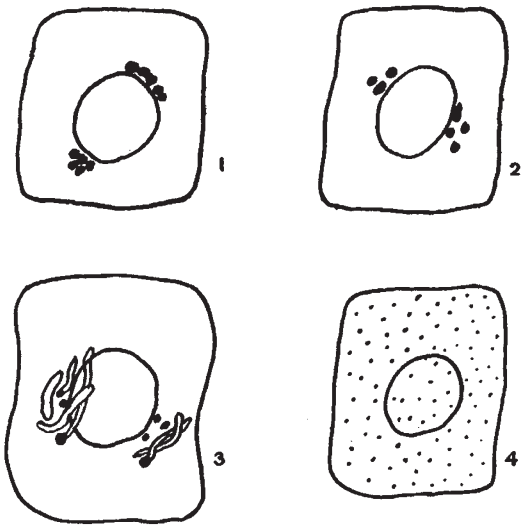

Figs. 1 and 2. Showing disposition of vitamin C granules in zona glomerulosa cells 30 sec. after contact with acetic acid – silver nitrate solution. Note that granules appear to have run together in one part of Fig. 1

Fig. 3. Cell of outer zona fasciculata twenty minutes after treatment with acetic acid – silver nitrate solution. Note myelin bodies and some black granules in association with them. Note other black granules separate from myelin bodies

Fig. 4. Cell of inner part of zona fasciculata 30 sec. after contact with acetic acid – silver nitrate. Note fine black granules scattered through the cytoplasm

of interest because it has been suggested that the vitamin C is not localized in any cell organelle, but that it is diffused throughout the cytoplasm. The apparent localization of these granules in the formed elements of the cell, it has been suggested, may be due to the aggregation of the silver particles in these regions following their production in the cytoplasm by the vitamin present there. If this were the case, one would expect the granules to come slowly into view, but in fact they come very suddenly into view; one moment they are not there and the next they are visible. This is not what one would expect if they developed in these sites only as a result of diffusion of silver micelles from the rest of the cytoplasm.

It is of interest that M. R. Lewis has shown[9] that if mice are fed Nile-blue sulphate, fine blue granules may be seen scattered through the body of many of the cells of the cortex. She found the distribution of these granules to correspond exactly with the distribution of silver granules in the adrenal cortical cells as demonstrated in rat adrenals by Dean and Morse[6] and in chick embryos by Barnett and Bourne[10]. Since the lipoid vesicles, from which Palade and Claude[8] claim myelin figures develop, have the ability to concentrate dyestuffs, these results suggest that, even when the vitamin C granules are widely distributed in the cell, they are still incorporated in what represents—although they are not localized near the nucleus—the Golgi system, or complex, of the cell.

After the disk preparations of the adrenal cortex had been under the influence of the vitamin C reagent for ten to fifteen minutes, myelin forms began to develop in the cells; but they did not blacken with the reagent, thus indicating that they contained no vitamin C.

After three minutes penetration, there was no sign of the yellow zone, and the first indication of the advancing silver ions was the sudden development of granules in one cell after another. In the inner parts of the disk Liesegang rings became obvious; their frequency was less than the diameter of a cell, so that individual cells had one or two bands across them in which the granules appeared more concentrated. It is of interest that Liesegang rings have never been observed in adrenals impregnated in the usual way by the vitamin C reagent.

These experiments support the observations of Palade and Claude[8] that treatment of cells with acids may cause the development of myelin forms. They also suggest that the Golgi nets described in the adrenal cortical cells are artefacts, and that the true Golgi element of the cortical cell may be represented by a series of vacuoles, probably phospholipoid in nature, which have the ability to segregate various substances, including dyestuffs. They confirm my previous contention that vitamin C is not diffused through the cytoplasm but is localized in the Golgi vesicles of the cell. They also show that although vitamin C is found in the Golgi vesicles it is not necessarily present in the myelin forms which have been described as the Golgi apparatus in the past.

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OPERATIONAL RESEARCH

APPLICATION TO PEACE-TIME INDUSTRY

SCIENCE in Great Britain is often accused of lagging far behind that in the United States in its application to industry. It is encouraging, therefore, to see the development in industry of the war-time technique of operational research. Such research is an attempt to apply scientific methods to determine the effectiveness of operations. The application was clear enough in many war-time problems where there were complex organisations, new apparatus and often inexperienced executives. It has the same role in industry—to discover and marshal the facts as an adjunct to the executive's experience and judgment and so help him to make rational decisions.

Many of the successes of operational research come from the study and improvement of traditional methods; it is, therefore, sometimes looked upon as a short-term policy to get quick results. Were it no more it would be valuable; but that it can do and is doing more is shown by the lectures and discussions held under the auspices of the Manchester Joint Research Council during the winter of 1949–50, now published as a booklet*.

An introduction by Prof. P. M. S. Blackett, reprinted from the *Operational Research Quarterly*, poses two questions: Is it scientific? Is it new? The first he answers "yes by definition"; the second is not so easily answered categorically. Prof. Blackett finds newness not so much in the material to which the scientific method is applied as in the level at which the work is done, in the comparative freedom

* Operational Research: its Application to Peace-time Industry. Pp. 152. (Manchester: Manchester Joint Research Council, 1950.) 10*s*. 6*d*.

of the investigators to seek out their own problems and in the direct relation of the work to the possibilities of executive action. One of the lecturers, Mr. A. W. Swan, puts rather a different view. In defining operational research as scientific management plus the statistical approach, he infers that the statistical approach is what makes this a new subject. The truth perhaps lies in a combination of these two ideas: on one hand the development of new scientific methods applicable to the problem (particularly the statistical approach); and, on the other, the development of a new scientist-executive relationship which makes possible the application of the new methods.

In the series of five lectures, examples are drawn from a wide field. Mr. H. Bradley shows how analysis of foot dimensions has pointed the way to a more rational range of shoe sizes. Mr. D. Hicks outlines the task of operational research in the coal industry, and Mr. L. H. C. Tippett shows what has been done by the Cotton Industry Research Association. An example of a study of the operations of a steel rolling mill is given by Mr. A. W. Swan, and Dr. W. H. Glanville explains some of the problems undertaken by the Road Research Laboratory of the Department of Scientific and Industrial Research.

These examples admirably illustrate the type of problem which the operational research scientist may be expected to answer. They do not perhaps always so clearly demonstrate the relationship between scientific worker and executive which is necessary to achieve successful results. Sir Raymond Streat finds this failure particularly obvious in the case of the two research associations and concludes that research associations, although doing much excellent operational research in the general field, lack the close contact with the executive which would be necessary for them effectively to carry out projects of this type in individual firms. It might be added that research associations are primarily concerned with their industry as a whole and mostly lack resources to commit to specific projects of interest only to individual firms. This leads on to a discussion of the important problem of the application of operational research in firms which are too small to have their own organisation for the purpose. It is clear that there is a strong case for some outside body to supply specialist operational research workers for particular investigations in such firms; and the tentative conclusion is reached that the most likely source of these is from paid consultants.

The special position of the operational research investigator in the works calls for outstanding qualities of personality. He must work for, and report to, the high executive; yet he must also win the confidence of the shop managers and workers if he is to be able to pursue his investigations freely and gain access to the essential facts. There is danger, however, of over-emphasizing the importance of this aspect and of forgetting the essentially scientific nature of the work. Operational research is more than just common sense. In the discussions at Manchester there appears such a tendency to stress the importance of 'the right personality' almost to the exclusion of anything else, scientific ability being held at a discount. Scientific ability and personality are not incompatible, and both are required in operational research.

In discussions of the technical knowledge required, it seems to be the general opinion that an operational research worker does not need a detailed knowledge of the industry in which he is to pursue his investigations. Indeed, it is argued that only a minimum of such knowledge is to be preferred, since much of the value of operational research lies in ceaseless probing of existing practices, and it is difficult to question practices which one has been brought up to accept. There is, however, much in the alternative view that the operational research worker will be lost without considerable background knowledge. The solution may lie in team-work; the team could be led by an outsider, who could introduce the new ideas and take away on his departure any opprobrium which might arise through unpopular recommendations, while some, at least, of the rest of the team could be normally employed in the factory or shop.

A final verdict is not yet possible on operational research. This booklet sets out to clarify thought on the subject; in this, it could perhaps have been improved by judicious editing to avoid the verbatim reporting of minor exchanges which are sometimes tedious in print. Nevertheless, it contains important ideas and opinions and well merits study by those interested either academically or industrially.

R. T. EDDISON

ADVISORY COUNCIL ON SCIENTIFIC POLICY

THIRD REPORT

WHILE the most important feature of the third report of the Advisory Council on Scientific Policy is the support it affords for the establishment of one or more higher technological institutions, with suitable governing bodies of their own but fitted into the university system, the report also contains ample evidence that the Advisory Council is discharging its other standing responsibility of reviewing the appropriate organisation for scientific research in government establishments in Britain. On the question of scientific man-power, the Advisory Council remains a little hesitant. It is plainly dissatisfied with the accuracy and comprehensiveness of the results obtained from the Ministry of Labour's Survey of Scientific Manpower, at least as a basis for concrete recommendations; but the Council should be seeking rather than hoping for other means of providing this type of information. Data collected by the Ministry of Labour lead to the general inference that we are approaching a point where the short-term demand for trained scientific workers may be satisfied, but where temporary maladjustments may occur; continuing shortages of chemists and chemical engineers and a probable surplus of biologists are specifically mentioned, while special stress is laid on the serious shortage of science teachers in schools and the probability that the present level of salaries will have unfavourable effects on the quality of men of science recruited for the teaching profession.

Here, as in the question of the supply of technologists, the Advisory Council does not accept the existing demand as the sole criterion. It believes rightly that if the value of qualified men of science in executive positions is properly appreciated the demand for them will show a marked increase, and, similarly, that the existing demand for technologists should not be taken as a measure of the numbers needed if British industry is to maintain and improve its position in the world. While the Advisory Council may well hold that it is premature to reach any firm conclusion as to the extent to which facilities for higher technolo-