The group of the conference particularly concerned with factors affecting wastage of man-power was circumscribed in that its discussions were limited to means of reducing the rate of accidents and the incidence of disease, and the sickness-rate caused by poor environment. The planning of factories and the training of young and older workers were discussed, while the group also considered that there is a great deal of valuable material within the Factory Department of the Ministry of Labour and National Service and that steps should be taken to ensure wider circulation of this material in such a form that it could reach and be understood by all grades in industry. A 'digest' of the annual report of the Chief Factory Inspector would assist executives who are overburdened with reading matter.

The conference also examined the factors affecting the will to work and concluded that experience has undoubtedly proved the desirability of expanding joint consultation in the broad sense of the term, that is, including formal and informal consultation between management and workers, and consultation between all levels of management. The machinery of consultation appears to be of less importance than the attitude of mind of all concerned. Machinery must not be imposed, even benevolently, from outside but should arise out of consultation with all those affected at every level both of management (including supervision) and workpeople.

Management and trade unions have a responsibility to take all possible steps to make all concerned better able to take part in joint consultation. This could be done not only by the organization of formal courses at technical colleges but also by "learning by doing", for example, the establishment of junior consultative committees. More care should be taken to ensure that the conclusions and activities of joint committees are reported adequately to all levels of the undertaking. It is of particular importance to ensure that in the process of giving information to workpeople, junior management and foremen should not be by-passed.

A works committee should be given all the necessary information and in such detail as will enable it to deal with the problems it has to face. These usually only exclude subjects discussed by joint negotiating machinery, subjects which are confidential to the firm and might damage it if known to competitors, and problems concerned with individual cases except where the individual's permission is obtained.

An interesting discussion took place on a variety of problems concerned with incentives in industry, particularly with the adoption of systems of payment by results. Among the suggestions were the following: other incentives besides direct financial incentives are of great importance, particularly in small firms where it may not be possible to introduce elaborate systems of payment by results; such incentives include satisfaction with the job, pride in the firm and good relations with the worker's immediate colleagues.

A sense of security is of great importance, and without this sense the introduction of systems of payment by results is not likely to be of value. A sense of security includes not merely a sense of security in the job but also includes, where bonus systems are introduced, the need for the worker to understand the basis of the bonus system and be able to anticipate and measure the effect of his own efforts.

Where it is practicable to adopt systems of payment by results there are substantial advantages to be gained by their adoption; there is more scope for the adoption of such systems in manufacturing industries than in service industries, but there is some scope even in service industries. Such systems are satisfactory only if introduced with great care, and, at all stages, there should be adequate consultation between management and workers; before the scheme is adopted there should be complete agreement both on the principle and the details. It was also thought that there is scope for the continued dissemination of information about systems of payment by results by Government agencies, but without any pressure for the adoption of any particular type of scheme. T. H. HAWKINS

SCIENCE AND AGRICULTURE IN INDIA

FOR his presidential address to the thirty-ninth session of the Indian Science Congress, held in Calcutta in January, Dr. J. N. Mukherjee took as his subject "Science and our Problems, Science and the Yield per Acre". In the first part of his address, Dr. Mukherjee reviewed the position of science in India to-day, pointing out the necessity for increased industrial and agricultural production if the pressing economic and social problems of the country were to be solved. To this end, he said, one of the first essentials is the proper organization of scientific education and research. Both the State and industry have large-scale development programmes in hand, and the closest co-operation with the scientific community is needed if their planning is to be fully effective. He welcomed the fact that industries are already showing a growing interest in establishing research laboratories of their own.

Before bringing forward a number of practical suggestions as to how agricultural production might be increased, Dr. Mukherjee directed attention to some of the inherent difficulties with which India is confronted. About 80 per cent of the cropped area is dependent on rains, many of the holdings are too small to allow of the adoption of improved techniques, and the production of the important grain crops is largely the occupation of the poorest section of the community. Much, however, has already been done to raise output, and agricultural research has received a considerable impetus from the establishment of commodity committees and the rice and potato research institutes. More attention is still needed in other branches of agriculture such as soil survey, plant (and insect) physiology and ecology, agricultural economics and engineering.

Among special aspects that would seem to merit greater intensive investigation, Dr. Mukherjee mentioned the production of disease-resistant strains, the working-out of suitable crop rotations with special reference to the ley, and the introduction of new grasses and legumes. The establishment of a bureau of plant introduction has, in fact, already been suggested. Seed-growing, he said, should be developed as an industry under the management of a seed-growers' association, and methods for the control of pests and diseases, found successful in other countries, should be tested under conditions in India. Problems relating to water supply are naturally of fundamental

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importance. The 'dry' farming stations in Sholapur and Hagari have developed successful methods for soil and water conservation, and extension of this type of work is needed in other arid areas. As regards irrigation, many new projects are in hand or under contemplation, and it is estimated that the irrigated area will eventually be doubled. Various methods are being developed to minimize loss of water: for example, the use of concrete pipes, and the lining of canals and the protection of breakwaters and river banks against water erosion with various bitumen and asphalt materials. Greater economy in water would also be effected if it were paid for on a basis of supply, instead of at a fixed rate per acre of a particular crop as at present.

In the long run, however, the success of any project depends on the farming community itself. Dr. Mukherjee pointed out that much can be effected with the co-operation of the efficient farmer, and local interest can be stimulated by the setting-up of village committees and demonstration plots. Full use must be made of all existing knowledge, whether derived from the good farmer or the experimental station, if India's hopes of increased agricultural production are to be realized.

RADIO DIRECTION-FINDING AND NAVIGATIONAL AIDS

THE use of direction-finding instruments for locating the source of radio signals is nearly as old as the technique of radio communication itself; and a great deal of research has been done in Great Britain and elsewhere on the various methods available to-day for radio direction-finding. In some of these methods special receiving aerial arrangements are used to indicate the direction from which the signals are arriving from the distant transmitting station, while in other systems the properties giving the finding of direction or position are incorporated in the principles of transmission employed. Two reports recently published under the auspices of the Department of Scientific and Industrial Research are of interest to contemporary scientific and technical workers on this subject.

The first of these, Radio Research Special Report No. 21*, contains translations, provided by the Admiralty, of nine papers written by German technical experts and not hitherto published. They describe some of the outstanding progress made in Germany in radio direction-finding during the Second World War. Seven of the papers were presented originally at an official German conference on navigational aids and allied problems in 1944, and two are later contributions.

Some of the papers contain the results of fundamental investigations designed to demonstrate the limitations in the accuracy of finding a position or direction imposed by wave propagation and other conditions. The relative merits of determining direction by the measurement of phase difference and time of arrival of the various component waves are discussed. Other papers describe the principles and experience obtained with new techniques demonstrating the influence of aerial spacing, a topic which has now become familiar to all those concerned with recent developments in the subject of radio direction-finding.

The second publication, Radio Research Special Report No. 22*, deals with the most important problem of selecting a satisfactory site for a radio direction-finding installation. Many radio direction-finders now available have a precision of better than one degree, and the accuracy of bearings is limited only by imperfections of the station sites, even when these are the best available in agricultural country of the type found in Great Britain. Much care is therefore necessary in the choice of sites, if full use is to be made of the potential accuracy of a direction-finder. Information on the effects of various imperfections of site, such as trees, buildings, hills and other sources of interference, is scattered throughout the literature of the subject. The report presents this information in a single publication.

The types of instrument considered are mainly those with loop or Adcock aerial-systems, and the frequency range covered, 100 kc./s.–300 Mc./s., is that in which such systems are commonly used. Poor sites in built-up areas or on ships are excluded, and the report deals only with normally acceptable sites. No precise definition of a suitable site is attempted, and the imperfections studied are those which would be undesirable within a quarter of a mile of the equipment and the effects of which might still be significant at a distance of one mile.

The report reviews the effects of natural and man-made objects, and, wherever possible, quantitative results of tests or operational experience are quoted. This cannot always be done owing to unpredictable variations between sites and sometimes between results obtained at the same site under varying conditions which cannot always be predicted. To demonstrate the theoretical aspects of the problems involved, the effect on accuracy of results of various simplified objects is discussed with particular reference to the effects of changes of frequency and the distance of the object from the receiver.

Special attention must be given to the calibration of direction-finders, particularly those with fixed Adcock aerial-systems. Allowance for site errors by means of corrections derived from observations on a local transmitter is possible in certain conditions, notably when errors are caused by objects close to the direction-finder: and the limitations on the choice of site imposed by the need for calibration to allow for instrumental errors are discussed. The main conclusions of the report are summarized in tables showing the minimum tolerable distances for different objects when it is desired to achieve specified accuracies. One table refers to good sites on which accuracies of $\frac{1}{2}°$ at very high frequencies, and 2° at lower frequencies, may be achieved. A second table refers to inferior sites where the corresponding figures are about 2° and 5°.

Prepared as it was at the suggestion of the Direction-Finding Committee of the Radio Research Board of the Department of Scientific and Industrial Research, this report brings together the extensive experience of specialist workers in this field, and its publication should be of direct assistance to those concerned with the installation and use of radio direction-finding equipment.

* Department of Scientific and Industrial Research. Radio Research Special Report No. 21: Radio Direction-Finding and Navigational Aids; some Reports on German Work issued in 1944–45. Pp. iv+92. (London: H.M.S.O., 1951.) 3s. 6d. net.

* Department of Scientific and Industrial Research. Radio Research Special Report No. 22: The Siting of Direction-Finding Stations. By W. Ross and F. Horner. Pp. iv+38. (London: H.M.S.O., 1952.) 1s. 6d. net.

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