parations seems to produce antibodies. In assessing the results of treatment the radiological response, provided it is carried out in the right way, seems to be superior to biochemical measurements.

PLANT BREEDING

Aseptic Culture Methods

from a Correspondent

THE European Association for Research in Plant Breeding (Eucarpia) held a very useful meeting on aseptic culture methods in plant breeding in Leeds during July 9–13. Because of the unavoidable absence of Professor H. W. Woolhouse, head of Plant Sciences, University of Leeds, the chair was taken at the first session by Mr D. Harberd, the local organizing secretary. Dr G. G. Henshaw (University of Birmingham), on the use of tissue culture storage for gene banking, reviewed problems of genetic and morphogenetic stability, and possibilities of low temperature storage. Dr C. L. A. Leakey (University of Cambridge) chided both plant breeders for being too conservative in their use of culture methods and plant physiologists for being too little concerned with the very real needs of plant breeders. This theme recurred repeatedly throughout the week and the greatest success of the meeting must be the way that members of the different disciplines learn to appreciate one another's problems.

The second day, chaired by Dr C. North (Scottish Horticultural Research Institute, Dundee), was concerned with the more applied and plant breeding aspects of tissue culture techniques. Five contributions during the morning explored the use of micropropagation techniques in a variety of crops. Dr P. Boxus (Centre de Recherches Agronomiques, Gembloux, Belgium) showed how it is possible to propagate a potential new strawberry cultivar from a single plant to 160,000 in only 8 months and on a similar theme Dr G. Hussey (John Innes Research Institute, Norwich), contrasting the responses of many bulbous crop species, covered the background of research necessary to establish a viable micropropagation technique for a specific crop. Dr P. C. Crisp (National Vegetable Research Station, Wellesbourne) described how a propagation technique for cauliflower can be used to unravel genetical problems during a breeding programme.

The afternoon session was devoted to the problems of genetical and cytological stability in culture. Occurrence and origin of cytological variation in culture were reviewed by Dr M. Bayliss (University of Leicester); mutational changes precisely like those in natural plant tissues seem to occur at a greater frequency in culture, particularly in callus and free cell, and are often selected for by the culture environment. In a notable contribution on chysanthemum Dr B. J. Machin (Frampton's, Chichester) indicated how intraclonal variability magnifies the problem.

On Wednesday, Professor H. E. Street (University of Leicester) chaired a series of eleven contributions of a more physiological nature. Uniformity, reliability, loss of potential, physiological control of development and responses to modifications of culture methods were the themes that recurred repeatedly. Drs S. Smith (Twyford Laboratories, Baltonsborough) and K. K. Nag (University of Leicester) again indicated that changes in properties can be attributed to unconscious selection for mutant strains within culture lines. Dr R. H. J. Kessell (Unilever, Bedford) gave an account of his evidence for believing that the local oxygen supply largely determines whether differentiation is along the rhizogenic or cauligenic pathways. Dr H. W. Kohlenbach (University of Frankfurt) described his attempts to regenerate whole plants from single mesophyll cells in species other than those from the families Solanaceae and Umbelliferae, and Professor W. R. Sharp (State University of Ohio) questioned the role of naturally occurring alkaloids as possible growth factors in those species that possess them.

The highlight of the week came on Thursday when Professor Y. Demarly (University of Paris, Orsay) chaired a series of contributions, largely from France, on pollen culture for the production of haploid plants. Dr C. Nitsch (CNRS, Gif-sur-Yvette) reviewed progress towards the culture of isolated pollen grains along the embryogenic pathway; particularly notable was her belief that a principle with the property of inducing embryogenesis in the pollen grains of species which have not yet responded might be extractable from embryonic anthers. She also told how low temperature treatments properly applied can greatly enhance the success rate in embryogenic cultures. Several workers who have recently studied in Dr Nitsch's laboratory pursued in greater depth specialized areas of these studies; for example, Dr K. Engvild (Research Establishment, Risø, Denmark), on the occurrence of diploid and triploid embryos in the pollen cultures of some species, Dr P. Debergh (Laboratorium voor Tuinbouwplantenteelt, Gent), on tomato haploid production, and B. Noreel (CNRS, Gif-sur-Yvette) on histochemistry and fine structure of androgenetic embryogenesis. Drs E. Picard and J. de Buyser (University of Paris, Orsay), described attempts at wheat anther culture, and Dr G. Pelletier (University of Paris, Orsay) drew attention to the particular importance of the anther wall in the process of androgenesis—and the possibilities of using nurse cultures of one species to stimulate pollen embryogenesis in another. In a specially extended contribution to include some of the very recent ultrastructural studies at the John Innes Institute, Dr N. Sunderland contrasted in detail the changes from normal development that occur in both tobacco and potato pollen after embryogenesis has been induced.

The final day was chaired by Professor D. R. Davies (John Innes). Production by embryo culture of hybrids from wide crosses was described by Dr North for *Lilium* and by Dr Harberd for *Brassica*, and though these techniques are still under-used by plant breeders the principal papers of the morning were even more forward looking. Dr M. Zenteler (University of Poznan) described progress towards very wide crosses, even at family level, by test tube fertilization. Dr C. J. Jensen (Research Establishment, Risø, Denmark) described the peculiar case of haploid production in barley following the embryo culture of hybrid embryos and the natural elimination of the foreign chromosomes: a technique with very real plant breeding potential. This contribution stimulated much discussion, and Professor K. Kasha (University of Guelph) was able to give further details.

In the afternoon new developments and their potential for plant improvement were discussed. Professor E. C. Cocking (University of Nottingham) reviewed progress in somatic hybridization of naked plant protoblasts and indicated possible implications for the plant breeders of the future. Professor G. Melchers (University of Tübingen) first reminded plant geneticists of the advances made by animal workers through somatic cell genetics and he forecast that parallel advances should ultimately be possible in the plant kingdom. He then talked about the successes of mutation genetics in lower organisms and pointed out that many of these could be achieved in higher plants grown as single cell cultures. This last point was well illustrated by Dr P. Maliga (NPI für Biologie, Szeged, Hungary) and his colleagues who have established streptomycin resistant cell lines from tobacco callus; plants regenerated carrying the new character as a heritable feature.

In summary of the whole week Professor Davies commented that, though plant breeders had shown some reluctance to make much use of aseptic culture methods in the past, it was clear that physiologists and others had opened the way. Callus culture and free cell culture techniques do not yet seem quite suitable for large scale use by plant breeders, though the potential is there, but techniques of culture of meristems, embryos, and, more recently, pollen grains, are already available.