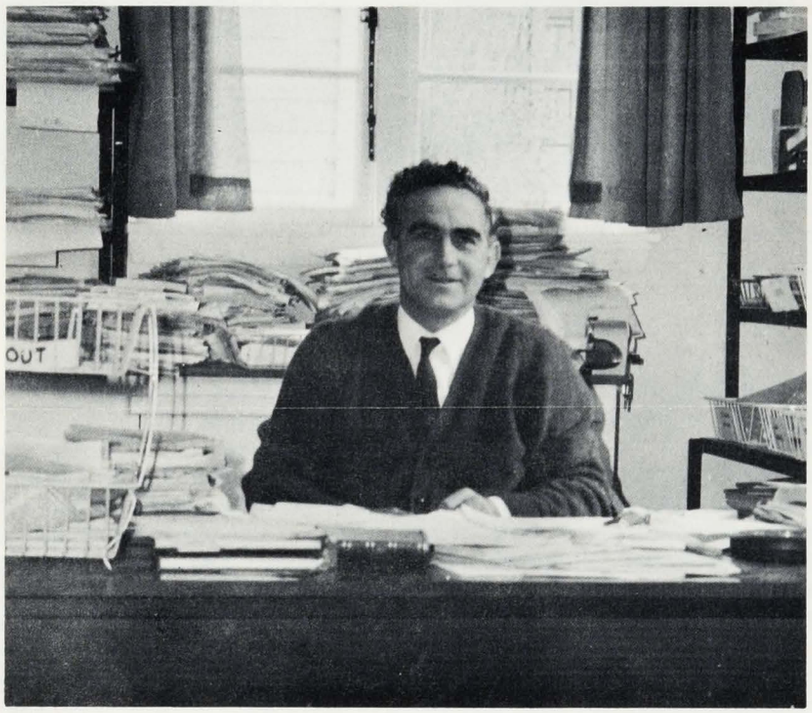
The NZAEI NEWSLETTER

No. 20 December 1970



Professor J. R. Burton—foundation professor of Natural Resources and permanent head of the School of Natural Resources at the University of New England.

First Director of the Institute to be Foundation Professor of Natural Resources at Australian University

This month Professor Burton will leave the Institute and New Zealand to return to his homeland where he takes up a post which will undoubtedly assume a growing importance as pressure to exploit the Australian environment increases. He is to be foundation Professor of Natural Resources and Head of the School of Natural Resources at the University of New England. The School will be concerned with professional training in natural resources management and conservation and will offer four year undergraduate course and a variety of post-graduate studies.

He leaves an agricultural engineering research and teaching organisation which is the largest in the southern hemisphere with a staff approaching 40. This is a considerable achievement. When Professor Burton was appointed Professor of Agricultural Engineering at Lincoln in the beginning of 1965, the Department boasted a staff of five, and the Institute of which he was foundation Director, possessed a staff of one. The Institute now has a staff of 23 including 10 professional officers and a wide-ranging programme of research and testing.

Besides his work as head of department and director of the Institute, he has given a great deal of time to serving on various committees including the International Hydrologic Decade Committee, the Engineering and Scientific Committees on Water, the Institution of Engineers Water Resources Comittee and as deputy-chairman of the New Zealand Inventions Development Authority.

During the six years in which Professor Burton has been director the Institute has grown from nothing into an organisation which plays an increasingly significant part in a widening area of farming techniques, land use and water conservation and control. From the first investigation into tractor safety frame testing based on Swedish methods the Institute has developed the present techniques and installation and is responsible for all frame testing done in this country. Additionally, original work is being done on the basic characteristics of safety frames. Continuing work is being carried out in evaluating aircraft spray techniques and in testing the performance of mechanical fertiliser spreaders. The initial work on the mechanisation of fodder beet, including the design and production of a successful harvester and a modified version of the dutch harrow, has spread into the whole field of process crops. Techniques of trickle irrigation and pip and stone fruit harvesting are under active development. Prototype strawberry and blackcurrant harvesters have been built. From small beginnings Institute staff have built up a reputation as consultants in soil and water projects and a valuable series of papers on the subject has been published. Design work for farm water supplies and dams, and the provision of stock and irrigation water have been included in Institute projects.

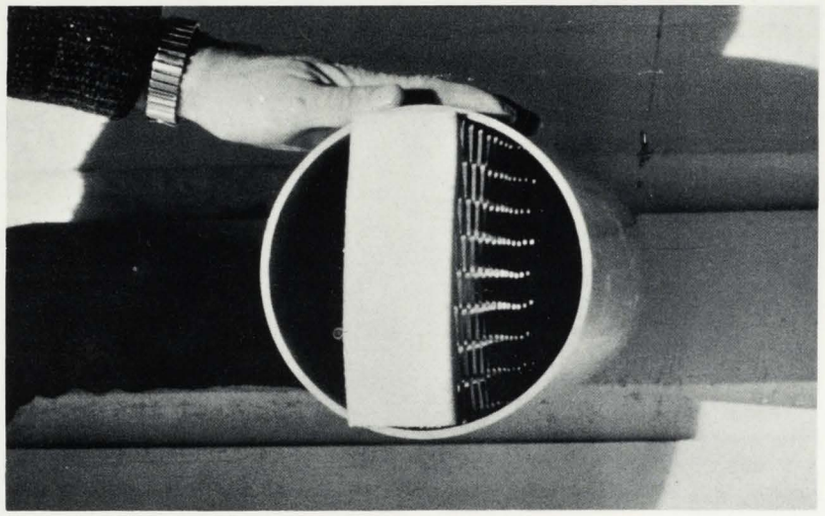
Over all of this work and over the general direction of the Institute Professor Burton has kept a watch-

ful eye and his never failing encouragement and support has maintained a high level of enthusiasm among the staff. His consistent and energetic emphasis on the aims and value of the Institute among members of government, industry and farming organisations has resulted in the value of the Institute being widely recognised and appreciated.

While members of the Institute staff regret his going they congratulate him on his appointment to a position which accords so well with his primary professional interests. The many members and other well-wishers of the Institute who have met Professor Burton in the course of Institute activities will no doubt also wish to be included with all those who wish him every success in his new appointment.

Professor Burton's successor is Professor C. T. Ward who is at present professor of engineering and agricultural engineering at Macdonald College, McGill University, Quebec. Professor Ward, who gained a doctorate of philosophy in agricultural engineering from the University of Durham in 1952, will take up his position with the Institute in June of next year.

Since 1960 Professor Ward has also been responsible for the establishment and development of the Brace Research Institute which controls a satellite research station in Barbadoes. The Brace Research Institute has the aim of developing irrigation and other techniques such as desalting water which could assist in making arid lands economically useful for agriculture.



End view of a filter with the end plate removed. The position of the sandwich of expanded metal and foam can be seen.

A Filter for Trickle Irrigation

Faced with the need for filtered water to prevent blockage of the microtubes used in trickle irrigation and deterred by the cost of commercially available filters, N.Z.A.E.I. staff set about designing a filter for the purpose. Most or all of the following requirements were to be met.

1. *Ample capacity*

A flow of up to 40 gpm is used in the 2-inch header pipes and the filter should handle this flow without being excessively bulky.

2. *Low head loss*

At the flows involved the head loss must be kept low as systems are often gravity fed at under 7-8 psi. A loss of 1 foot head was set as a target.

3. *Particle size removal*

The microtubes currently used in trickle irrigation are of 0.035in and 0.020in nominal diameter. Thus particles down to at least this size must be removed.

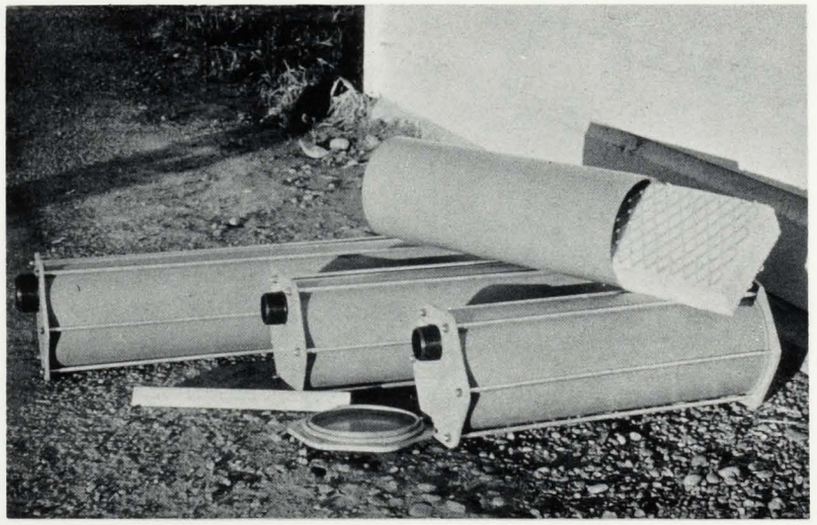
To take some account of possible aggregation a British Standard sieve No. 85 of opening 0.007in was used as a reference.

4. *Low cost*

Commercial filters, which were not built specifically as low pressure filters, were considered too costly, at some $35 each, for trickle irrigation.

5. *Permanence and serviceability*

The materials used should be corrosion resistant. Also the filter



Three sizes of prototype filter constructed by the Institute. The end plate has been removed from the fourth filter and the filter element partially withdrawn.

should be easily cleaned if this becomes necessary.

With these criteria in mind, 2-inch thick foamed polyurethane was chosen as the filtering medium.

Preliminary tests showed that an area of about three square inches was needed to pass a flow of one gallon per minute. To allow a margin for satisfactory performance under conditions of partial blockage this flow was decreased by 50% for rating purposes. A prototype with a nominal 10 gpm rated capacity was constructed using 72 square inches of 2in thick foam. A block of foam 12in x 6in x 2in was sandwiched between two 11in x 5½in sheets of expanded aluminium. The foam was compressed and the metal /plastic sandwich slid into an 11in length of 6in diameter PVC soil pipe. Thus the cylinder was divided into two chambers by a wall of foam.

End caps were made by attaching a 1½in PVC fitting to a hexagonal PVC sheet 6mm thick. These end caps were clamped to the barrel of the filter by six through bolts of ¼in aluminium alloy and a seal was obtained using O-rings made from ¼in rubber barrier cord.

Water was introduced into the lower chamber and allowed to percolate up through the foam to be drawn off from the upper chamber.

Leakage round the perimeter of the foam filter block was prevented by compression of the foam in each direction. It was thus seated firmly against the filter walls.

The prototype was tested to evaluate its performance under three headings.

1. *Sealing*

Static pressure tests of up to 15 psi showed no leakage although 8-10mm sheet would be a more rigid end cap material than the 6mm sheet used. At the higher pressure metal straps were placed across the caps and clamped by two of the cap bolts to prevent bulging.

2. *Head loss*

The filter was tested at flows of up to 16 gpm and the pressure drop read by manometers. The results are shown on the attached graph.

It will be seen that considerable blockage could occur before the 1ft loss would be reached at the flow of 10 gpm.

3. *Particle size removal*

The filter was loaded with 2lb (900 gm) of sand with a size range down to that passing a No. 85 sieve but retained by a No. 100 sieve. The unit was rolled upside down so the sand lay on the foam rather than settling on the casing. Water was run through at approximately 10 gpm for four hours with the outlet water being passed through screens of sizes No. 50 and No. 85.

The material on the screens was dried and weighed with the following results:

No. 50	zero
No. 85	0.53 grams

Thus, of the 900 grams of sand introduced, only 0.53 grams or 0.06 percent passed through the filter even though it was inverted.

Cost

The cost of materials only was calculated and for the various sizes of filter can be found by using

$$P = \$3.00 + X\ (\$3.40)$$

where P = Price

$3.00 is the cost of a pair of end plates.

X = length in feet (use 1ft/10 gpm rated capacity).

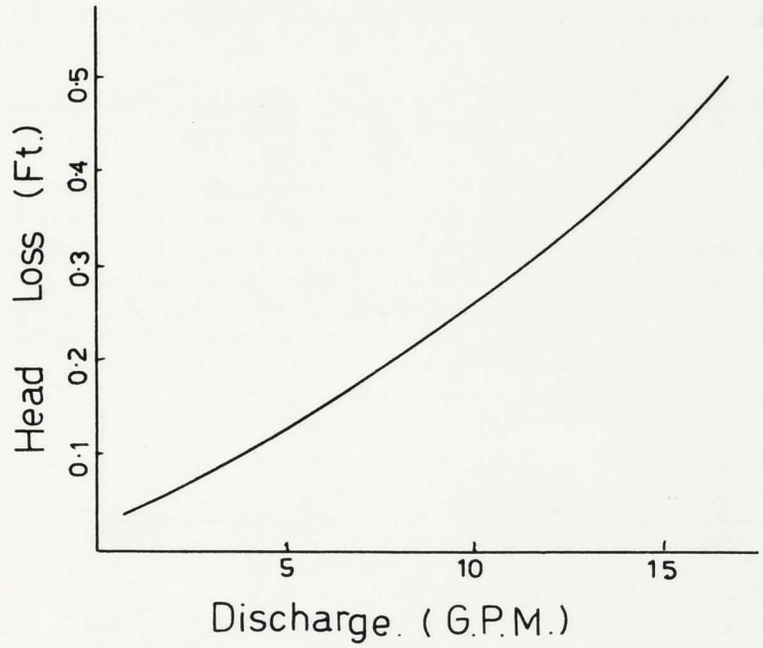
$3.40 is cost of 1ft length of barrel.

Thus we have costs for material only.

10 gpm	filter	1ft	long costs	$6.40
15 gpm	„	1½ft	„ „	$8.10
20 gpm	„	2ft	„ „	$9.80
25 gpm	„	2½ft	„ „	$11.50
30 gpm	„	3ft	„ „	$13.20

These are the material costs at retail prices and are not a manufactured price.

Such filter units could be produced relatively cheaply in commercial form. Moulded rather than fabricated end caps would be an advantage. They would fill a need for a low cost, low pressure filter for trickle irrigation schemes and could have other applications.



The relation between head loss and discharge of the low-cost filter.

Evaluation of Aircraft Spray Techniques - 2

The series of routine pattern measurements and measurements of recovery rates under monitored micrometeorological conditions referred to in the last issue of the Newsletter were carried out at Amberley and more recently at Rangiora with the co-operation of two aerial contractors—Aerial

Sowing Ltd and Airwork N.Z. Ltd.

The test gear used included some designed and constructed by members of the Institute. The basic item was a mast 32ft high and constructed of aluminium tubing. It was built in 8ft sections and could be readily raised and lowered by a three man crew. On this mast instruments measuring wind speed, humidity and temperature were mounted. Three, light weight, low-torque cup anemometers, located at 32ft, 16ft, 8ft and 4ft measured the wind speeds at these heights and the readings were fed as electrical signals to counting instruments. The output from the anemometer at 16ft could also be fed to a rate meter as required. The rate meter converted the electrical pulses from the anemometer into a varying voltage which operated a chart recorder. A permanent record was thus available.

To obtain an indication of atmospheric turbulence a formula was used which required the difference between the temperatures at 8ft and 32ft to be recorded and also the average wind velocity present at 16ft. The accuracy of the measurements had to be high—to within 0.01 of a degree centigrade as a small difference could be significant.

The temperature difference was obtained by using platinium resistance thermometers of a type originally used to measure oil temperature in DC3 aircraft. These thermometers were connected into an electrical bridge so that differences in temperature were represented by an out of balance voltage which would operate the chart recorder. The particular formula used gave an index of turbulence in the form of a *stability ratio*. A large positive value for the ratio, usually obtained under conditions of strong temperature inversion and a low wind velocity, represented a very stable atmospheric condition, while negative values are associated with unstable or turbulent conditions. Values near zero are considered nearly neutral. This of course applies to stability in the vertical plane. The intensity in the horizontal plane can be calculated from the fluctuations of a low inertia wind vane mounted on the top of a second portable mast 16ft high.

Humidity of the air was calculated from the readings of wet and dry bulb temperatures. Once again platinum resistance thermometers were used as arms of electrical bridge circuits. They were mounted in aspirated radiation shields constructed at the Institute. Each shield contained a dry and a wet bulb thermometer with air being drawn past them by a miniature electric motor driving a fan.

Before undertaking any live tests sufficient dry runs were made in the vicinity of the Institute workshops to make sure that the instrumentation worked correctly. The opportunity was also taken to practise raising and lowering the masts and laying out the gear with its considerable number of interconnecting cables. The recording equipment was mounted in the tray of the Institute truck.

Using these instruments and their associated recording gear the micro weather at the time of the tests was monitored and the results were later analysed and correlated with the patterns resulting from the aircraft spraying runs.

The initial test runs were made with a 235 h.p. Piper Pawnee aircraft fitted with Transland spray equipment. At a speed of 100 mph the system produced a flow rate of 117 gallons a minute. At a 36ft bout width an average application rate of 16 gallons an acre was obtained.

A remotely controlled camera located on the flight path was used to record the altitude and position of the aircraft over the sampling line.

The spray samples were collected on stainless steel plates each 3in. by 6in. which were placed at intervals of 2ft. across the line of flight over a distance extending from 20ft. up wind to 140ft. down wind. For another 480ft. down wind the plates were laid at 10ft. intervals.

The spray consisted of a tracer, manganese sulphate, dissolved in water. After a spraying pass by the aircraft the collecting plates were collected and carefully washed down using metered quantities of water. The solution taken from each plate was identified as to position and the concentration of manganese in each sample was established. Samples were also taken from the aircraft spray tank and analysed for each test.

The percentage of spray recovery resulting from each test was found by calculation based on the amount of manganese recovered from the plates and on the weight of manganese emitted for each foot of travel by the aircraft. As would be expected there was a smaller recovery for a stronger crosswind component, and for a higher release height.

The information collected was also used to test the practicability of establishing the quality of a spray pattern and its use in establishing a satisfactory bout width having regard to the micro-climate ruling at the time.

The results did indicate that further tests would be justified.

As well as field measurements John Hager hopes to initiate laboratory research into droplet sizes. To this end a small wind tunnel will be set up in the Still Air Laboratory together with sampling facilities. This will be followed by a programme to measure the droplet size range produced by commonly used nozzles under simulated aircraft conditions.

The Director and Staff join in wishing all members and other supporters of the Institute a Merry Christmas and a Happy and Prosperous New Year.

Membership has continued to increase over the past twelve months which indicates a steady growth in interest in the work the Institute is carrying out.

This year the fitting of safety frames to most types of new farm tractors became compulsory and led to a dramatic increase in the number of safety frame tests carried out.

The methods of trickle irrigation being developed have also attracted widespread attention.

And now shortly before Christmas our Director leaves to take up a new appointment in Australia.

In short, the year has been one of change and growth.

Published by the New Zealand Agricultural Engineering Institute, Lincoln College, Canterbury. Printed by the Lincoln College Press.