contacts with both these presidents of the United States. When he was at Leyden, John Adams was sent by Congress to Holland to court an alliance, but he was forced to remain a year before he was publicly recognized as the American minister. During this time Adams, his two sons, his secretary, and Waterhouse formed one family⁹. Twenty years later he sent Jefferson a copy of his pamphlet on cow-pox—that is, the first part of his “Prospect”—and on December 25, 1800, the President sent him a very cordial letter of thanks, which Waterhouse published in his second part¹¹. Six months later Waterhouse wrote a long letter to Jefferson, giving instructions how to perform vaccination, enclosing infected thread and books and drawings. In this letter he also suggested that the President should arrange for an experiment to be made by “some cautious discerning person, perhaps his own family physician. A series of experiments may be directly instituted by him.” Three unsuccessful attempts were made to vaccinate the President’s family with three separate batches of “virus”. A fourth attempt was successful. The President was attentive to all applications made to him for cowpox matter, and he it was who was thus responsible for introducing vaccination into the District of Columbia, Pennsylvania, Maryland and Virginia.

The reference to Woodville recalls the fact that he was one of the first in London—after Cline—to practise vaccination. But he performed the operation in the Smallpox Hospital, and three days after vaccinating he inoculated the patients with smallpox matter. The result was that the “cowpox matter” from the pustule was really a combination of cowpox matter and smallpox matter. This material, distributed far and wide, caused many smallpox rashes. Jenner had considerable difficulty in saving the situation.

The great esteem in which Waterhouse held Jenner is seen in this letter, and is even more fully expressed in the second part of his “Prospect”¹².

Back to Jenner

If much of this article has been devoted to persons other than Jenner he would not have minded—even on his birthday. In the mass of correspondence which has been preserved, dating from the time of publication of the “Inquiry”, we get a very good picture of the man. During the early stages of the movement to promote vaccination he was the oracle to whom everyone turned for guidance, and loaded with honours as he was, he never lost his head. Even his erroneous views—and that there must have been erroneous views at that period when immunology was still unborn is obvious—were often blessings which kept some semblance of correctness when some men tended to stray into dangerous by-ways.

Jenner became almost at once a national hero, and his name was nearly as well known abroad as it was in his own country. His vast correspondence led him to term himself “the vaccine clerk of the whole world”. His private practice certainly suffered, and in 1802 Parliament made him a grant of £10,000. In 1806 he was voted a further £20,000. To the end he worked unceasingly for the cause of vaccination. On January 26, 1823, he passed peacefully to his rest.

Jenner never cared very much for the high honours which he received; but he did care a great deal for the practice which he had discovered and helped to foster. That is why he would have

perhaps preferred an article on the movement to a eulogy of the man.

¹ Baron, J., “Life of Edward Jenner”, 1, 33 (1838).

² Jenner, E., *Phil. Trans.*, 78, Pt. ii, 219–237 (1788).

³ Baron, *op. cit.*, (1), 1, 121.

⁴ Underwood, E. A., presidential address to the Hist. Sect., Roy. Soc. Med. (1949).

⁵ Baron, *op. cit.*, (1), 1, 334–39.

⁶ *idem.*, *ibid.*, 392.

⁷ *idem.*, *ibid.*, 359.

⁸ *idem.*, *ibid.*, 155.

⁹ Welch, W. H., “The Jenner of America”, *Proc. Philadelph. Co. Med. Soc.* (1885).

¹⁰ Waterhouse, B., “A Prospect of Exterminating the Small-Pox” (Boston, 1800).

¹¹ *idem.*, *ibid.*, Part ii (Cambridge, Mass., 1802).

¹² Baron, *op. cit.*, (1), 1, 386, and Waterhouse, *op. cit.* (10).

¹³ *idem.*, *ibid.*, 439–43.

¹⁴ Spalding, J. A., “Dr. Lyman Spalding” (Boston, 1916).

¹⁵ Leikind, M. C., *Bull. Hist. Med.*, 7, 671–86 (1939).

¹⁶ Appleton’s “Cyclopædia of American Biography”, 5 (1888–89).

¹⁷ Kelly, H. A., and Burrage, W. L., “Dict. of Amer. Med. Biography” (1928).

¹⁸ See sonnet by Basil Lanneau Gildersleeve in H. Cushing’s “Life of Osler”, 1, 671.

¹⁹ For other Waterhouse letters, see especially:

Halsey, R. H., “How the President, Thomas Jefferson, and Doctor Benjamin Waterhouse established vaccination as a public health procedure” (New York, 1936).

Fitz, R., *Bull. Hist. Med.*, 11, 239–264 (1942).

Spalding, R. W., *Bull. Hist. Med.*, 20, 69–75 (1946).

Trent, J. C., *J. Hist. Med.*, 1, 25–40 (1946); and *ibid.*, 1, 357–364 (1946).

INDUSTRIAL RESEARCH AND MANAGEMENT

A WEEK-END conference of industrial research directors and managers was held at Ashorne Hill, near Leamington Spa, during March 11–14. It was organised by the Industrial Research Committee of the Federation of British Industries, under the chairmanship of Sir Wallace Akers. The proceedings of the conference were divided into five sessions, at each of which two papers were read. Except for the first session, at which spoken contributions to the papers were made from the body of the hall, the arrangements for discussion were unusual. Immediately after the reading of the papers, the company was divided into six groups which repaired to separate rooms, where each group appointed a chairman to guide about an hour’s discussion. Afterwards, the conference re-assembled and the six chairmen reported. Sometimes the groups were given specific questions to try to answer, at others their discussion was unrestricted. In either case, the method appeared to be remarkably successful in promoting full discussion of the papers in the short time available.

At the first session papers were read on the relationship between the research department and the management and other departments of an industrial organisation. Mr. F. H. Saniter described the origin and development of the United Steel Companies’ Research and Development Department. It is recognized, Mr. Saniter said, that the amount of new knowledge created by an industrial research establishment is small in relation to the new knowledge continually becoming available from all sources. The Research and Development Department is therefore regarded as having three main functions: collection and dissemination of information, creation of new knowledge by research, and application of knowledge, from whatever source, to practice. The effective functioning of such a department depends on its proper integration into the general structure of the company. At the United Steel Companies this is

achieved by a series of committees ranging from a top-level committee, under the chairmanship of the managing director, downwards. These committees are considered primarily as a means of bringing people together periodically to discuss the technical needs of the firm and the ways in which they can be met by the Research and Development Department.

Dr. W. D. Scott (Monsanto Chemicals, Ltd.) gave the second paper in this session, and widened the scope of the discussion to embrace the influence of the research mind throughout the entire industrial organisation. He pointed out that there are three prime executive functions to be performed: to produce, to sell and to plan. The planning function is the intimate concern of the research department, the relationship of which to the management can be established through a number of different types of internal organisation which were illustrated by charts. Throughout, the emphasis was on a proper appraisal of the financial implications of the activities of the research department, particularly in the selection and continuation of research projects.

"Finance, Costing, Laboratory Administration and Scientific Staff, Research Programmes and their Formulation" was the comprehensive subject-heading of the second session, and both the papers and discussion which followed were of necessity selective. Mr. A. W. Montgomery (Standard Telephones and Cables, Ltd.) dealt mainly with human relationships in the research laboratory. Every establishment needs rules, however few, and since research scientists are usually knowledgeable and intelligent people, the rules of a research organisation must be reasonable and arguable. Provision must be made for staff training after engagement, and the need for adding wisdom to knowledge was emphasized. The difficult question of special treatment given to any particular member of a laboratory was touched upon, also the problem of how to treat fairly and employ correctly the older scientific worker of considerable experience who, although he has kept his knowledge up to date, has to some extent, of necessity, lost his original fire and enthusiasm. In one laboratory in the United States, such people are transferred to a group of consultants who are free of access to any individual in the company. In other places their experience is often used successfully in other parts of the company.

Another problem of great difficulty is to decide when a piece of work is complete. It is necessary to stop the work at suitable stages and consider how much can be applied, since it is through the application of research results that the upkeep of the laboratories is ultimately paid for.

Dr. I. J. Faulkner (I.C.I.), dealing with the organisation of research in the chemical industry, emphasized the necessity of not overburdening the research staff with administrative duties. It is also desirable that no individual should have to look after too many others; between four and six was considered to be the maximum. Such small teams can be easily handled, and all have a reasonably rapid approach to their chief.

A special type of organisation is required where research is carried out on a factory-scale. At the I.C.I. works at Billingham, semi-technical and pilot plant involve several hundred pay roll employees, as well as design, construction and maintenance engineers. This is all brought under the 'research works manager', who takes off the research staff the heavy task of administering this kind of large-scale research activity. He is directly responsible, along

with four other assistant research managers concerned with smaller scale research, to the research director.

The distinction between the research budget, the programme expenditure and the costing of research was also discussed by Dr. Faulkner. There are difficult decisions involved in the detailed costing of research, the allocation of costs and the definition of 'overheads', as well as in answering the all-important question, "How much should be spent on research?"

The third session, on the "Application of Research to Production", was opened with a paper from Dr. J. Park (British Oxygen Co.). Industry, and in particular the production man, the salesman and the accountant, live by what is being made now, and they inevitably acquire a vested interest in the present. The research man is concerned with what is coming next and is less interested in existing processes. The research department must win confidence at an early stage and prove that it is more than a 'frill' paid for by the profits of the other departments. It must remember that no new product is industrially significant unless somebody can find a use for it. A modest contribution to the company's present business may win more respect than a successful piece of fundamental work. Finally, the results of research must be effectively 'sold', the proper sales instrument being the concise and clearly worded research report.

Mr. L. J. Davies (B.T.H., Ltd.) classified industrial researches into five groups: (1) ancillary researches (instrumentation, measurement, etc.); (2) materials research; (3) process research; (4) design research; and (5) device research or invention. The difficulties, both technical and personal, which have to be overcome in the course of introducing new methods were illustrated by two examples taken from the electrical industry.

In the fourth session, on "Information and Intelligence, Publications and Publicity", Mr. O. W. Humphreys (General Electric Co., Ltd.) touched upon a topic which was much in evidence in the informal discussions throughout the conference, namely, the form and style of scientific reports. He said that the scientific paper enjoyable for style as well as subject-matter is all too rare; and he thinks that lectures on the English language should be included in all science and engineering courses. Any necessary reduction in the standard of the first degree would be worth it in return for some attention to the humanities.

Dr. C. G. Williams (Shell Petroleum Co.) spoke on the problem of keeping in adequate touch with the ever-rising output of technical literature. As much as can be assimilated in one to two hours a day of general technical reading was thought to be sufficient without too much interference with practical work or risk of mental indigestion. The habit of abstracting is valuable, but classification presents problems; there does not seem to be general acceptance of the Universal Decimal Classification.

The importance of presenting the results of research was emphasized by means of a formula:

$$\text{value of a research} = \frac{\text{worth-whileness of objective}}{\text{efficiency of presentation}} \times \frac{\text{effectiveness of reporting}}{\text{effectiveness of reporting}}$$

If any one of these three factors is zero, the result is zero.

Dr. L. B. Pfeil, in the first paper of the fifth session, described the relationships between the Mond Nickel

Co.'s Research and Development Department and the research associations, universities and Government departments. He made a strong plea for the expansion of Government research activities by enlargement of such establishments as the National Physical Laboratory. There is a great lack of fundamental data now badly needed by industry. Germany was, before the War, a substantial contributor to the pool of fundamental knowledge, but this source has dried up. The work of the N.P.L. and similar establishments is valuable, but much more is needed.

The universities should not generally be used as consultants by industry, but should concentrate rather on the task of providing men of sound character and personality who can think honestly and convey their thoughts with facility to others. Government grants to students and research workers are more helpful in this direction.

Mr. R. M. Winter (I.C.I. Ltd.) urged that fundamental research at the universities should not be swamped by purely tutorial duties. The training of first-class research workers is of more importance than a large output of technicians trained mainly in manipulative skills and laboratory methods. The present urgent requirements for scientific man-power should not be allowed to lower the standards of training of fundamental scientific workers. The Government's spending of £69 millions in 1947-48 on research and development, of which recurrent grants to universities and similar institutions accounts for only £3½ millions, invites comment, Mr. Winter said.

The discussions which followed each of the five sessions were so varied and often lively as to make them difficult to summarize. There appeared, however, to be a general concern over both the quantity and quality of new recruits to the industrial research laboratories. The problem of quantity is largely a result of heavy demand coupled with interruptions to the normal flow of graduates from the universities caused by the War and by the subsequent arrangements for military service. On the side of quality, there was a strong feeling that scientific education should be on broader and less specialized lines, particularly up to the first degree.

As regards the conference as a whole, there was a general impression that it had provided an excellent opportunity for the airing and discussion, between research executives in different industries, of many common problems and interests.

W. C. F. HESSENBERG

OBITUARY

Dr. G. Shearer

GEORGE SHEARER died on March 13 in Addenbrookes Hospital, Cambridge, on the eve of his fifty-ninth birthday.

Shearer entered the University of Edinburgh from George Watson's College in 1907, having taken high places in both the John Welsh Classical and Mathematical Bursaries lists: for his first session he read Latin and Greek, and graduated as M.A. and B.Sc. in 1910 in mathematics and natural philosophy. He remained at Edinburgh as an assistant in natural philosophy until the outbreak of the First World War, and during this period published his first papers, on atmospheric electric potential, and Fourier and periodogram analysis, in collaboration with Dr.

G. A. Carse; during this period, too, he began, under Barkla, his X-ray work, which was to be the main subject of his scientific work for the next quarter of a century. As an instructor lieutenant in the Royal Navy during 1914-19 he served afloat on navigational and gunnery duties.

On his release from war service, Shearer resumed his X-ray researches, going to Emmanuel College, Cambridge, as an 1851 Exhibition research student, and working at the Cavendish Laboratory under Rutherford. In 1922 he moved to London, as chief research assistant to Sir William Bragg, first at University College and, from 1923, at the Davy Faraday Laboratory, Royal Institution. During this period he was particularly interested in the newly discovered technique of X-ray photography of powders, and developed the application of this method to the study of the geometry and the symmetry, both of the crystalline arrangement and of the molecules themselves; one of his outstanding achievements was the X-ray chemical analysis and identification of long-chain ketones.

In 1927 Shearer was appointed to the National Physical Laboratory as a senior assistant to take charge of the work for the Committee on the Application of X-ray Methods to Industrial Problems. The group under his charge developed and used both X-ray and electron diffraction techniques, and devised various special items of equipment, such as a rotating anode tube. The problems tackled included the structure of many industrial materials (special steels, paint materials, carbon blacks, insulating materials, etc.) and the basic properties of metals. On the outbreak of the Second World War, he was transferred to the Metrology Division for work on gauges for war production. In 1941 he was seconded, and in 1948 was posted, to the Research Department (now the Armament Research Establishment) of the Ministry of Supply, in which he served until his death; in this last appointment he returned to Cambridge in charge of an out-station, and in 1947 his promotion to senior principal scientific officer enlarged his responsibilities to include the charge of other out-stations. The group of which he was the inspiration was studying the penetration of armour by projectiles, and their work contributed largely to the effectiveness of the British anti-tank artillery and aircraft cannon. Shearer's encouragement and guidance greatly facilitated the application to ballistic problems of such techniques as 'Arditron' flash photography and Kerr cell shutters.

Shearer was granted the degree of Ph.D. at Cambridge in 1921 and D.Sc. at Edinburgh in 1923 for his X-ray work. He was a fellow of the Institute of Physics and of the Physical Society, and a member and past president of the British Institute of Radiology. He also served as a member and chairman of the Committee of Visitors, and as a member of the Committee of Managers, of the Royal Institution.

On his return to Cambridge in 1941, Shearer again had rooms in his old College, Emmanuel. This was a great joy to him, although the arduous nature of his duties left him little leisure for his favourite recreations, bridge and golf, at both of which he was no mean performer. During these years he made a real contribution to the social life of the High Table and the Parlour of the College, and his wide interests and broad sympathies made him a gracious host to many official visitors. An able physicist, a wise administrator, and a modest man, he will be missed by many friends.