resolutely endeavoured to make good our past deficiencies the effect has been wholly beneficial." From these postulates he proceeds to argue powerfully for a new method and purpose in our educational system. "For every national purpose brains are of more use than bodies," and "the most mechanical job is the better for a little intelligence." But it is not merely on the ground that a training in science and in scientific methods would make the nation more effective in its industrial and commercial activities that the author pleads so powerfully for the inclusion of scientific aims and training in the curriculum of the schools from the earliest period of child-life, but from the much higher consideration that only in so far as this is done can the real, permanent well-being of the nation, both material and spiritual, and of the individuals comprising it, be achieved, and the thesis is worked out with surprising cogency and supported by a wealth of apt allusion. The pamphlet is accompanied by a diagram showing the place of science in the service of man and its importance in industry.