# IRRIGATION IN GREAT BRITAIN

THE water supply problem created by the spread of irrigation in Great Britain has already attracted the attention of the Central Advisory Water Committee of the Ministry of Housing and Local Government. A preliminary study was undertaken by the Sub-Committee on the Growing Demand for Water and forms the subject of the committee's second report issued in 1960. It was, however, a very brief document of two pages; the first detailed and objective study of irrigation in Great Britain in which practically all aspects have been covered has been prepared and recently published as a report of the Natural Resources (Technical) Committee of the Office of the Minister for Science[1]. It is a notable document which casts considerable light on a significant agricultural trend about which few quantitative data have hitherto existed.

The report, prepared by a strong sub-section of the Committee on Agriculture, examines the possibilities and consequences of irrigation in Great Britain. It brings together a considerable range of available information on crop responses, costs and returns; and assesses the likely value of irrigation to the farmer and to the community. Tentative estimates are also made of the potential demands for water for irrigation.

It is quite clear from the report that irrigation of certain crops in parts of Britain can lead to a major increase in productivity. With the continued loss of agricultural land to housing, industrial and amenity uses, and the need to produce at home the major portion of the food for the inhabitants of these islands, the extension of irrigation in the right areas could become a significant factor in promoting economic recovery coupled with an increasing standard of living. The main problem is, of course, the need to provide the water in the right place at the right time.

The area where irrigation can be utilized to increase output, reduce unit costs and improve efficiency of production is very largely that part of England receiving less than 35 in., together with that part of Scotland receiving less than 30 in., of rain a year. The frequency of the need is greatest in the south and east, being about nine years in ten in the Thames Estuary and diminishing north and westwards towards the higher rainfall areas. In most years up to 4 in. of rain would be needed to make good the shortage. At present some 130,000 acres of land are irrigated, and this is increasing by about 15,000 acres per annum. If expansion continued at this rate some half a million acres might be subject to irrigation by 1980. The application of 4 in. of water to this area would, according to the Natural Resources Report, require 50,000 million gallons. Rough estimates of the eventual practical limits suggest an area of $1\frac{1}{2}$ million acres with a peak annual demand of well over 100,000 million gallons. This represents a possible peak daily demand for water ranging from about 2,000 million gallons a day in April and September to 3,000 million gallons a day from mid-June to early August. This is in excess of the total amount of water at present being supplied throughout the country by all statutory water undertakers.

The water so far used in irrigation has been obtained from a variety of sources of supply, and increasing competition with other users has raised many problems. The irrigation demand varies considerably and reaches its maximum when supplies are often at their lowest. It is clear that substantial expansion in irrigation will only be possible by increased conservation, mainly by storage of excess winter flow. The report considers the ways and means whereby this can be most effectively undertaken and suggests in the first instance the extension of farm conservation schemes by means of storage reservoirs. More than 250 of these have already appeared in the past year or two. Eventually, however, the problem can only be solved by the transfer of surplus water from the wetter highland zone of Britain to the drier lowland zone.

At present the water is largely applied by overhead spray methods. To be effective the farmer needs to know when to spray and how much to apply. The report details the technique which has evolved so far. Some interesting figures are also given for the likely return in both production and value. Maincrop potatoes receiving about 4 in. of water may give an increased yield of 3 tons per acre, valued at about £50; cauliflowers, receiving 2 in., an increase of 3 tons, valued at up to £150; soft fruits, receiving 2–4 in. of water, an increase of yield of from 20 to 50 per cent valued at between £50 and £100 per acre. Grass may give an increased return of about £20 per acre from 5 in. of water, but here the cost of the water becomes critical.

The actual costs of the irrigation vary according to the availability of water and equipment. For the now almost standard overhead spray method capital costs come out at about £25 per acre. Where water is 'free' running costs plus depreciation and interest may average out at 45*s*. per acre-in. of water for an application of 3 in. The detailed economics of irrigation have yet to be worked out, however. But it is quite clear that the method pays dividends almost everywhere with vegetables, fruit, potatoes and peas, but that it might be marginal with grass, sugar-beet, field beans and cereals.

The Committee comes, without difficulty, to the conclusion that the judicious use of irrigation in agriculture and horticulture should be encouraged. It recommends that active steps should be taken to improve conservation of water, especially by local storage in small units close to the land to be irrigated. In the larger sphere conservation works should be properly planned in relation to each other and in conjunction with the proper development of the water resources of a particular river basin. Demands for water for irrigation should, it is thought, be considered together with demands for water for industrial purposes. Further research is also considered desirable on the fundamental, technical and operational aspects of irrigation and for this purpose a research station or experimental husbandry farm is proposed. The need is also expressed for longer-term quantitative rainfall forecasts to avoid wasteful application of water.

A few years ago any suggestion of irrigation in Great Britain would have produced a derisory reaction

in most individuals. This new Report, however, demonstrates quite clearly that the scientific application of water over much of lowland Britain would constitute a minor agricultural revolution, increasing output and strengthening our economic position immeasurably. To bring this about, however, requires a national approach to the problem of water conservation in Great Britain. Encouraging progress is, however, now being made in this direction[2,3].

W. G. V. BALCHIN

[1] *Irrigation in Great Britain, a Report by the Natural Resources (Technical) Committee, Office of the Minister for Science, London.* (H.M.S.O. 1962.) 5*s*. 6*d*.
[2] *Water Conservation, England and Wales.* (London: H.M.S.O., 1962.) 1*s*. 3*d*.
[3] *Nature*, **193**, 1244 (1962).

# DIAMOND PHYSICS

THE 1962 Diamond Conference, sponsored by the De Beers Group, was held at Cambridge during June 25–26; the delegates were accommodated in Gonville and Caius College, and the conference sessions took place in the Hopkinson Memorial Theatre. The sixty or so members were drawn from universities, research establishments, and the research laboratories of the diamond industry; in addition to England and South Africa, the United States and several European countries were represented. The attendance might have been greater had the First International Congress on Diamonds in Industry, with its scientific and technological sessions, not taken place in Paris only four weeks previously

The Diamond Research Laboratory in Johannesburg was the originator of this conference, and much of the work in this field is done by members of that body, either in their own departments or during secondment to other laboratories. While the conference is not in itself a novelty (it has been held on twelve occasions previously), it has always been regarded up to now as a wholly private occasion, and for this reason no reports have been issued. This has in no way implied a prohibition on publication (most of the papers presented have been published in some form in this or other scientific or technical periodicals), but formal Proceedings have not been issued, and direct reporting by the Press has not been allowed. Although this meeting is still private in the sense that attendance is only by invitation, the papers are to be published as from the conference and reports of its activities will be permitted.

As at all the previous Diamond Conferences, the range of the subjects covered was extensive, from the history of the early attempts at diamond synthesis to the latest investigations of present-day synthetics, and from geology to nuclear physics. In fact, although the history of research into the nature and properties of diamond has a respectable antiquity, there is still a vast field for further exploration into a material that is unusual from a number of points of view.

The conference was divided into four sessions; the morning of June 25 was devoted to the nuclear physics and electronics aspects of diamond, while the afternoon covered the geological aspect and the growth history of diamonds. Tuesday morning had as its principal subject the mechanical strength of diamond, and the afternoon was given up to a miscellany of papers. The conference ended with a dinner in the hall of the College; not the least important part of conferences such as these is the opportunity they give for meeting and talking informally to other workers in the same field.

As has now come to be expected on these occasions Prof. S. Tolansky (Royal Holloway College) produced a number of remarkable slides of the surfaces of diamonds, both natural and synthetic, produced by the multiple beam interference method which he has developed to a high degree of excellence. Another paper illustrated by extremely interesting pictures was that prepared by Dr. T. Evans and C. Phaal (University of Reading) and presented by Dr. Evans. The subject was "Transmission Electron Microscopy in Diamond", and the description of the techniques used for the preparation of the samples was as interesting as the results obtained.

The three papers presented by Dr. D. R. Grantham (Selection Trust), Dr. P. Stevenson (Royal Holloway College) and Dr. M. Seal (Engelhard Industries Inc.) on coated diamonds and growth history of diamond crystals produced some controversial matter; it is clear that this is a field in which a considerable amount of investigation still remains to be carried out. Even the meaning of the commonest of all the surface features of natural diamonds—the trigons that appear so numerously on the octahedral faces—still remains in doubt, and the two schools of thought that relate them respectively to growth and to etching seem to be still far from reaching agreement; it is interesting to note that these features seem to be rare on synthetic diamonds, although very common on the natural stones.

Dr. E. M. Wilks (University of Oxford) produced some interesting facts on the effects of neutron irradiation on the mechanical strength of diamond, including a checkered cracking effect produced during polishing the diamond (by methods similar to those used in gem polishing); these, to judge by the illustrations shown, may well be analogous to the 'fire marks' known to be produced in polishing synthetic sapphire, which are due to local strain.

The cleavage of diamond and the propagation of fractures were dealt with by Dr. J. H. Brunton (University of Cambridge) and Dr. J. E. Field (University of Cambridge) respectively. Dr. Field's ultra-high-speed photography and the calculations resulting from it have produced interesting information about the speed and method of the propagation of cracks started by small explosive charges and mechanical impact at different points in sample pieces, and Dr. Brunton's paper made it clear that the differences of energy involved are not in themselves sufficient to account for the marked preferential cleavage of diamond along octahedral planes.

In a second paper, read during the last session of the conference, Dr. Seal reported on electron microscope investigations made on the 'Hannay Diamonds' from the British Museum (Natural History), and although his results were not conclusive he appears to have added some further evidence for the genuineness of Hannay's success in diamond synthesis; Dr. H. J. Milledge announced that University College, London, was undertaking further work on these diamonds using X-ray diffraction methods, and the