REG. 20-10-28

# SCIENCE AND INDUSTRY.

## Sir William Bragg's Address.

The presidential address at the recent Glasgow congress of the British Association for the Advancement of Science was delivered by Sir William Bragg, who spoke on the help which science could give industry, the history of craftsmanship, and the relations between pure and applied science.

In opening, Sir William said that in recent years the application of science to industry had become increasingly important. When the country was struggling to free itself from distress due partly to the war and partly to violent changes in economic conditions, it was of interest and importance to consider what science could do to accelerate recovery. In less material realms the applications of recent research had aroused wide interest. He could not deal with all the issues raised by these considerations, and proposed to pay attention particularly to the relations between science and the craftsmanship of their own country. By "craftsmanship" he meant the skill exercised in the production of whatever was wanted for human welfare. We have a profound feeling for any example of an old craft, and for very good reasons. Among them I do not include the sentimental regret that, in some cases, a past time skill seems to have disappeared. We may be sorry, but after all it is but a receipt that has been lost and may be found again any day, if proper search is made for it. Modern knowledge and methods of analysis are at least good for that much.

The Greek gave exquisite form to his vase, and decorated its surface with equal art. He copied from the growing things of Nature the adjustment of lines and surfaces which give the sense of fitness for a purpose. The outlines of his vases are so perfectly adjusted that their representation in a drawing will not bear alteration by the width of a line. That the Greek should with so much skill take lessons from what his perception made clear to him and should with so much care choose his materials and mould them to his purpose is what we should expect from a nation that shows also in its literature a passion for justice and harmony. The fine accuracy of his line is in agreement with his delicate sense of differences in thought and words. The Roman developed the principle of the arch, and enough remains of what he built to show the daring and the power of his work. The great arches that spanned his public buildings seem to stand for the Roman rule and law under which the whole world might find shelter and be at peace. The sword of the Indian workman was gradually brought to its temper by an infinite series of local applications of heat alternating with the few blows that could be skilfully given while for a moment it was in the workable state. The poverty of the craftsman's appliances, the meagreness of his little fire, and the scantiness of the tools with which he made his way bit by bit to his final achievement are in consonance with his life of small details ruled by overmastering ideas.

### The Mind of a Nation.

These illustrations, he continued, were sufficient to show that the mind of a nation was expressed in its craftsmanship, because that represented its efforts to live. That which we did ourselves was as representative as a Greek vase or a Roman aqueduct or a suit of armour from Milan. The craftsmanship of a nation was its very life, and even from a material point of view an index of its health. But as a people departed from its primitive condition so also did its craftsmanship. The elements of primitive craftsmanship centred round the individual in whose brain were the knowledge and imagination, in whose hands the skill, and round whom were the materials and the tools. Later on it became impossible for all the knowledge and technical skill to be found in one person, and for all the tools to be owned by him. The craftsman became an association of men and many hands working in an alliance which was often unconscious, were employed in bringing a product to its finished form. It was a long step from the simple workshop of the old single-handed craftsman to the vast, complex factory of modern industry. The change which had brought us to this new kind of modern craftsmanship, this dependence on machinery with its wealth of production, its clattering, bustling activity, and its compelling influence on the lives of all was due to nothing less or more than the urgent wish of the individual to better his own condition, and, in his disinterested moods, the condition of his neighbours. The change could never have been prevented.

### Science and Craftmanship.

Under the urgent drive of self-preservation, the craftsman had often called scientific knowledge to his aid. When coalmining was at a low ebb because the mines were becoming waterlogged and no available power was strong enough to clear them, Savery and Newcomen made use of the new discoveries respecting the pressures of gases and vapours which Torricelli and Pascal, Papin and Hooke had been examining. The steam engine thus came into being, and saved the situation. Later on, James Watt, by further application of the same laws, had added fresh powers to the engine, leading to the modern steam engine, with all its marvellous modern applications. In 1831 Faraday, in the course of certain systematic searchings, had found out the way in which one electric current could bring another into being, the so-called electro-magnetic induction, and with that single day's work there had begun the whole development of electrical engineering. More often scientific knowledge entered into the history of a craft with less instantaneous and startling effect. In considering the various details of some modern product of craftsmanship, such as one of the magnificent ships for which the Clyde was famous, it became apparent that the scientific laboratory was behind everything. The hull of steel depended on a wealth of research in works and in metallurgical laboratories. A range of enquiry and trial and development lay behind the engines, depending always on principles of physical and chemical science, and tested at every stage by instruments which were a craft in themselves. The curious and most efficient thrust block, by which the force of the screw was brought to bear on the ship, had lately been designed by Michell on the basis of the physical laws of liquids. The wireless sprang directly from the physical laboratory, and the sounding apparatus was based on Kelvin's designs. The refrigerating apparatus was due to investigations into the production of cold by students such as the Frenchmen, Cailletet and Pictet, by Onnes in Holland, and by Dewar, the Scotsman. If the growth of science were hindered in any way, the growth of craftsmanship was hindered. Science advanced on a broad front and the various branches moved on together, not absolutely keeping step, but preserving a general line. The 10 years' holiday in certain directions suggested at Leeds last year by the Bishop of Ripon was impossible. You could not prevent the growth of knowledge or even select those points of advance which might lead to certain classes of results. No one knew what was over the hill. If the march of science were to be conducted in an effective and orderly way, were it only for the purposes of industry, there must always be a certain number of laboratories, or parts of laboratories, where scientific research had no immediate thought of possible applications.

### Effect on Industry.

Continuing, he said:—The most active of modern industries are those founded on recent scientific research. The most notable is, of course, that of electrical engineering. Though the electrical engineering industry with all its branches may be said to have its source in a single laboratory experiment, yet it has grown by the continuous adaptation of fresh streams of knowledge. The huge American corporations maintain research laboratories costing millions of pounds annually, and find that the financial return justifies their policy. The General Electric Company found that a costly research into the structure of the electric lamp repaid itself over and over again. The very important technical discoveries of Langmuir and Coolidge were consequent upon an attempt to find out what happened on the surfaces of the glass bulb and of the glowing filament. The point is that the electrical industry was not merely launched by a single discovery; it is continually guided, strengthened, and extended by unremitting research. The very active motor industry, he said, the aeroplane industry, and the chemical industries were equally important examples of dependence on very intricate problems, on which intense research was being conducted in laboratories. Few persons knew the research on the study of rubber; they only knew that motor tires now lasted longer.

### Mass Production.

He continued:—Mass production is in its way splendid, ministering to the necessities and conveniences of many who must otherwise have gone without. But, if it is brought to such a pitch that its processes call for little intelligence in their working, then cheap people of little intelligence will be found, in the end, to be in charge. The relation of science to mass production is both that of builder and that of destroyer. Mass productions are temporary lulls in the movement of imagination and knowledge. Much skill and thought and care may be required to arrange for one of those quiet and profitable times; the machine is set going and for a while goes by itself. But new applications of scientific knowledge, new ideas, new processes, new machines must always be in preparation. If craftsmanship, to fulfil its task of providing for the people, must be continually improving it processes, then the nation that is to be successful must possess the means and the will to improve, and here we come, I think, to a notable point. May it not be said that in this country the means exist even to a remarkable degree? Our craftsmen as a whole, including all grades, are possessed of qualities—intelligence, skill, accuracy, and so on—which make improvement possible. How could our enterprises in the past have been so often successful if this had not been so? How can we be succeeding so well in respect to the new industries of the present if the capacity is not there? Should it not, therefore, be our policy to take advantage of our country's qualities by continually seeking for fresh industries or fresh adaptations of the old? We can, of course, bolster up old industries by political methods, and I have no wish to decry such methods as always incorrect. But clearly the best production of all is the knowledge and skill which can enable us to produce what others must ask us for because they cannot so well make it themselves.

### New Class of Worker.

A new class of worker was growing up, consisting of men engaged in research associations and industrial research laboratories. A high value ought to be placed on their services, especially because they formed a direct link between the employer, like themselves often trained in the university, and their fellow-workers in the shops. They were in personal contact both with capital and with labour, and might overcome the dangerous separation that had been in existence between, on the one hand, the manipulator in the shops and the designer in the drawing office, and, on the other, between the factory directorate and scientific knowledge. So far there was not sufficient appreciation of the interests and rewards in the life of a student of research, but with the growth of this new class there would be more value attached to the great services it could render.

Concluding his address, the president said:—Scientific research in the laboratory is based on simple relations between cause and effect in the natural world. These have, at times, been adopted, many of us would say wrongly, as the main principle of a mechanistic theory of the universe. That relation holds in our experimental work; and as long as it does so we avail ourselves of it, necessarily and with right. But just as in the case of research into the properties of radiation we use a corpuscular theory or a wave theory according to the needs of the moment, the two theories being actually incompatible to our minds in their present development, so the use of a mechanistic theory in the laboratory does not imply that it represents all that the human mind can use or grasp on other occasions, in present or in future times.

### "Not Soul Destroying."

The proper employment of scientific research is so necessary to our welfare that we cannot afford to allow misconceptions to hinder it; and the worst of all are those which would suppose it to contradict the highest aims Science, as a young friend said to me not long ago, is not setting forth to destroy the soul of the nation, but to keep body and soul together. And some, perhaps, might say that in considering science in relation to craftsmanship I am pressing the less noble view; that I am not considering knowledge as its own end. It is said that uselessness in science is a virtue. The accusation is a little obscure, because it may justly be said that knowledge is never useless. If I have thought of science in relation to craftsmanship it is because I have tried to set out the vast importance of what craftsmanship means and stands for. I have not forgotten that there are other aspects of the enquiry into the truths of Nature. Indeed, I could not carry out the lesser task without considering the whole meaning of science. And no clear line can be drawn between pure science and applied science; they are but two stages of development, two phases which melt into one another, and either loses virtue if dissociated from the other. The dual relation is common to many human activities and has been expressed in many ways. Long ago it was said in terms which in their comprehensiveness include all the aspirations of the searcher after knowledge:—"Thou shalt love the Lord thy God with all thy heart and with all thy soul and with all thy strength;" and "Thou shalt love thy neighbour as thyself." In the old story every listener, from whatever country he came, Parthians and Medes, Cretans, and Arabians, heard the message in his own tongue. A great saying speaks to every man in the language which he understands. To the student of science the words mean that he is to put his whole heart into his work, believing that in some way which he cannot fully comprehend it is all worth while, and that every straining to understand his surroundings is right and good; and, further, that in that way he can learn to be of use to his fellow-men.

97

REG. 23-10-28

# ANIMAL NUTRITION.

## New Laboratory Opened.

The Prime Minister (Right Hon. S. M. Bruce) opened on Monday morning the new Laboratory of Animal Nutrition, which has just been erected on the University grounds.

There was a large attendance of University professors, graduates, students, and other persons interested in scientific research, and the ceremony took place in the open on the eastern side of the laboratory. As rain fell heavily while the speeches were being made, the audience had a rather unpleasant time. On a protected dais which had been erected were the Prime Minister, the Chancellor of the University (Sir George Murray), the Minister of Agriculture (Hon. J. Cowan), Mr. Justice Angas Parsons, the Director of the Waite Institute (Dr. A. E. V. Richardson) and Professor T. Brailsford Robertson.

### The Prime Minister Welcomed.

The Chancellor tendered a hearty welcome to the Prime Minister, who had come at considerable inconvenience, in the midst of the distractions of a political campaign. He was present that day to open the laboratory of the Division of Animal Nutrition, erected by the Commonwealth Council for Scientific and Industrial Research. When the proposal for the erection of the laboratory was made to the Council of the University, a difficult problem had to be faced. The land at disposal was limited, but on the other hand they wished to do their utmost to be of service to the community as a whole. They desired that the best use should be made of the scientific resources of the University. They had in Professor Brailsford Robertson a man than whom no one in Australia was better qualified for the particular investigations which had to be made. The council had assented slowly but with conviction, and the result was that the University of Adelaide was engaged, in co-operation with the Council for Scientific and Industrial Research, in the investigation of one more problem which was of high importance to Australia. Others were being conducted at the Waite Institute, where such subjects as plant diseases, soil analysis, and the mineral contents of the native pastures were being investigated. The design of the building had been left in the hands of the University architect, for the purpose particularly of having an edifice which would harmonize with the other buildings that had been erected on the adjacent University ground, including the Lady Symon wing of the Union Building, the Darling Building, and the engineering department on the hill. How Mr. Laybourne Smith had succeeded would be at once recognised. The interior fittings had been the especial care of Professor Robertson himself, and he thought they would agree that they had arranged a most beautiful building, and one that was an ornament to the University. The new laboratory would prove an enormous benefit to Australia as a whole. (Applause.) He then asked the Prime Minister to declare the building open.

### A Pleasant Interlude.

The Prime Minister said the ceremony was a pleasant interlude in a somewhat hectic political campaign. (Laughter.) The building was one of the first practical signs that Australia was taking the question of research in a serious spirit. That had to be done if the great problems of Australia were to be faced, and if the industries were to be consolidated and expand, so as to contribute in large degree to the welfare of our own people, the people of the Empire, and, one might say in some degree, that of the people of the whole world. (Hear; hear.) The building was also a sample of what was to be done in the way of bringing scientific aid to the great industries, and of giving the people conducting them a better opportunity of building up those great industries on which all depended. It was an example of practical co-operation between pure and applied science—co-operation between the University and the organization which had been created for a material purpose. Three years ago provision was made to the extent of £500,000 for the work of the Council of Scientific and Industrial Research. An endowment of £100,000 had also been created for the training of research workers, of whom there was a strictly limited supply at present. At the same time the Federal Government was in no way overlooking the great work of the Universities and the Departments of Agriculture in the various States. One had only to travel to see the results of the careful and patient work of those bodies. They were not being superseded, but the council would complement and supplement their work, and it was allowed on all sides that that co-operation would be most valuable to every one in Australia.

### Primary Industry Problems.

The council had then to consider to what they should first address themselves;