

of ten south of a line drawn from the Humber to the Severn, and a deficiency in nine years out of ten in Essex, Suffolk and Kent. The magnitude of the deficiency varies from place to place and from year to year with theoretical values ranging from 1 in. to 12 in. of rain. The irrigation that would be needed to meet this deficiency would depend on soil moisture retention conditions and plant rooting characteristics, and might amount to a rainfall equivalent in some places of up to 6 in. All the water would be used in transpiration or evaporation, or absorbed by percolation, and would not be capable of re-use. Calculations indicate that a possible demand of some 8,000 million gallons a day might exist in very dry years south of the Humber-Severn line. This amount is more than four times that supplied in 1955 by all the public water undertakers in England and Wales, and it indicates the potential demand which exists and which the subcommittee has ignored in its first report. It is proposed, however, to give further attention to this problem, but the approach appears to be negative as the possibility is mentioned of some form of control over the abstraction of surface water analogous to the existing protection of underground water. If the national policy is to secure the maximum food output from the agricultural industry, farmers in south-east England should be actively encouraged rather than discouraged to irrigate, in which case a more positive approach to the water supply problem and a completely different attitude of mind are then needed.

The reluctance of the Subcommittee to look further ahead than 1965 is also unfortunate, although the difficulties can be fully appreciated. The Ministry of Health Committee on Causes of Increase in Consumption of Water (1949) was prepared to look ahead for a period of some 22 years up to 1970. Past experience clearly shows that water-supply schemes take many years to come into operation and that reliability in supply largely depends on one generation

planning for the next. The blue prints to meet the requirements of the late 1970's should be in process of formulation in the early 1960's if the real needs of agriculture and industry are to be satisfied.

Possible economies in the use of water in industry have also been deferred for future consideration, although the report does direct attention to waste prevention and leak detection; the recommendation is made that all water undertakers should operate an adequate waste prevention service.

There is clearly much food for thought in both of these reports. The rising standard of living of an increasing population in Great Britain has, in the present century, brought water to the forefront as a vital and essential commodity in the life of the nation. Although the natural resources of the country in terms of rainfall are theoretically adequate, Nature has a habit of distributing the precipitation unevenly in both time and place. This situation can only be remedied by care in use and by the conservation of supplies in periods and areas of plenty. Lowland Britain, where consumption is greatest, is also the area where the population is densest, the rainfall least and where local water resources are nearing full utilization. Highland Britain, on the other hand, has a low population, the highest rainfall and a relative over-abundance of water of which only a small proportion has yet been developed. To what extent would the gains from scientific irrigation in agriculture and a guaranteed domestic and industrial supply in lowland Britain outweigh the cost of storage and movement of water from highland Britain? And how far might the conversion of saline water in Great Britain assist in the solution of the water-supply problem? It seems that these are the major questions on water supply that must be answered if the problem is to be approached with vision and concern for the needs of the next generation.

W. G. V. BALCHIN

TEN YEARS OF ERGONOMICS

ERGONOMICS is mainly about 'human factors' in the design and operation of machines, and about the physical environments in which men use their machines. Moreover, it is multidisciplinary. Nobody who attended the tenth anniversary meeting of the Ergonomics Research Society, held in Oxford during April 6-9, could have much doubt on either of these points.

The Postmaster-General, Mr. Ernest Marples, apparently less damaged than he should have been by a 400-mile cycling trip in France on what seems to have been a highly unergonomic saddle, opened the conference. He had hard things to say about the word 'ergonomics'. Unlike his chairman, the Master of Balliol, who thought it was splendid because it told us exactly what it meant, Mr. Marples thought it was frightful because it did not. However, for ergonomics itself he had nothing but praise. The General Post Office had used it for nine years; and it was his intention to build it into the General Post Office structure so firmly that it could be got out again only by 'positive action'. He pledged his support for everyone, everywhere, including housewives in their kitchens, who moved ergonomically with the times.

Following up a point Mr. Marples made about the frequency with which "backroom boys" are either not understood or misunderstood, Sir Frederic Bartlett, formerly—for twenty-one years—professor of experimental psychology in the University of Cambridge, inquired how common difficulties of communication might be overcome, so that proved advances (for example, in the design of altimeters) might be adopted with reasonable rapidity. Mr. Marples advised him to get into touch with the top people concerned, or with the Parliamentary and Scientific Committee, or with Mr. Marples himself. Sir Frederic looked rather less happy about this than did Mr. Marples.

There was more to come from the General Post Office. A paper by Dr. R. Conrad, of the Medical Research Council Applied Psychology Unit at Cambridge, dealt with mass communication systems; and a couple by Dr. W. F. Floyd, of the Middlesex Hospital Medical School, and Miss June I. Jones, of the General Post Office, covered some problems of lighting, posture, thermal conditions and energy cost of work in telephone exchanges and Post Office factories. These gave a clear indication of what ergonomics amounted to in practice. Dr. Conrad told us that to obtain a weather report he had to

dial 96618312274. As this kind of thing was spreading, it had been decided that some General Post Office-based studies of immediate memory might pay off. One proved useful in comparing conventional dials with push-button arrangements; and another helped in working out the kinds of codes that might be suitable for trunk numbers or postal addresses. Dr. Conrad's concern with efficiency was matched by the interest Dr. Floyd and Miss Jones displayed in comfort; but Dr. Conrad led the other two in his theorizing.

These three early speakers did, in fact, throw up, without explicit formulation of them, problems which were to rear their heads frequently during the conference. What had Dr. Conrad in common with Dr. Floyd and Miss Jones apart from the General Post Office roof over his head? All he said—and, indeed, all his director, Mr. D. E. Broadbent, said in a later paper—could easily have been labelled 'applied experimental psychology'; and all that Dr. Floyd and Miss Jones said is usually called 'applied physiology'. Where does ergonomics come in? Does it seek to be regarded as a new science? If so, on what is its claim to independent scientific status founded? Has it any distinctive concepts or methods? Is it, perhaps, mainly a convenient gathering-place for people belonging to certain technological wings of certain human sciences, and their agents and users in industry?

As if these puzzles were not enough for us, more were produced by delegates who came from the work-study sector of industry. One, Mr. A. Graham, of Imperial Chemical Industries, created a small squall after some plain speaking by Mr. H. Murrell, the founder of the Society. Mr. Graham asked scornfully why industry should be expected to prefer the 'toothpick' of ergonomics to the 'pneumatic drill' of work-study; and having delivered himself of this broadside, he switched on his own pneumatic drill and demanded that work-study practitioners should be offered both help and respect. He gave the impression that what was really worrying him was the intrusion of still more outside 'experts'. At this point Mr. A. T. Welford, the editor of *Ergonomics*, deftly applied the oil-can. However, it seems that later in the day, at the Society's annual general meeting, Dr. E. A. Müller, of Dortmund, set the cat among the pigeons again by suggesting that meetings between research workers and people from industry were a doubtful blessing and should be only occasional.

It may appear, from all this, that the conference was a bit of a mix-up. So indeed it was. But it was probably a healthy one. The physiologists and psychologists, though going their separate and unintegrated ways, somehow did battle together with the delegates from industry. True, each side paid tribute to the other and to some extent shared a common cause; but the sparks flew. Perhaps even more would have flown if the meeting had been held in less academic surroundings. The industrial contingent were inclined to be a little shy.

The nature and quality of the papers were as mixed as the audience. Though the title given to the conference as a whole was "Symposium on Ergonomics, its Place in Industry (Past Progress and Future Trends)", only a few of the contributions played up to it. These came mostly at the beginning, from Mr. Welford and from Dr. O. G. Edholm, of the Medical Research Council Division of Human Physiology; and at the end, from Mr. Broadbent,

from Dr. E. H. Christensen, of Stockholm, and from Mr. L. V. Green, of Dunlops. The rest were chiefly individual papers. Among them were a description of work done on design problems in E.M.I. Electronics, given by Mr. B. Shackel; and an account of activities in the Clothing and Stores Experimental Establishment of the Ministry of Supply, given by Dr. E. T. Renbourn and Mr. H. C. Stockbridge. Mr. C. E. Brooks, of Personnel Administration, Ltd., had some sensible things to say about improving the quality and output of inspectors by systematic re-training, but the information he produced in support of his findings did not carry conviction to everyone; nor did it seem to have much to do with ergonomics.

Despite this bitterness, a good deal of stimulation was provided. Mr. Murrell's own contribution, mentioned earlier, was not what he meant it to be, because a midnight argument had made him decide to scrap the original. In the event it turned out to be a usefully provocative statement about what 'ergonomists' could do for industry that methods engineers could not. They could bring to their task knowledge of the capacities and limitations of human beings not to be found in the publications of Shaw, Mundel or Barnes. More than that, they could bring to it skill in the conduct of experiments with 'chaps'. A methods engineer plus a psychologist or half a physiologist would produce a different outlook on industrial problems. This was the straight-from-the-shoulder stuff that caused offence to Mr. Graham. To some others it caused perplexity, for it left unclear the distinguishing characteristics of the ergonomist, the psychologist, and the physiologist. A few among the faithful were dismayed, because although they talk about ergonomics, they do not like the label 'ergonomist'.

In a comment on a paper by his E.M.I. Electronics colleague, Mr. J. R. Arrowsmith, Mr. Shackel had a good point to make about the function of machines in relieving the anxieties of skilled men who build up great tension as the possibility of spoiling several days work mounts. So had Mr. Broadbent, in the same discussion, when he remarked that in our hopes for the elimination of human error, through the taping of instructions, we must not neglect the risk that the typist typing the tape may err. Earlier, Mr. W. D. Seymour had asked, rather drily, how many of the matters discussed at the conference had not been investigated by industrial psychologists twenty-five years ago.

So some extent, Mr. Seymour's question was answered in a later contribution by the present writer, who made comparisons between the first ten years of ergonomics and the first ten years of occupational psychology. The chief differences seemed to lie in the wider scope of occupational psychology. It encompassed problems of 'fitting the man to the job' as well as problems of 'fitting the job to the man'; and it studied attitudes as well as skills. Dangers arising from narrowing the range of the industrial problems taken into account were illustrated by Dr. J. J. O'Dwyer, of Unilever, who spoke about informal groups in industry, and the importance of perceiving and using them; and by Mr. R. M. McKenzie, of the Social Sciences Research Centre at Edinburgh, who showed—entertainingly—how social factors could keep a worker's output well below his potential.

What of the next ten years? If the members of council of the Ergonomics Research Society have not

yet drawn their conclusions from their experience of the first decade, they might think about covering the following points in their discussions. First, there is perhaps little to be gained by making ergonomics out to be a science. It is a kind of conglomeration—not even a compound—of technologies; and it might be a good thing for it to continue like that. Possibly the Society should be content to serve the same kind of admirable purpose as the British Nuclear Energy Conference, which pulls in people from a number of fields without seeking to detach any of them from their primary allegiances.

Secondly, there is undoubtedly a lot to be said for the running of courses of lectures and practical work for people, from a variety of levels and types of work, who are faced with 'ergonomic' problems. The short Bristol course outlined by Dr. S. Griew seems sound in its aim, which is to put across useful facts about the structure and functioning of the human body; to show where more can be found; to explain and demonstrate experimental approaches to problems of equipment design; and to suggest that 'fitting the man to the job' and 'fitting the job to the man' should often be tackled together.

Thirdly, however, there is perhaps room for far more stress on the need to look into, learn about and teach people about, individual differences, especially on the psychological side. Mr. Stockbridge's *cri-de-coeur* ("Individual differences are a frantic nuisance. . . . If only we had a standard man . . .") brought out this need. Some workers in this field are clearly tempted, not merely to wish that there were such a creature, but to assume that there is. Mr. Welford seemed almost to succumb when he spoke hopefully

about the discovery of 'standard times' for mental operations, and more particularly when he hinted that one had been run to earth in Antwerp, where telephonists had consistently coped with five bits of information a second. Dr. Conrad, commenting on this later, unwittingly challenged Mr. Welford by revealing that Norwich girls could manage seven without any trouble.

Discrepancies like this cannot really be met by jocular references to the possible existence of 'national' differences. They must be taken seriously. Could they arise from differences in the kinds of people being guided into and selected for the work in different places or at different times? Or from differences in training arrangements? Or from differences in methods of work adopted? Or from differences in equipment? Or from differences in working conditions of several kinds, including the physical, the social and the financial? All these and other possibilities should be explored.

But here we encounter two important snags. Can exploration of the kind needed be carried out satisfactorily on the tiny, homogeneous, doubtfully relevant groups often used by researchers in the vast field of ergonomics? And can it be tackled adequately by researchers whose devotion to 'precise' measurement is such that they are inclined either to forget or to ignore deliberately the existence of possibly influential factors which lie beyond the reach of their cherished clocks and counters? The state of play in ergonomics ten years from now may depend a good deal on the answers the Council of the Ergonomics Research Society gives to these two questions.

ALEC RODGER

DISTRIBUTION OF SCIENTIFIC PUBLICATIONS IN UNDER-DEVELOPED COUNTRIES

THE Scientific Publications Council, which has recently been formed, includes the editors of twenty scientific journals and the authors of a number of scientific books. It was started by a group of scientists who felt the need for an independent body that could uphold the interests of scientific authors and editors in working for higher standards in the publication and distribution of scientific books and journals. The Council is intended to provide a means for scientific writers and editors to maintain contact with each other and exchange views with others concerned in scientific publication in Great Britain and overseas: it provides a forum for the discussion of matters of mutual interest and a means of obtaining advice in technical and legal matters relating to publication. It is intended that the Council should work to establish good relations between scientific writers and publishers, and co-operate in setting up agreed standards that are acceptable to scientists and publishers alike. The officers of the Council are appointed for a term of three years; Prof. G. W. Harris is chairman of the Council and Dr. D. Richter, Neuropsychiatric Research Unit, Whitchurch Hospital, Cardiff, is honorary secretary.

At a meeting of the Scientific Publications Council held on April 10 at the Ciba Foundation, London, Mr. John Hampden (British Council) opened a discus-

sion on the distributions of scientific publications in the under-developed countries. He described the difficulties experienced in many countries in obtaining British books and periodicals. In Asia and Africa there is rapidly growing up a new literate class which wants to read, but in many places no British publications are available. In some places it is hard to persuade any bookseller to obtain them, as the necessary currency authorization is difficult, expensive or impossible to get, and the profit is small. On the other hand, there is an abundant supply of State-subsidized cheap editions from the U.S.S.R., China and also the United States. The English language is now an international possession. The students wanting books are the scientists, professional men and leaders of the future, and it is bound to affect their future reading and outlook if the only books they can get are not British.

Currency shortages are mainly responsible for the situation in some countries, including Poland, Turkey, Israel, Pakistan and Indonesia. How can people in these countries buy British books and periodicals if they have no sterling to pay for them? Other difficulties in some countries include the shortage of bookshops stocking British books and the lack of libraries where British publications can be seen. The difficulty is especially acute for scientific