POTATO DISEASES

POTATO production is beset with persistent troubles which all add to uncertainties of cropping, so potently felt in Britain at present. In addition to vagaries of weather, it sustains the heaviest loss from disease of any single crop—28 per cent of total value in west Scotland, and only about half this loss is controllable by economic methods known at present. Here is a challenge, and it is most opportune that the Pathology Section of the European Association for Potato Research arranged a meeting at the Edinburgh School of Agriculture during March 26–29. It was particularly well organized by Dr. A. E. W. Boyd, chairman of the Section, with the assistance of Dr. J. H. Lennard as secretary.

The first session discussed black scurf (*Rhizoctonia solani*) and common scab (*Streptomyces scabies*), two 'nuisance' diseases which reduce market value in times of plenty, out of all proportion to their minute effect on nutritive quality though *R. solani* can also reduce the yield. R. E. Labruyère reported the appearance of both diseases in newly reclaimed virgin polders in the Netherlands; infection by *R. solani* (though not of scab) could best be prevented by treatment of seed tubers with organo mercury compounds. In Sweden, G. Smedgard had used thiram powder (TMTD) as a control of black scurf on the tubers, with increases of yield between 8 and 16 per cent. Elizabeth G. Gray reported that fumigation of washed or brushed tubers with trichloroethylene greatly reduced germination of sclerotia, but warned that the bacterial disease blackleg could be increased by washing and chemical treatment. Organo-mercurial compounds are toxic, and D. C. Graham has investigated the use of safer organo-tin substances; one gave good control of *R. solani* but is at present uneconomic. Soil treatment with PCNB was found by O. Wagn to control both scab and black scurf in Denmark. B. G. Lewis described his experiments on moisture-level in scab infection, a subject on which much information is needed. Control by resistant varieties would be ideal though commercial stocks are all more or less susceptible, but R. K. McKee described the testing of new varieties.

Potato root eelworm, *Heterodera rostochiensis*, is not so much a cause of present loss as a huge menace for the future. The present policy is to avoid potato growth in infested ground; but the amount of eelworm-free land is diminishing exponentially. Again the ideal solution would be to produce resistant varieties, and suitable genes occur in certain wild *Solanum* varieties. There are, however, resistance-breaking biotypes of the parasite, as described by J. M. Dunnett (Scotland) and C. A. Huijsman (Netherlands). An extensive survey by F. G. W. Jones, followed by detailed assessment, showed that resistance derived from *S. andigenum* would be immediately useful on about half the potato fields of Britain, that from *S. multidissectum* on about one in ten and that from *S. vernei* on about nine out of ten. The possibility of obtaining clones resistant to more than one biotype has been investigated by H. W. Howard, using hexaploid *S* × *juzepczukii*, but so far no seedlings with dual resistance have occurred. H. den Ouden showed that eggs from cysts less than a year old gave lower rates of reproduction than those from more mature cysts, and E. Dunn described how 'pre-conditioning' at 32° C. stimulated greater larval emergence than at lower temperatures. In direct control, J. E. Peachey found the most satisfactory assay of performance was by root invasion and that sodium methyl dithiocarbamate was the best of 12 compounds tested. J. Grainger described practical 'disease escape' where first-early potatoes can grow before the eelworm becomes active at a soil temperature of 7° C. A suitable variety must be able to devote a large proportion of its dry weight to tuber production during low temperatures and short, dull days, and, so far, none better than the variety Epicure has been found. He also demonstrated a new type of tractor-mounted machine for mixing the cheaper non-volatile control materials very intimately with the soil mass, thus bringing the possibility of control sufficiently economic for field use.

An urgent problem with bacterial disease is to exclude from temperate countries the pathogens *Pseudomonas solanacearum*, causing brown rot, and *Corynebacterium sepedonicum*, giving a tuber ring rot. Bacteriologists held a separate session under the chairmanship of Dr. D. C. Graham as a result of the European Plant Protection Organization conference on this subject in Paris, 1960. A. C. Hayward reported four strains of the brown-rot organism and the discovery of such variants makes it more imperative than ever to avoid the introduction of this disease on ware potatoes imported during the present potato shortage in Britain. International quarantine arrangements make a co-operative approach impossible, so the value of such consultations as were held in Edinburgh is greatly enhanced.

Late blight, *Phytophthora infestans*, is the most serious potato disease at present. G. A. de Weille showed that bright sunshine reduced spore germination by lowering air humidity and by direct inactivation. Sunshine and rainfall forecasts can be used to predict the progress of crop infection. I. F. Storey found that only some 'Beaumont' periods actually forecast the first appearance of the disease, and V. Mélard compared genetically produced field resistance of the foliage with hypersensitive resistance and correlated both with tuber resistance, where the disease causes the heaviest loss and that most difficult to control.

The production of virus-free potato seed has helped to stabilize yield more than any other factor, and the process could be carried further if transmitting aphids on the crop could be controlled. Menazon, a systemic insecticide, has been used by J. F. Newman as a tuber dressing to protect the young sprouts for eight weeks, and C. E. Taylor reported a correlation between severity of aphid attack and physiological state of the host plant. Short communications were made by Maria Kostrowicka (unusual symptoms of potato rots), Mary Noble on races of wart disease which can attack 'resistant' varieties, and E. P. Keller on the detection of tuber discolorations by the relative transmission of strong light through them. Visits

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were made by members of the conference to the Scottish Plant Breeding Station, Pentlandfield, for demonstration of genetic resistance to blight, root eelworm, scab and viruses, and the Agricultural Scientific Services Station of the Department of Agriculture and Fisheries for Scotland, for disease testing, eelworm assessment and experimental washing and disinfection. Visits were also made to the original Wedderspoon plant at Castleton, Eassie, for commercial washing and fungicidal dipping, and a store at Muthill, Crieff, where the palette system of storage is utilized, and where fungicidal dipping of cut ware tubers is carried out before planting. An informal reception by the Potato Marketing Board completed the proceedings.

Shortage of potatoes engenders public clamour and the acceptance of relatively low standards of quality: excess of supply excites less comment, but brings a fussy rejection of tubers with but slight blemish from scab or blight. Neither extreme is good, and the Potato Marketing Board has gone as far as it can by administrative means to steer between plenty and scarcity. The only valid long-term solution requires the technical discovery of an economic method of preserving surplus production for human food in times of shortage, and the Board has initiated a research programme that includes this. Such a technical solution would, moreover, contribute to the larger question of adjusting the world's food supply to its growing population. J. GRAINGER

THE BIOLOGICAL ENGINEERING SOCIETY

THE Biological Engineering Society held its second meeting of the year in the Physiological Laboratory, Cambridge, during March 23 and 24, under the chairmanship of the president, Prof. R. Woolmer. Sir Bryan Matthews, the guest speaker, described some engineering methods in physiology. Sir Bryan gave some instances both of the way in which apparatus has been designed at Cambridge, both past and present, to assist in teaching and research, and of the ways in which advanced engineering principles are found in biological material; the mammalian ear was invoked as an elegant example here.

P. E. K. Donaldson (Physiological Laboratory, Cambridge) described a machine for the automatic simulation of human skills. The simplest skills seem to be those of the $S \rightarrow R$ kind, in which S and R can each be described by a single continuous variable. Tracking tasks, and tasks involving the stabilization of unstable systems (for example, bicycle riding) require skill of this class. It has been known for some time that human operators can be represented quite closely by relationships of the form:

$$R = e^{-p\tau}\,(Ap + B + C/p)\,S$$

Mr. Donaldson described a machine which automatically forms an image of a human operator performing a simple balancing trick, and in so doing finds values for A, B and C which, on the average, give the best fit. It is hoped to develop this device so as to be able to describe analytically what happens when an individual's skill improves with practice, or when it deteriorates in consequence of various kinds of distraction.

Dr. H. Barlow (Physiological Laboratory, Cambridge) discussed learning machines and generalization. Dr. Barlow felt that designers of existing learning machines, or of proposed learning machines, are trying to achieve too much too quickly. These machines can be regarded as linking units in which input data from the environment are acted on by a number of 'demons' which operate on the inputs in a variety of ways to form the outputs of the machine. Some sort of 'teacher' monitors the outputs in the light of some criteria, 'rewarding' the demons when their output is deemed valuable and 'punishing' them when it is not. Though such systems can be made to work, they are characteristically unable to do any kind of generalization, for example, to respond correctly if gaps or mistakes occur in the input data.

What is needed in order to generalize and fill gaps is knowledge of the statistics of the input. This leads to the idea that linking units should be preceded by a 'precoder', the function of which is to form, from the raw inputs derived from the environment, new signals with known predetermined statistical properties. It is these new signals which are fed to the linking unit. Such precoding may be done by a demon-flogging feedback technique, as is done in the linking unit itself, but with some important differences: the rate of feedback of information is much larger than the 1·6 bits per trial gained in the linking unit (outcome of each trial 'reward', 'punish' or 'neutral', $\log_2 3 = 1{\cdot}6$); the statistical requirement can be built in; and the teacher does not need to have access to the raw inputs. The output of the precoder is simpler than the raw input, since its statistics are now known, and forms a more suitable input to the linking unit.

The dynamics and operating characteristics of a common artificial kidney system were described by H. A. F. Dudley (Department of Surgery, University of Aberdeen). Dr. Dudley has been carrying out some performance measurements on an artificial kidney of the twin-coil type, the channels being 20 m. long. The performance of such a device should be described by:

$$D = V\left[1 - \exp - \frac{PS}{V}\right]$$

where V is the rate of flow of blood, D is the rate of flow of filtered blood in the output, P is the permeability constant for the 'Cellophane' membrane, and S the surface area of the membrane. For small values of V the theoretical performance can be obtained in practice, but for higher values, which are nevertheless within the range of flow-rates possible in human subjects, the artificial kidney falls far short of what may be expected; especially if the output blood pressure is high. The discrepancy seems to be caused, at least in part, by a decline in the surface-to-volume ratio of the blood channel toward the output end. The deficiency can probably be remedied by a change in the design of these instruments; but in any event it is clear that preliminary work with models is necessary to produce an artificial kidney to meet a previously laid down specification.

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