

*Ag. Chem. 2*

*M. Clark*

*M. van Wijck*

*Branch Lib.*

**Queensland Department of Primary Industries**  
**ANNUAL REPORT 1970-71**



Research Vessel "Nikarem" at Mourilyan Harbour on Crown-of-Thorns Starfish Investigations.

**Presented to Parliament by Command**

# Harvests From The Land And The Sea



A sunflower crop on the Darling Downs, where renewed interest is being taken in the crop.



A haul of banana prawns taken in the Gulf of Carpentaria.

## CONTENTS

I. General Comments .. .. .	3
II. Livestock Research and Extension .. ..	11
III. Dairy Research and Extension .. .. .	21
IV. Pasture Research and Extension .. .. .	27
V. Field Crop Research and Extension .. ..	30
VI. Horticultural Research and Extension .. ..	36
VII. Development Planning and Land Use .. ..	41
VIII. Special Field and Laboratory Services .. ..	43
IX. Agricultural Standards .. .. .	47
X. Fisheries .. .. .	49
XI. Review of the Primary Industries in 1970-71 ..	51

## ORGANIZATION OF THE DEPARTMENT

**MINISTER FOR PRIMARY INDUSTRIES** .. Hon. J. A. Row, M.L.A.

### CENTRAL ADMINISTRATION AND CLERICAL AND GENERAL DIVISION—

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Deputy Director-General .. .. .	A. A. Ross, M.Agr.Sc.
Chief Advisory Officer (Administration) ..	C. L. Harris, F.A.S.A.
Assistant Under Secretary .. .. .	R. V. Riley, B.Com., A.A.U.Q.
Accountant .. .. .	H. J. Evans, A.A.U.Q.
Executive Officer, Research Stations Section	G. H. Allen, Q.D.A.
General Manager, Agricultural Bank ..	F. J. Strutton, A.A.S.A., A.C.I.
Director, Information and Extension Training Branch .. .. .	C. W. Winders, B.Agr.Sc.
Director, Fisheries Branch .. .. .	G. G. T. Harrison, B.Sc. (Apptd. 29-7-71)
Director, Fauna Conservation Branch ..	G. W. Saunders, D.Agr.Sc. (Apptd. 29-7-71)

### DIVISION OF ANIMAL INDUSTRY—

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Deputy Directors .. .. .	L. G. Newton, M.V.Sc., J. W. Ryley, B.V.Sc.

#### Animal Research Institute—

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Husbandry Research Branch .. .. .	L. Laws, M.V.Sc. (Director)
Pathology Branch .. .. .	W. T. K. Hall, M.V.Sc. (Director)
Beef Cattle Husbandry Branch .. .. .	B. A. Woolcock, B.V.Sc. (Director)
Veterinary Services Branch .. .. .	K. M. Grant, B.V.Sc. (Director)
Sheep and Wool Branch .. .. .	A. T. Bell, B.V.Sc. (Director)
Slaughtering and Meat Inspection Branch ..	B. Parkinson, B.V.Sc. (Director)
Pig and Poultry Branch .. .. .	F. N. J. Milne, B.Sc. (Director). (Apptd. 29-7-71)

### DIVISION OF DAIRYING—

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Deputy Director .. .. .	G. I. Alexander, B.V.Sc., M.S., Ph.D.
Dairy Cattle Husbandry Branch .. .. .	N. C. E. Barr, B.V.Sc. (Director). (Apptd. 12-8-71)
Field Services Branch .. .. .	W. D. Mitchell, B.Agr.Sc., Dip.Agric.Ext. (Director)
Research Branch .. .. .	V. R. Smythe, M.Agr.Sc. (Director)

### DIVISION OF LAND UTILISATION—

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Assistant Director .. .. .	A. Hegarty, B.Sc.
Development Planning Branch .. .. .	A. Hegarty, B.Sc. (Director)
Soil Conservation Branch .. .. .	J. Rosser, B.Agr.Sc. (Director)

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Assistant Director of Marketing .. .. .	E. O. Burns, B.Com., A.A.C.A., F.A.S.A.
Economic Services Branch .. .. .	E. O. Burns, B.Com., A.A.C.A., F.A.S.A. (Director)
Marketing Services Branch .. .. .	D. R. Lewis, B.Sc. (Econ.) (Director)
Standards Branch .. .. .	A. C. Peel, Dip.Ind.Chem., A.R.A.C.I. (Director)

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Agricultural Chemical Laboratory Branch ..	W. J. Cartmill, M.Sc., A.R.A.C.I. (Director)
Botany Branch .. .. .	S. L. Everist, B.Sc. (Director) (Apptd. 29-7-71)
Entomology Branch .. .. .	A. R. Brimblecombe, M.Sc., Ph.D. (Director). (Apptd. 29-7-71)
Plant Pathology Branch .. .. .	G. S. Purss, M.Agr.Sc. (Director). (Apptd. 29-7-71)

# QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES

## Annual Report 1970-71

To the Honourable the Minister for Primary Industries,

SIR,

I have the honour to submit the following report on the operations of the Department of Primary Industries for the year ended June 30, 1971.

Yours faithfully,

J. M. HARVEY,  
Director-General.

### I. General Comments

In this preliminary section of the report, brief comment is made on points of particular interest related to production, Departmental organization and staff matters, and miscellaneous aspects of the Department's operations.

#### PRODUCTION

In July 1970, conditions were continuing to deteriorate over the greater part of inland Queensland and, by the end of October, over 80% of the State was drought stricken, notwithstanding widespread partial relief over wide areas of the subtropics during September. Conditions improved over the following 3 months but it was not until February that substantial rains in the north-eastern tropics ended the drought in that area, and a massive tropical rain depression maintained widespread heavy to flood rains over the far west and south-west areas of the State. Beneficial rains followed in March but unseasonal heavy falls were recorded during April in the Far North, and this excessive wet adversely affected crops on the Atherton Tableland.

Cool dry conditions in southern and central Queensland after May dried off grass and retarded crop growth, and the year ended with concern for the rest of the winter in these areas. In the south-west, the feed condition was good as a result of the heavy runoff into the channel country from good rains in the earlier months, as also in the north-western cattle country.

Overall, the year was a difficult one for Queensland primary production, with low production of many agricultural crops such as wheat, barley, peanuts, navy beans and cotton and low returns at the wool auctions. Dairy production reached the lowest levels in 50 years. Average net returns to egg producers were at least 5 cents per dozen below the 1969-70 level. On the other hand, a record crop of grain sorghum was harvested. Had restrictions under the International Sugar Agreement not been imposed, the tonnage of cane harvested would also have reached record proportions, exceeding the 18.4 m. tons of cane crushed in 1968.

#### DROUGHT RELIEF AND ASSISTANCE

During the 1969-70-71 drought a wide range of drought relief assistance measures first provided for primary producers in 1965 were re-introduced with the support of the Commonwealth Government.

In summary these consisted of:

- (a) Rail and road freight concessions on the transport of fodder.
- (b) Rail and road freight concessions on the transport of stock to slaughter, to and from agistment, and for re-stocking.
- (c) Carry-on and re-stocking finance available through the Agricultural Bank.
- (d) Other benefits such as a grant for the payment of half shire rates in certain shires for one year; reduction of Crown rents on sheep properties;

waiving of registration and stamp duty fees on drought loan mortgages; remission of interest on succession duties on properties in drought declared areas; extension of time to pay and "funding" of arrears of Crown rent.

Towards the end of 1970-71, 16 shires still remained wholly or partly in the grip of the prolonged and severe drought which commenced in 1969. These were mainly located in the major wool-producing areas of the State in the north-west, central-west and south-west. For many of these shires, drought declarations have been current for a continuous period since the beginning of 1969. Such harsh climatic experience superimposed on the declining profitability of the industry has produced the worst rural depression in recent times in this sector of the State's rural economy.

An indication of the extent to which the Government (generously assisted by the Commonwealth) was able to assist primary producers reduce the impact of drought is given by the following information.

Drought Relief Assistance Measures	Total Expenditure 1969-70 and 1970-71 (to 31-12-70)
	\$
Carry-on and re-stocking loans to grain growers, graziers, dairy farmers and other producers	13,285,988
Rebates and subsidies on the transport of fodder and stock .. .. .	14,539,018
Unemployment grants (to shires) .. .. .	2,354,222
Grants for payment of half shire rates .. .. .	3,514,552
Miscellaneous .. .. .	881,157
<b>TOTAL .. .. .</b>	<b>\$34,574,937</b>

In view of the current outlook it is apparent that drought relief measures will need to be continued into the financial year 1971-72.

The Drought Secretariat set up within the Department to develop a long-term approach to drought problems and their mitigation, and to provide technical support towards the implementation of the Government's drought relief strategy, was fully operational throughout the year.

### AGRICULTURAL BANK

Advances approved during the financial year 1970-71 under the various Acts administered by the Bank are as follows:—

Agricultural Bank Acts .. .. .		\$12,707,910	
Farm Water Supplies Assistance Acts ..		\$886,069	
War Service Land Settlement Acts .. ..		\$99,654	
Soil Conservation Act .. .. .		\$10,450	
Drought Relief to Primary Producers Acts—			
Relief to Graziers (1969 Scheme) ..	\$2,785,840		
Restocking Loans (1969 Scheme) ..	\$791,790		
Relief to Dairy Farmers (1969 Scheme) .. .. .	\$735,097		
Relief to Grain Growers and Others (1969 Scheme) .. .. .	\$1,232,435	\$5,545,162	
TOTAL .. .. .			\$19,249,245

Despite some general improvement in overall seasonal conditions there has been a sharp decline in the amount of approvals under the Agricultural Bank Acts. It can be assumed that the depressed conditions occasioned by past years of drought and some lack of confidence in the future prospects of certain segments of primary industry have been the principal factors underlying the reversal of the trend of previous years. Doubtless, operations of the Marginal Dairy Farms Reconstruction Scheme and, to some extent, recent unavoidable increases in the Bank's interest rate have been responsible, also, for a certain loss of new business.

Drought relief assistance on concessional terms to eligible graziers, grain-growers and other primary producers was continued during the year along similar lines to that extended in 1969-70. Improved conditions in dairying areas allowed assistance to dairy farmers to be phased out and relief to this industry was concluded in all areas as at March 31, 1971.

Payments from the Drought Relief Rate Rebate Fund totalled \$4,229,466. The Fund was established to enable eligible drought-stricken primary producers, exclusive of certain types of registered Companies, to meet by way of a non-repayable grant half of one year's Local Authority rates assessment.

The rate of interest on all overdraft loans and on any new loans under the Agricultural Bank (Loans) Act, the Farm Water Supplies Assistance Acts and the Soil Conservation Act was increased to 7½ per cent. per annum as from July 1, 1970. Application of the increased rate was deferred in the case of those clients whose properties are in areas which were declared drought-stricken.

### AFTER THE COMMON MARKET

The extent to which Queensland primary producers will be disadvantaged if Britain enters the European Economic Community remains a matter for speculation. It will certainly depend to a large degree on decisions taken by the Community after Britain's entry, if this is effected.

At this stage it is obvious that even though not all Australian exports could be affected, the repercussions of entry would be widely felt, particularly by the dairying and sugar industries, and also among fruit growers.

The ingredients certainly exist for an initial dislocation of trade in raw sugar, dairy products, apples and pears and canned fruit.

Whether the Community will take quick and effective action to deal with this disruption remains to be seen. Assurances have been given that the Community is interested in promoting the conclusion of an international agreement on dairy products. It has undertaken to have regard to the situation of Commonwealth raw sugar producers in the post-1974 period under the International Sugar Agreement.

Our apples and pears and our canned pineapple products have certain advantages that can be pressed home as a partial counter to the loss of preference.

We would be wise to plan to meet the initial dislocation, then work for the recovery of such markets as may be lost to us.

### DAIRY PASTURE SUBSIDY SCHEME

At the conclusion of the fifth year of operation, 60 per cent. of the dairy farms in the State had participated in the Scheme. The degree of participation varies between districts and it is obvious that, in the areas of lower rainfall, acceptance of the Scheme has not been as widespread, at least in the early stages of the Scheme, as in the higher rainfall regions or where permanent irrigation is available. However, the lifting of the

total subsidy payable to \$2,000 and the removal of the acreage limitation of 100 acres has done much to make the Scheme more applicable to the drier dairying areas.

Two major policy changes were made in the Scheme. The first concerned the special category of irrigated pastures. This category was eliminated as a separate one when drought experience indicated that few farms had permanent supplies of irrigation water. The other change removed anomalies resulting from the previous policy on payment of deferred subsidy when a farm changed hands.

It is anticipated that in the 1971-72 year a number of participants will reach their limit of entitlement. Some will have obtained maximum subsidy of \$2,000 while others will have exhausted their entitlement on cow numbers and carrying capacity. In some districts, particularly in the far north, availability of land suitable for pasture establishment may be the limiting factor.

Reports from district committees indicate that apart from Malanda, Beaudesert, part of South Burnett and all Wide Bay districts, where reductions are forecast, average numbers of applications are anticipated. This suggests that approximately 3,000 applications could be expected in 1971-72.

The Scheme must be regarded as having contributed substantially to improved production conditions on dairy farms in all districts. The total subsidy paid or approved since 1966—approximately \$2,380,000—has been applied to the planting of nearly 200,000 acres of improved pasture, much of which would not have been planted if the Scheme had not been operating.

Some details of the Scheme appear in Section III of this Report.

### TOWARDS BETTER LAND USE

The Australian system of farming is much more sophisticated than the system of shifting agriculture based on "bush" fallow practised in many parts of the subtropical and tropical world—a system which is leading to a gradual decline in soil fertility and an increase in soil erosion.

But despite our knowledge of non-exhausting rotations, of the fertilizer needs of crops, of soil conservation measures, and of correct land preparation and cultural operations, some of our farming is tending towards the end point of low soil fertility and soil erosion.

A similar trend towards degradation of natural resources—soil, water and vegetation—is observable over some of our grazing country.

Governments and most landholders have never been ignorant of the many threats to the long-term stability of croplands, pastures and water supplies.

Some legislative requirements on land and water use have been laid down from time to time. For example, there are restrictions on ringbarking of trees, restrictions on use of artesian waters, and insistence on experience in particular enterprises in allotting certain land leases.

Governments have also adopted other measures to ensure proper land use. Various research and advisory services are devoted to this end. Over a million acres of Queensland cropland have been marked out by the Department for contour farming. Crown land in the wallum country is made available only to applicants who submit approved detailed development plans. Settlers in the brigalow land settlement schemes are assisted with development plans relating land use to resource conservation.

What has been done in the past, whether by governments or by landholders, has of necessity been piecemeal in nature. No overall strategy for achieving optimum use of our rural resources has been developed. This will need to wait until a comprehensive catalogue of resources is available and until valid assessments of desirable changes in land use have been made over a broad spectrum.

Considerable progress has been made by State and Commonwealth authorities in examining our resources. Broad mapping of soils and vegetation has been done for most of the State both on the ground and from the air. Some detailed soil surveys have been carried out, particularly in the irrigation areas.

Sample properties have been examined in detail in many districts in order to get a picture of present land use and misuse. The limits of viable crop production are being determined. The suitability of a wide range of crops and pastures and breeds of livestock to different environments is known for much of the State. Underground and surface waters have been mapped and assessed over large areas.

A good outline of our resources can now be drawn, and considerable detail of resources and their utilization in particular areas can be filled in.

Much remains to be done. One comforting fact is that methods which have been developed for detailed land use assessment in relatively small districts have been refined to the point at which they can be applied directly to masses of information as they become available from surveys of other districts.

The degree of co-operation which is developing among Federal and State authorities concerned with land use is very encouraging.

Land use will of course always have to be related in some measure to markets for primary products.

At the present time, many landholders wish to change from unprofitable to profitable enterprises. Reconstruction schemes are under way to restore viability to properties seriously affected by economic conditions.

Unfortunately, what we know about land-use systems is not yet comprehensive enough to enable us to use this changing situation to full advantage in promoting optimum land use throughout the State.

### THE WOOL INDUSTRY

It is apparent that difficult times have overtaken the Australian wool industry in general and the Queensland wool industry in particular. If present circumstances persist there will be little hope of rehabilitation for numbers of Queensland graziers in the absence of assistance with their debt and earning situations. Even so, many will have to leave their properties or be forced into bankruptcy because of their inability to service accumulated drought debts on the present low prices. Furthermore, those woolgrowers who do not face bankruptcy, but who are no longer finding wool production profitable, can only be expected to leave the industry in favour of some other rural enterprise or other occupation.

Questions also arise as to whether some form of production control should be introduced, whether growers should be assisted to rehabilitate, and thus many country towns preserved as viable centres of population, or whether difficulties can be overcome from reorganization of marketing procedures on a statutory basis so as to achieve minimum costs and sales disposal to best advantage.

The continuing financial crises led to appeals from growers for assistance and to the establishment in Queensland of a Rural Reconstruction Board to finance debts of viable farms and reconstruction of other farms into viable units. The funds of \$16 million over four years being made available to the Board are unlikely to satisfy these purposes. Grower demands are also being considered in relation to total acquisition of the clip and payment of price support subsidies.

Following the report on wool-marketing reform and emergency measures by a special committee set up by the wool industry, the Minister for Primary Industry announced early in the year that the Commonwealth Government would establish a statutory reserve price plan for wool. An Australian Wool Commission was set up and began reserve price support operations at the fourth Brisbane series of sales for the 1970-71 season. It was envisaged that the Commission would even out short-term fluctuations in the market to prevent wool being sold under the market level, but that it would not interfere with the free flow of wool to consumers nor attempt to raise the general price level. Nevertheless, it had the power to do these things, with public funds to support it in its first year of operation. When the Commission began operations in Brisbane prices rose by 25% compared with the previous sale, which was the lowest for the season, but the market fell again at subsequent sales and remained very depressed.

### ANIMAL DISEASE ERADICATION

Constant monitoring of the bovine pleuropneumonia-position has revealed a very satisfactory state of affairs. Not one confirmed lung lesion has been found in slaughtered cattle for 4 years, and no field outbreak of the disease has occurred for 11 years.

At the end of 1970 there were 32 properties operating under restrictions imposed by the national eradication scheme. Restrictions on all of these properties were removed at the beginning of 1971 as an acknowledgement of the favourable position.

The present position with regard to eradication is that a large area of the State has been declared pleuropneumonia-free and a large area is "protected" against the introduction or re-introduction of the disease. It is expected that a considerable area will be raised from "protected" to "free" status in 1972.

Another massive national eradication scheme, that for bovine tuberculosis and brucellosis, was launched in 1970. In Queensland, the scheme has been devised to operate initially along the eastern coast and its hinterland. After a fairly slow start, increasing interest has been shown by cattle-raisers in the tuberculosis eradication scheme and some 152,000 cattle have been tested to date, with an incidence tentatively estimated at less than 0.1%.

Vaccination of dairy cattle against brucellosis will be carried out as a routine measure over as many herds as practicable, but vaccination in beef herds will for the time being be restricted to herds determined to be infected and possibly herds on adjoining properties.

The last two waves of ephemeral fever to sweep through the State have stimulated research into protective measures and efforts are being made in Australia to develop a suitable vaccine.

### BEEF HERD IMPROVEMENT

Early in 1970 this Department came to an agreement with the New South Wales Department of Agriculture so that performance recording of beef cattle could be initiated in Queensland. New South Wales has had a Performance Recording Scheme in operation for some time and as certain economies could be gained through central and large-scale processing this agreement is advantageous to both parties.

Under the agreement, the Beef Cattle Husbandry Branch is responsible for the Scheme in Queensland and is to organize participation in the Scheme and the checking of source data before they are forwarded to Sydney for automatic data processing. Enrolment in the Scheme has been limited and to date 34 herds have enrolled approximately 5,000 breeders. These herds are fairly well dispersed throughout the State, with a good representation of various breeds and top studs.

The Scheme is progressing satisfactorily. However, expansion is limited and the agreement with New South Wales is only an interim arrangement until the National Scheme becomes operational, probably early in 1972. Once this occurs all herds presently performance recording will transfer to the National Scheme and entry into the Scheme will be unrestricted for both stud and commercial producers.

### USE OF EXOTIC BLOOD

A survey conducted by the Bureau of Agricultural Economics in 1965 revealed that less than 12% of the State's total cattle population had some infusion of blood of *Bos indicus* (Zebu-type) cattle.

A survey of 915 herds totalling three-quarters of a million cattle, carried out by the Beef Cattle Husbandry and Veterinary Services Branches in 1970, indicates a dramatic change in the composition of the State's beef herds.

Of the 350,000 breeding stock on the properties surveyed, 31.2% of all breeding females had some infusion of *Bos indicus* blood.

Analysis on a regional basis showed a strong concentration of *Bos indicus* type stock in the coastal and hinterland areas extending from Gladstone to Port Douglas. In this area more than 80% of all breeders surveyed had some infusion of *Bos indicus*.

The data are being analysed further to obtain information on reasons for the use of this blood and producers' opinions of desirable levels of *Bos indicus* blood.

### EXPANDED A.I. CENTRE

The exceptionally wide range of dairy and beef cattle breeds in Queensland herds has promoted expansion of the Department's Artificial Insemination Centre at Wacol to the point at which it has probably the widest range of breeds of bulls of any artificial insemination centre in the world.

Semen is available from six dairy breeds (Australian Illawarra Shorthorn, Australian Milking Zebu, Ayrshire, Friesian, Guernsey and Jersey) and six beef breeds (Africander, Angus, Brahman, Droughtmaster, Hereford and Sahiwal). In addition, the Centre has a Charolais cross bull and a selected Sahiwal/Friesian bull being reared for later use.

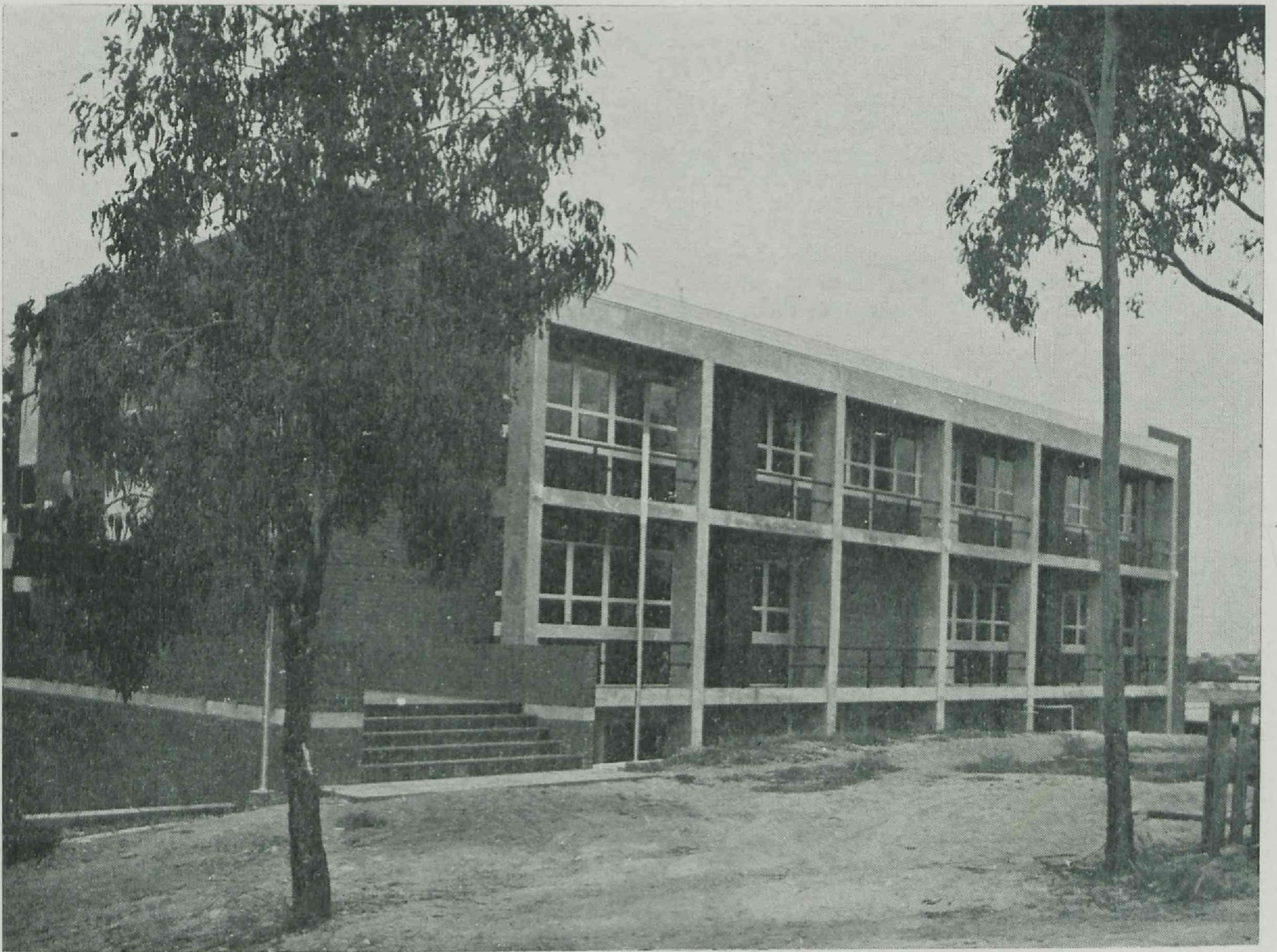
Arrangements are in hand to accept privately owned bulls into the Wacol Centre so that semen sales can be extended to cover a wider range of bulls.

A good export market has been established both for semen collected at the Centre and for custom frozen semen. There is exceptionally good potential for export of A.I.S. semen, as this breed has attracted attention in many dairying countries and the Wacol Centre is the only source of semen from progeny tested bulls.

The Brahman is the main beef breed in demand for export semen, but custom frozen Murray Grey semen is also being called for by overseas breeders.

Coincident with a decline in the demand for dairy breeds semen there has been an upsurge in the demand from beef cattle owners. This has prompted the addition of representatives of the beef breeds to the Artificial Insemination Advisory Committee.

The developments mentioned, as well as the appointment of the Centre as an agency of British Semen Exporters Ltd., necessitate considerable rearrangement of the facilities at the Centre. These must be kept to the level of excellence expected by local and overseas users of semen and facilities, and animal health and quarantine authorities.

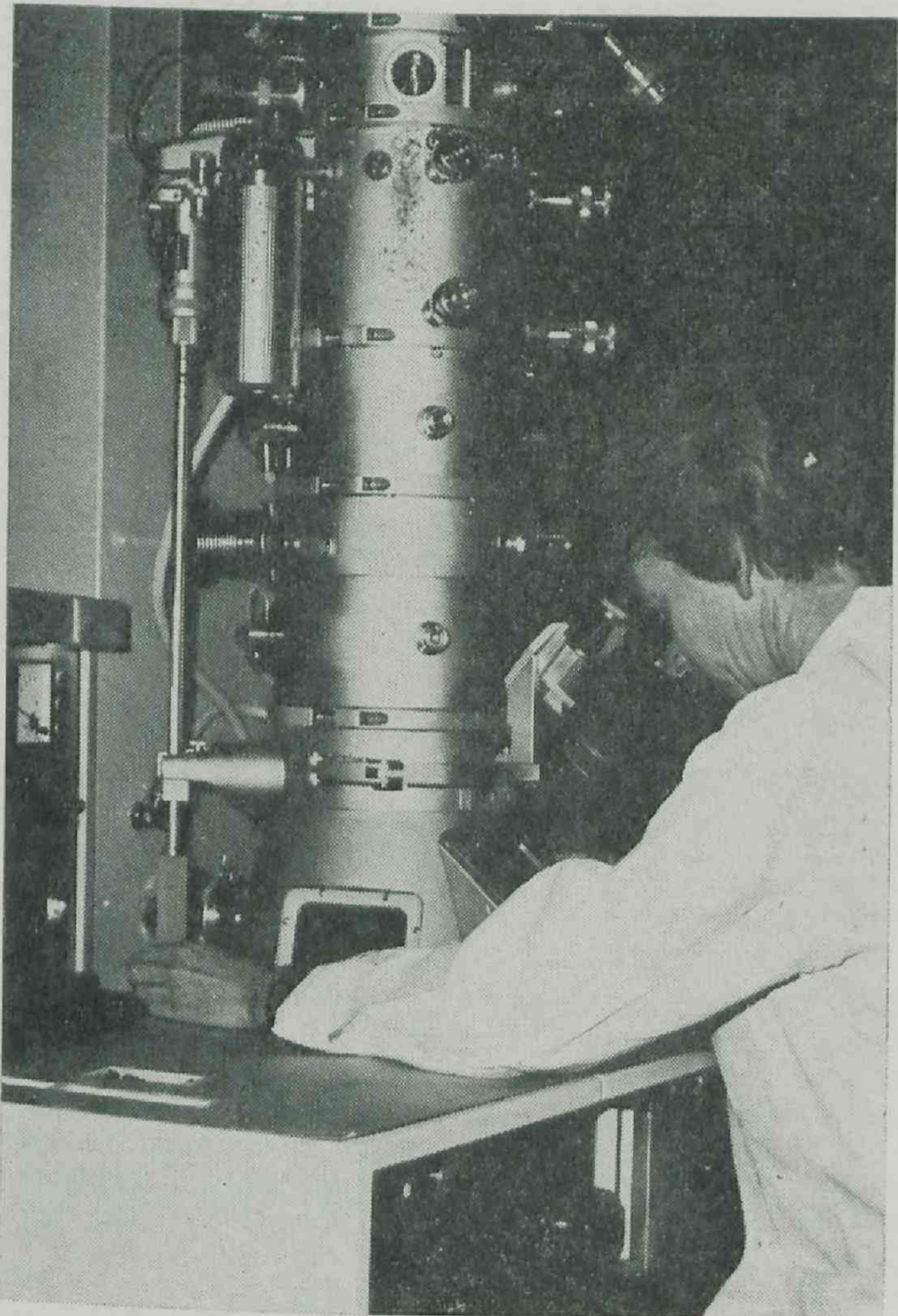


The new Plant Pathology Laboratory at Indooroopilly.

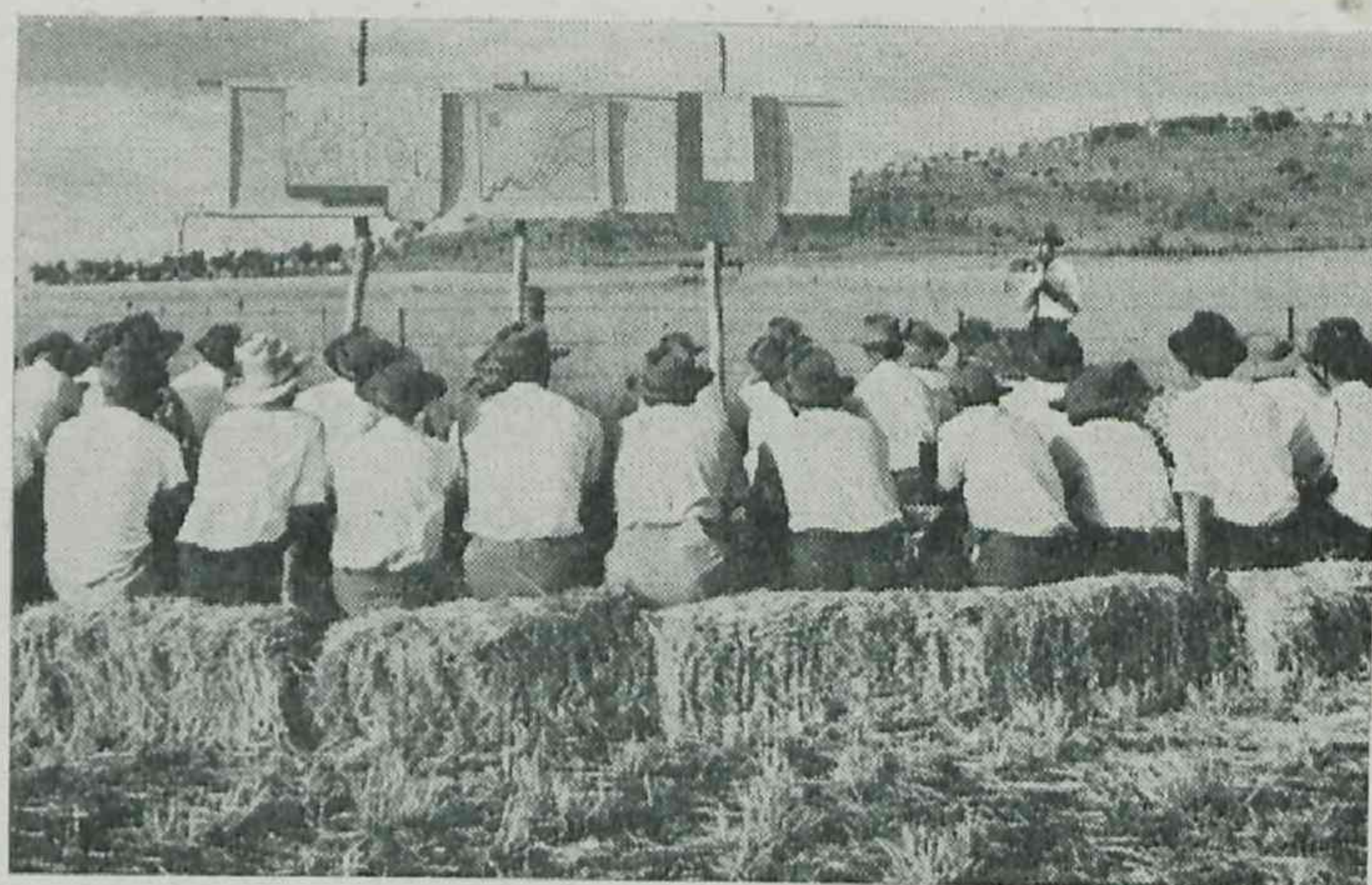
A pangola grass pasture planted on a new scrub burn in North Queensland.







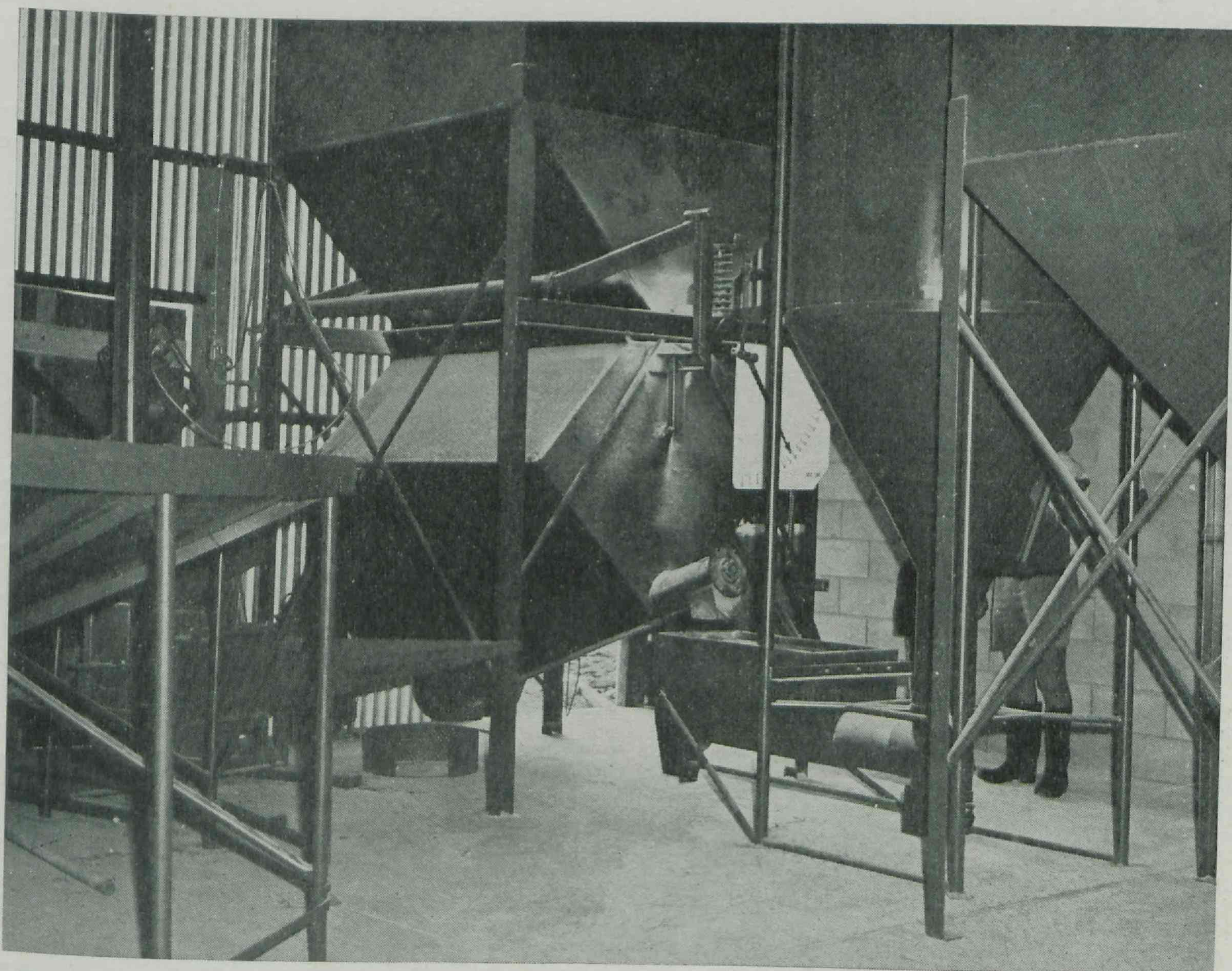
The Department's first electron microscope, installed in the new Plant Pathology Laboratory, will greatly facilitate plant disease studies.



Graziers at a field day at "Brian Pastures" Pasture Research Station learn something of the results of beef cattle nutrition investigations.



Silage is becoming increasingly popular as a long-term fodder reserve on beef properties in southern districts.



The pig producer who has invested in complex milling and mixing facilities requires technical advice in depth.

The officer in charge of the Centre is spending a period overseas studying the operations of European and American Centres as well as methods of integrating insemination and herd recording services for the dairying industry.

### PIG INDUSTRY CHALLENGE

The pig industry, although not ashamed of past performance, has accepted the challenge to improve efficiency. This is evident from the approach to various management problems on which Departmental advice has been sought, and from the results being obtained.

Various innovations have been readily adopted. For example, weaning earlier than the traditional 8 weeks of age is now the rule; herd improvement schemes are being implemented; boars, performance tested at Rocklea, are keenly sought; management and litter records are much more frequently kept; and carcass quality has improved.

Of particular interest to an industry where feed costs account for some 80% of the cash costs is the expansion in the production of soybeans. Two commercial processing plants have been installed for the production of full-fat soybean meal by a roasting process, while facilities for the production of expeller soybean oil meal have been expanded. This will reduce the reliance of the industry on imported protein-rich ingredients.

### DAIRY FARM DECLINE

The decline in the total number of dairy farms supervised by officers of the Department continued, with a reduction of 8.5% from 8,826 to 8,125. The rate of decrease was about the same in all districts.

It is difficult to foresee when this decline is likely to end. Certainly it is unlikely to be arrested while the problems associated with the disposal of butter surpluses on export markets hang over the heads of dairy farmers.

It might be expected that as the industry consolidates it will involve a higher proportion of farms using more efficient production methods and making full use of available aids to herd and farm management.

This has not yet occurred to a very obvious extent with the use of production recording and artificial breeding, although greater proportions of the dairy herd population are now covered by these services.

The number of farmers using relatively sophisticated methods to achieve high production and satisfactory economic returns is, however, increasing. Sound, relevant applied research may thus be more important now than previously to keep pace with the demands of the industry.

Dairy beef production is not increasing rapidly but farmers who have adopted this form of enterprise tend generally to continue and expand it. More research on this form of production in the context of local farm conditions is urgently needed.

The analysis of gross farm income from the sale of dairy produce during 1969-70 showed an improvement on the 1968-69 year which was affected by drought conditions. Income ranges and percentage distribution were as follows:—

	All Suppliers	Milk Suppliers
Less than \$1,000 .. .. .	13.2%	2.3%
\$1,001-2,000 .. .. .	16.5%	4.6%
\$2,001-3,000 .. .. .	14.6%	7.6%
\$3,001-4,000 .. .. .	12.5%	10.3%
\$4,001-6,000 .. .. .	15.6%	19.8%
Greater than \$6,000 .. .. .	27.6%	55.4%

The marked advantage held by milk suppliers in the income distribution is quite evident, although their fixed and variable costs are higher than average. Cream suppliers, on the other hand, have higher complementary incomes from other sources.

Two factories, Gladstone and Grantham, ceased butter production during the year as their parent companies rationalized their manufacturing operations. Pomona factory ceased to receive milk supplies, and Malling cheese factory ceased operations.

There has been a continuing interest in casein manufacture and it is expected that additional factories will commence production in 1971-72.

A fleet of 66 bulk collection tankers services the 31 factories which now receive portion or all of their raw milk in bulk.

### OILSEED CROP EXPANSION

The institution of wheat quotas has speeded up diversification in grain and oilseed crops. There has been particular interest in sunflowers and soybeans, with nearly 60,000 acres of sunflowers and over 10,000 acres of soybeans being grown in the last summer.

The already comprehensive Departmental research programme has been expanded, particularly in the sphere of varietal improvement. A plant breeder was appointed to work with sunflowers early in 1970. Later in the year another plant breeder returned from the U.S.A. after completing his Ph.D. degree with work on soybean genetics and has taken up a programme of soybean breeding.

There is scope for considerable further expansion in these two crops. The availability of varieties adapted to our growing conditions, with high yields and suitable oil and protein content, will play a major part in the development.

### RICE PRODUCTION

In the space of five years a small but viable rice industry has developed on the Burdekin River. An area of 6,000 acres was grown under irrigation in the past year with 4,000 acres in the summer and 2,000 acres in the winter. Yields have averaged 2½ tons of paddy rice per acre. There has also been some development without irrigation in the Ingham district.

The Departmental research programme at the Millaroo Research Station was instrumental in triggering off this development. A suitable variety, Bluebonnet, fertilizer requirements, weed control and other production requirements have been established. The research effort is continuing to further refine production methods. Further varieties from the International Rice Research Institute in the Philippines are being tested.

### CROP PROTECTION

Political and public agitation throughout the world for an immediate massive reduction in the use of agricultural chemicals takes insufficient cognizance of possible dramatic reduction in food supplies.

Nevertheless, the movement away from the use of chemicals for the control of pests and diseases must be encouraged.

In the current state of our knowledge of the biology and ecology of pests and disease organisms, alternatives to chemical control are not readily available.

For some time ahead, then, the most profitable approach will be to develop strategies for the use of insecticides and fungicides and to integrate these with such biological methods as are available. It is pleasing to be able to say that the Department is in the forefront in Australia in pursuing the painstaking biological and ecological studies of insect pests that are a prerequisite to the phasing out of chemicals as the main control agents.

Recent experiences have underlined the plant breeder's responsibility for taking disease resistance into account in developing more productive crop varieties. It is one thing to deliberately breed disease resistance into a variety, as has been done by the Department with maize and other crops. It is another thing to concentrate a substantial proportion of a country's food supplies in a variety bred for yield but with no inbuilt resistance to a devastating disease. This is an ever-present danger in "miracle" varieties that must be guarded against.

### AGRICULTURAL CHEMICAL STANDARDS

An important development in the registration and sale of agricultural chemicals has occurred through the establishment of an Australian Technical Committee on Agricultural Chemicals and an Australian Technical Committee on Veterinary Drugs. Both of these Commonwealth/State Committees have a Co-ordinator within the Commonwealth Department of Primary Industry.

Representatives on the Committees consider applications for the clearance of chemicals before these chemicals can be the subject of application for use in agriculture. Factors considered before clearance of a chemical include efficacy and toxicological aspects relating to the effect of the chemical on human beings and stock. The possibility of a harmful residue after application of a chemical is given close scrutiny.

The Director of Agricultural Standards is the Queensland representative on the Technical Committee on Agricultural Chemicals.

### WORLD SEED SCHEME

Following Australia's acceptance of membership in the Seed Certification Scheme of the Organisation for Economic Co-operation and Development, a Co-ordinating Committee on Seed Certification and a Seed Industry Advisory sub-committee were formed.

These Committees consist of Commonwealth and State representatives who will work towards achieving uniformity in certification procedures required by the Scheme, and thereby facilitate international trade in Australian certified seeds.

The Queensland representative on O.E.C.D. Seed Certification matters is the Director of Agricultural Standards.

### SEEDS TRAINING

For the first time, examinations were conducted during the year on an Australia-wide basis for a Seed Testing Proficiency Certificate.

This Certificate has been approved by the Standing Committee on Agriculture and is awarded to seed analysts who have had three years' experience in an official Australian seed testing laboratory and who have passed written and practical examinations set by a panel of three examiners. Examiners on the panel are seed-testing authorities from Queensland, Victoria and Western Australia.

Ten seed analysts sat for the examination: two from Queensland, five from Victoria, and three from South Australia.

### FAUNA CONSERVATION

A significant move in fauna conservation was made during the year in raising the status of the subsection of fauna conservation to that of a Branch of the Department.

This is not to imply that fauna conservation was neglected in the past, but the appointment of a director able to give his full time to planning and supervision of operations will certainly have beneficial effects.

It is opportune at this time to recall that the Department has been in fauna conservation since 1905, when it took over administration of the Native Birds Protection Act. The Under Secretary of the day, commenting on lack of public interest in the Act, said "What is everybody's business is nobody's business, and as the public will take no interest in protecting what is of value to them, it is time that restrictions should be placed upon those who have not the sense or knowledge of discrimination". That official commented further that the Act was "somewhat difficult of administration".

One can say today that public consciousness of conservation of native birds and animals was never greater; in fact, absolute protection rather than conservation seems to be the dominant thought in the minds of many people.

Despite the growth in the ranks of conservationists there are still many people who through thoughtlessness or perversity breach the regulations relating to the taking of birds and fauna under the Fauna Conservation Act. As in 1905, the Act in this respect is "somewhat difficult of administration". However, a careful examination of the provisions of the Act has been made with a view to amendment in the light of today's needs.

The new Fauna Conservation Branch starts off with a technical staff of 15, comprising a director, six graduate zoologists, three fauna rangers, and several experimentalists. Most of the staff will continue to engage in research and survey work from the two main fauna research centres—Hermitage Research Station (near Warwick) and Townsville.

### BARRIER REEF PROTECTION

The committee of inquiry into the infestation of coral reefs by crown-of-thorns starfish, mentioned in last year's report, completed its hearings and submitted a report to the Prime Minister and the Queensland Premier in March 1971.

The committee recommended the establishment of a trust fund of between \$90,000 and \$120,000 in the first year to finance research into the starfish.

This recommendation was adopted and the Prime Minister announced in August 1971 that the Commonwealth Government would make \$90,000 available. A special committee of four, including the Director-General of Primary Industries, has been set up to recommend allocation of funds to finance the research.

As mentioned in another section of this report, the Fisheries Branch of this Department has progressed with investigations into the pest centred on a wet laboratory at Mourilyan Harbour.

### RESEARCH STATIONS

Progress was made in expanding and developing facilities at various research stations. Considerable funds were made available for this purpose from the section of the Commonwealth Extension Services Grant covering regional research facilities. They were expended for a variety of purposes, including structures and improvements, farm machinery and laboratory equipment.

Eleven research stations, each with a variety of interests, are controlled by the Research Stations Board of the Department. They are situated near the following centres: Kairi, Walkamin, South Johnstone, Ayr, Millaroo, Biloela, Theodore, Moura, Coolum, Gatton and Hermitage. Each of these stations is supervised by a Station Committee representative of the various aspects of research undertaken. In some areas, advisory committees of primary producers give valuable assistance in planning and adapting research to meet local needs.

Some specialized research stations are operated by individual Branches. Thus Horticulture Branch has research stations at Kamerunga, Bowen, Nambour, Ormiston and Applethorpe. Sheep and Wool Branch operates "Toorak" Sheep Field Research Station in the north-west, Beef Cattle Husbandry Branch "Swan's Lagoon" Beef Cattle Field Research Station on the Upper Burdekin, Agriculture Branch the tobacco research station at Southedge and the pasture station at Parada. "Brian Pastures" Pasture Research Station in the Central Burnett is owned by the Australian Meat Board and staffed mainly by Agriculture and Beef Cattle Husbandry officers.

From time to time, the Department receives requests for the establishment of further research stations to serve particular districts. Though finance would be a barrier to developing and staffing new stations, the main argument against their establishment is that the location of existing stations is fairly adequate to meet the needs of most districts. Research stations are required mainly for developing new crop and animal varieties and strains and for devising basic production and management techniques. Such research work is always associated with field testing under commercial or semi-commercial conditions throughout the various regions. To substitute further research stations for field testing centres would not only lead to duplication of basic research but also limit the practical testing of basic findings.

### ADDITIONAL FINANCIAL SUPPORT

The Commonwealth Government again provided substantial support for Departmental research and extension activities through the Commonwealth Extension Services Grant and various Government/Industry funds.

The mounting salaries and wages component of the various funds has caused much concern, particularly in relation to those funds which have no inbuilt growth factor. With salaries and wages absorbing an ever-increasing proportion of the funds available, less money can be spent on equipment and materials for servicing projects.

The Commonwealth Extension Services Grant for 1970-71 covered salaries and wages, in whole or part, for a large number of field research workers, extension officers, agricultural economists, soil conservation officers, and herd recorders. It provided equipment for several laboratories and machinery and other requisites for many research stations. It supported a large number of specific projects aimed at improving agricultural and pastoral production methods. It also provided funds for in-service staff training at various levels.

An extension of the Grant for 3 years was approved. Plans for the period which have been drawn up provide for the winding up of some projects of low priority in order that provision may be made for projects of higher current importance.

The wheat, tobacco, dairying, beef cattle, wool, poultry and fruit and vegetables industries in particular provided substantial direct financial support for the Department's operations. Additional support came also from commercial bodies by way of contributions of funds and materials.

### BUILDINGS AND EQUIPMENT

The Plant Pathology building at Indooroopilly was occupied towards the end of the year. The equipment includes an electron microscope, the first to be acquired by the Department.

The Seed Testing Laboratory in Stage I of the Standards Branch building at Indooroopilly became fully operational. Construction of Stage II of the building is nearing completion.

Construction of a modern laboratory at Indooroopilly for the Agricultural Chemical Laboratory Branch was commenced, as was construction of a Husbandry Research/Biochemistry building at the Animal Research Institute, Yeerongpilly.

A Sheep and Wool Laboratory and Animal House in the Charleville Pastoral Laboratory complex was completed.

A small laboratory for research into the Crown of Thorns starfish was occupied and a launch was acquired for field work in this project.

A good deal of useful equipment was purchased for use in laboratories and on research stations.

### ORGANIZATIONAL CHANGES

An important organizational change made during the year was the establishment of a Fauna Conservation Branch to take over the responsibilities in fauna conservation which had for many years been exercised by the Entomology Section.

Three long-established Sections of the Division of Plant Industry—Botany, Entomology, and Plant Pathology—were raised to the status of branches, and the status of the Fisheries Branch was increased by the creation of the position of Director.

Some changes in the organization of Herd Recording and Artificial Insemination were made to improve these services.

In the Division of Animal Industry, the Pig and Poultry Branch, which had always previously operated as two independent Sections, was re-established under the control of a Director.

#### EXTENSION PLANNING

The Extension Planning Committee set up in 1969 presented recommendations on regional organization of extension services to the Director-General early in 1971 and the implementation of these recommendations is under consideration. The main objective is to co-ordinate planning of extension projects on a district basis with regional supervision of operations.

At this critical stage in various primary industries, the Department's advisory services can be of particular assistance to farmers and graziers. Measures designed to assist producers to analyse their economic and management situations have been built into various programmes. From co-operative effort by producers and Departmental officers in designing and conducting programmes have come such benefits as low-cost, increased yields in tobacco and rice, diversified cropping on grain farms, and rational capital investment in pasture improvement.

The involvement of field agricultural economists in the planning and servicing of extension activities covering a wide range of enterprises has increased. This close association of economists with crop, pasture and animal extension officers assures the stressing of the economics of production and the whole farm approach by extension workers.

#### STAFF TRAINING

Short induction training courses were provided for most professional and technical appointees.

In-service training as usual took several forms.

Several branches provided opportunities for their field staff to attend intra-Departmental refresher courses and workshops in technical subject matter. Some officers attended refresher courses in other States.

Training schools and workshops in extension methods and farm management were held, with representation of all field branches.

Many officers attended conferences or workshops or made study tours in other States, the branches represented being Information and Extension Training, Plant Pathology, Entomology, Biochemical, Husbandry Research, Beef Cattle Husbandry, Veterinary Services, Dairy Field Services, Development Planning and Soil Conservation.

Overseas visits included the following:

T. Passlow (Senior Entomologist): Research and extension in pest control in U.S.A.

B. L. Oxenham (Director of Agriculture): Integration of research and extension services and potential crop diversification. U.S.A., United Kingdom, South Africa.

M. Bengston (Entomologist): Pest control methods in U.S.A., Canada, United Kingdom, Netherlands, Israel and India.

R. W. Johnson (Botanist): Post-graduate studies in taxonomy techniques in U.S.A.

G. C. Simmons (Chief Bacteriologist): Attendance at International Microbiological Conference (Mexico City) and study tour of U.S.A., United Kingdom, Israel and Malaysia.

F. N. J. Milne (now Director, Pig and Poultry Branch): Attendance at World Poultry Science Congress (Madrid) and study tour of United Kingdom, Denmark, Holland and North America, with particular reference to pig husbandry research and extension.

L. Pedley (Botanist): Appointment for 12 months as Australian Botanical Liaison Officer at the Royal Botanic Gardens, Kew, England.

A number of scholarships were allotted to allow prospective officers to continue or commence tertiary courses in agricultural science, agricultural economics, veterinary science, agricultural engineering, science, poultry technology and rural technology. Officers were also supported in full-time post-graduate University training in agricultural extension, science and animal science.

#### STAFF LOSSES

The prevailing employment situation for scientific and technical personnel in both Government and industry has arrested the free movement of these people from job to job. Consequently, Departmental losses due to resignation were much lower than usual during the year.

Officers who retired under age provisions included four who had given long and valuable service to the Department. They were Mr. J. Cauty (District Inspector, Slaughtering and Meat Inspection Branch), Mr. N. G. Cassidy (Senior Chemist, Agricultural Chemical Laboratory Branch), Dr. W. A. McDougall (Government Entomologist), and Mr. C. R. Smith (District Adviser, Sheep and Wool Branch).

The deaths of several serving officers during the year are recorded with regret. They included J. G. Young (Director, Dairy Cattle Husbandry Branch), C. P. Craven (Chief Veterinary Officer), L. S. Smith (Senior Botanist), L. R. Wentholt (Soil Technologist), and R. A. Petie (Clerk).

#### OVERSEAS AID

The services of Mr. J. K. Teitzel (Agrostologist) were made available to the Thailand Government to advise on pasture requirements and other matters relevant to the introduction of Droughtmaster cattle from Queensland.

Numerous scientists, technicians and administrative officers from overseas, sponsored by the Commonwealth Government or United Nations agencies, were afforded study facilities for periods up to 6 months.

The Department collaborated with the Commonwealth Government in providing International Training Courses in Seed Improvement and Certification, Poultry Husbandry, Dairy Husbandry, and Marketing of Primary Products. Group courses such as these are advantageous by lessening the burden on the training bodies of a large number of individual training commitments, and providing for valuable contacts and interchanges between representatives of many countries.

## II. Livestock Research and Extension

The livestock industries (beef cattle, sheep, pigs, and poultry) are given particular services by special branches, while a number of other branches also serve these industries.

The Beef Cattle Husbandry Branch undertakes field investigations and provides extension and other services in breeding, feeding and herd management. It operates a cattle field research station on the Upper Burdekin and is concerned with beef cattle trials on several other research stations.

The Sheep and Wool Branch conducts field investigations at Toorak Sheep Field Research Station in the north-west and on private properties. It conducts a fleece testing service for stud and flock owners.

The Pig and Poultry Branch is concerned mainly with extension in the respective industries but also undertakes experimentation and certain disease services.

The constituent Branches of the Animal Research Institute—viz. Biochemical, Husbandry Research, and Pathology—provide research and diagnostic services for all branches of animal industry at various centres and conduct the pig, poultry and beef testing services. The Veterinary Services Branch has a major responsibility for the health of livestock and for brands administration.

The Slaughtering and Meat Inspection Branch is concerned with hygiene in the production of meat and meat products, including pet foods, and with classification and grading of carcasses.

Various Branches of the Divisions of Dairying, Marketing and Plant Industry provide services related to animal production. Services to beekeepers are also provided.

### BEEF CATTLE

#### Breeding Herd Trials and Surveys

A review of aspects of reproduction in beef cattle covering Beef Cattle Husbandry Branch research over a period of years has been made available in a form which can be of direct use to the grazier, as well as to extension officers. It deals with basic causes of low reproductive performance and shows how such adverse effects can be reduced by sound management procedures. It also gives some breed comparisons, and a considerable amount of information on results achieved in supplementary feeding trials.

It is apparent that supplementary feeding for improved reproduction is a subject which needs considerable investigation and definition if an economic return is to be obtained. This does not apply to low-level supplementation for survival, which has found a definite place in the industry. In the seasonal mating system commonly employed in Queensland, from October to March, it seems that much of the benefit from low-level supplementary feeding is removed by compensatory weight gains and compensatory fertility occurring at the break of the season. It is possible that different mating methods will need to be employed, if supplementation is to be used to maximum advantage. In this connection, the responses to urea and molasses obtained at "Swan's Lagoon" field research station in early calving cows is of considerable interest.

In a field trial conducted by the Beef Cattle Husbandry Branch in the Brisbane Valley, a new approach was adopted in an endeavour to convert a survival situation into a production situation in breeding cattle. Drought-stricken breeders which calved from June to August, 1970, with calves at foot and weighing 460-700 lb., were fed a relatively high level of supplementation (3 lb. cottonseed meal a day) for two months (September and October). Feeding then ceased. Good rain was received in November. The supplemented group showed a significant advantage over controls in pregnancy rate and calf weights. The strategic supplementation enabled the cows to make better use of the improvement in nutritional conditions by restricting weight loss in a critical period. The difference in pregnancy rate between the groups was 33% (76% v. 43%), and the response was sufficient to give an economic return. As a corollary to this work, strategic high-level supplementation is being closely investigated at "Brian Pastures" Research Station.

In a detailed breeding herd investigation at "Memooloo", Central Queensland, the results of which were presented at a well attended field day in April, conclusions reached from work extending over a 6-year period were of extreme interest. It was shown that pregnancy rates averaging 94% can be obtained using an October-March mating period. The range of pregnancies was 91-96%. Time of conception within the mating period was variable. The proportion of cows pregnant by the end of December varied from 15% to 76%, averaging 49% on a whole-herd basis.

Since strategic weaning (May or June, depending on seasonal conditions) is used to conserve body condition in breeders, the early calf, born in July or August and averaging 474 lb. at weaning, fits into the system better than the late calf, born in December or January, and averaging 328 lb. at weaning. In limited observations, it appears that the early calf maintains and even improves this advantage through the next 12 months. This results in a more suitable animal for fattening for slaughter by two years of age.

Cows which calve earlier are heavier at weaning, averaging 974 lb., than cows which calve late, averaging 911 lb. The difference represents a valuable reserve for the following dry season. Experience in the 1969 drought showed that cows which calved in June and July, together with aged cows, were a worse drought risk than cows calving in other periods and younger cows. However, in average to slightly below average years the system is compatible with virtually 100% survival in breeders.

Losses from recorded pregnancy to weaning averaged about 8% per annum. This is a continuing problem in the Queensland beef industry.

In a trial at "Brian Pastures" Pasture Research Station, aimed at testing the effect of stocking rate on breeding performance, an interesting comparison was made at a stocking rate of 1 beast to 4 acres on black spear grass, between a group of cows supplemented with urea-molasses and another group not supplemented. The non-supplemented group lost 294 lb. body-weight between April and September 1970, while the supplemented group lost 224 lb. in the same period. The weight loss was recorded from pre- to post-calving. The difference in practical terms was that the group receiving no supplement had to be withdrawn from the trial, while the supplemented group was able to continue even at this heavy stocking rate.

In conception rate studies, it has been shown that, under the conditions at "Brian Pastures", an early mating, from October to December, gives very satisfactory conception rates and improved liveweight in weaners compared with later matings. Foetal loss is a significant factor reducing calving percentage, and there appears to be a seasonal effect involved. For example, in 1970 losses between pregnancy diagnosis and calving were 1% for early-mated cows and 11.5% for cows mated from January to March. In heifers in that year an 8% loss between pregnancy diagnosis and calving was recorded in the early-mated group, and a 19% loss was noted in the January to March group.

An examination of records relating to affected cows is proceeding. Age, nutrition, stocking rate, seasonal variations, cow history and body-weight are being considered. This work complements a similar investigation at "Swan's Lagoon", where an intensive investigation into disease aspects of these losses is proceeding. There is reason to believe that such losses play a major part in reduced breeding performance in beef herds of the State.

A variation of the supplementary feeding approach is provided by a trial which was commenced at "Brian Pastures" in May 1971 with heifers calving during the winter months and receiving a short period of fairly high-level supplementation to carry them through to mid August, when they will revert

to normal herd treatment. The aim here is to use the body condition of cows calving at the end of the pasture season combined with supplementation in early lactation to get them back into calf quickly, while their calves have a maximum period of growth before weaning into good pasture conditions in February. If successful, this trial will lead to turn-off of finished cattle at younger ages.

In an experiment conducted by the Husbandry Research Branch with Hereford cows, a submaintenance pre-natal nutrition significantly reduced calf birth weight by 6.8 kg. to 24.1 kg. and length of gestation by 5.4 days to 277.3 days compared with an above-maintenance ration. Dam nutrition did not influence the number of retained placentae, calf mortality or incidence of dystocias. Dam parity did not significantly influence calf birth weight or length of gestation but reduced the number of retained placentae of second parity cows.

The restriction of calf growth early in post-natal life did not influence subsequent growth and feed efficiency to 400 kg. liveweight when animals were placed on a high-quality ration fed to appetite. There was little difference in the body composition of calves restricted and realimented compared to calves grown unrestricted from birth.

#### Artificial Insemination

Six Angus bulls were performance tested between 250 kg. and 450 kg. liveweight by the Husbandry Research Branch. The average performance of the group was 0.88 kg. per day gain and 9.72 food conversion ratio. The two best bulls averaged 1.03 kg. per day gain and 9.0 F.C. ratio. These two bulls were transferred to the Artificial Insemination Centre, Wacol, as suppliers of semen for their breed.

#### Nutrition

Experiments were continued by the Husbandry Research Branch on intensive finishing on high-grain rations, growth of animals finished on grain compared with pasture, several facets of survival feeding, the use of molasses for production, and the effect of pre-natal and post-natal nutrition on the growth of calves.

Hereford steers, individually fed, were finished on a ration of 85% wheat, 15% barley straw and 1% urea, the animals averaging 1.01 kg. liveweight gain per day and an efficiency of conversion of 6.3. None of the animals showed evidence of ill-health. Neither the use of 1% sodium bicarbonate nor the processing of the wheat by rolling yielded benefits.



Stud breeders being fed crushed grain on the ground during a drought. Ground feeding is desirable to ensure equal access to all animals.

Cattle intensively finished on an all-sorghum grain ration low in sodium were depleted of sodium. Total body exchangeable sodium decreased by 0.8 equiv./100 kg. compared with 0.6 equiv./100 kg. in supplemented animals. Depleted animals lost 10 m-equiv. of sodium daily compared with a retention of 87 m-equiv. in supplemented animals. The physiological adaptation to sodium depletion was demonstrated by very high plasma aldosterone levels.

In a survival feeding experiment, steers were fed 210 kg. of an all-sorghum grain diet during 120 days. More efficient utilization of the grain as measured by body-weight change was not demonstrated by the various methods of restriction applied. No significant differences in growth rate occurred on realimentation.

A trial conducted for a longer period than in previous work again indicated that the frequency of ingestion of urea is important in the efficiency of urea utilization by ruminants.

Studies by the Beef Cattle Husbandry Branch on the utilization of Townsville stylo on commercial beef properties in North Queensland were continued. In July 1970, at "Salisbury Plains", near Bowen, a line of No. 8 Brahman steers was divided into two groups, one of which grazed fertilized Townsville stylo while the other grazed similar pasture which was not fertilized. Following good rains, more stock were introduced in December to the fertilized area to bring the stocking rate to 1 beast to 2 acres, while the

unfertilized area remained stocked at 1 beast to 7.5 acres. Further steers were introduced to both areas in February and final stocking rates were: fertilized area 1 beast to 1.5 acres, unfertilized 1 beast to 6 acres. Liveweight gains were comparable in both groups, 1.3 lb. per day for 293 days. Comparative gross margins for the two treatments were \$18.41 per acre for the fertilized area and \$6.87 for the unfertilized area, indicating the potential of fertilized Townsville stylo in a season such as was experienced in the past year.

A feed-lotting trial involving comparisons between high-moisture grain, dry grain and molasses was completed at Jimbour on the Darling Downs. Steers fed moist grain had a 5% better daily weight gain than the dry-grain group and a slightly lower dry-matter intake. Compared with dry grain, there was a greater efficiency of feed conversion, representing a saving of 6.5% dry matter.

The addition of molasses to dry grain increased dry-matter intake by 15%, increased cost by 9%, and resulted in a 9.4% decrease in feed conversion. It would appear that the addition of 5% molasses is not an economic proposition under the conditions of the trial. The addition of molasses to moist grain increased feed intake by 7%, increased cost by 9%, and resulted in a 10% decrease in feed conversion. The feed cost per 100 lb. of liveweight gain ranged from \$7.71 for moist grain to \$8.98 for dry grain and molasses.



Departmental investigations of feedlot feeding are aimed at providing useful information for enterprises such as this 800-head capacity feedlot on the Darling Downs.

Observations were made by the Beef Cattle Husbandry Branch of Hereford heifers grazing nitrogen fertilized pangola grass at Coolum Research Station with a view to observing the incidence of dystocia, which had been reported as high from commercial properties, and the efficiency of reproduction following first calving. A comparison of rotational grazing and set stocking at 3 heifers to the acre was also included. The heifers were in calf to Sahiwal bulls. All heifers were in good strong forward store condition during the calving period which began on 1-11-70 and finished on 26-1-71. There were no undue problems in the 52 heifers which calved. Six heifers were given varying degrees of assistance at calving. Five calves were dead at birth or soon after.

Pasture oxalate analyses showed the highest level of oxalate attained was 1.5%. Serum calcium levels of the heifers remained within normal ranges throughout the season. Blood phosphorus also remained at quite good levels during the season. Milk production of the heifers was extremely low, and this was correlated with poor calf growth. The incidence of anoestrus was high and this was related to low body-weight in affected heifers. In addition, there was a high incidence of suboestrus, i.e. ovarian activity without visible signs of oestrus. As a result, breeding performance was extremely unsatisfactory, leading to termination of the trial in its present form. It will be repeated at lower stocking rates.

Under the rotational grazing system pasture growth was estimated at an average 16,770 lb. of dry matter per acre per year, but there was little difference in animal performance between the rotational and set-stocking segments of the trial.

A trial on Coolum Research Station to measure liveweight performance of steers grazing pangola grass fertilized with two levels of nitrogen (300 and 500 lb.) at three stocking rates (2, 3, and 4 to the acre) was adversely affected by extremes of temperature and rainfall. The winter of 1970 was one of the severest on record on the station with more than 40 frosts recorded and temperatures reaching a minimum of 17°F. Then midsummer rainfall was the heaviest and most persistent for many years, resulting in flooding with removal of cattle twice from the experimental area to the ridge.

The trial was grazed from June 1970 to May 1971. In terms of liveweight gain, the greatest production per acre was 498.3 lb. from 300 lb. N at 3 beasts to the acre, followed by 433 lb. from 300 lb. N at 2 to the acre; 500 lb. N at

2 and 3 beasts to the acre produced 348 lb. and 272.7 lb. liveweight gain respectively. Production from 4 beasts to the acre treatments was very low. The 300 lb. N treatments were superior both for daily liveweight gain and for production per acre. Poor overall production at 4 beasts to the acre was due to heavy winter weight losses. It would seem that nitrogen-fertilized pangola grass in this environment should not be stocked until September if the best production per beast and per acre is to be obtained. Alternatively, if it is desired to carry cattle through winter without appreciable weight loss, the low stocking rate of 2 beasts to the acre should be used.

The pasture productivity trial being conducted by the Beef Cattle Husbandry Branch at Brigalow Research Station, which compares the effect of grass species on cattle performance and productivity per acre, is now nearing the end of its third year. The trial area used was originally brigalow scrub with wilga, sandalwood and belah on deep cracking soils with some brigalow-blackbutt patches. The area of 840 acres was pulled and burnt in 1966, and seeded in February 1967 to equal areas of green panic, Biloela buffel and Rhodes grass. Each pasture species was stocked at rates of 1 beast to 2½ acres, 1 beast to 5 acres and 1 beast to 7½ acres and the first intake of steers was made in March 1968.

Average lightweight gains for all species and all stocking rates varied from 335 lb. to 363 lb. per head and from 76 lb. to 82 lb. per acre in the first 2 years of the trial. Over the whole period, the effect of the heavy stocking rate (1 to 2½ acres) compared with the light rate (1 to 7½ acres) has been to reduce per head performance by 16-23%. However, liveweight gain per acre has increased by 126-160%. Differences between the moderate (1 to 5 acres) and light (1 to 7½ acres) are not so marked.

Stocking rate is critical when considering annual liveweight gain per acre. This seems more important than the type of grass under the condition of the trial. Owing to the depressing effect on liveweight gain per acre and consequent effect on carcass grading, high continuous stocking rates (1 to 2½ acres) are justifiable only when alternative fattening methods are available. Again, under the conditions of the trial, light stocking rates (1 beast to 7½ acres) appear to be an unnecessary luxury. Differences in liveweight performance per head between the moderate (1 beast to 5 acres) and the light rate (1 beast to 7½ acres) do not warrant the depressed production per acre.



Hereford steers grazing green panic pasture in the pasture productivity trial at the Brigalow Research Station. This pasture has been continuously stocked at 1 beast to 5 acres for almost 3 years.

While the differences between the three grass species are less than between the three stocking rates, there seems little point in planting Rhodes grass where buffel and green panic can be grown. Current indications are that in addition to poorer liveweight performance, Rhodes grass will not tolerate heavy grazing pressure as well as the other two species.

In all years, daily liveweight gains of up to 3.3 lb. per head have been obtained on the improved pastures of this trial during the periods of maximum pasture growth, usually December and January. In view of the assured beef production, year after year, off these pastures, it would appear that they offer a very sound method of brigalow land utilization with a return in each year, even during periods of drought.

At "Swan's Lagoon" Cattle Field Research Station, Townsville stylo grazing trials were continued in a modified form, with stocking rates on both native pasture and Townsville stylo of 1 beast to 5 acres. Phosphorus in the form of commercial phosphoric acid was fed through the drinking water as an additional treatment on fertilized and unfertilized Townsville stylo as well as on native pasture.

In the first draft of steers grazing the trial, no response was obtained to phosphorus supplementation on either fertilized or unfertilized Townsville stylo, but an advantage of 39 lb. was seen on native pasture. Most of this gain was obtained during the period of rapid pasture growth. Weight gains followed the pattern recorded previously, with a gradation from fertilized Townsville stylo through unfertilized Townsville stylo to native pasture. In the next draft of steers water consumption varied between 5 and 7 gal. per day. This draft of steers has been grazing the treatments since May 1970 and high rates of gain have been recorded, with the advantage again to fertilized Townsville stylo. In this draft, a response to phosphorus supplementation in steers grazing unfertilized Townsville stylo was recorded, but there was no advantage on native pasture. It is therefore apparent that, in the marginal phosphorus conditions obtaining at the station, the benefit of phosphorus supplementation has not yet been clearly defined. Investigations are continuing, and attention will be given to the possible variation in effect of phosphorus depending on the form in which it is fed.

The use of non-protein nitrogen in supplementary feeding has continued as an important part of research activities at "Swan's Lagoon". In a group of weaner steers supplemented from July to October 1970 positive responses of the order of 26 lb. and 11 lb. were obtained to supplementation with urea (2 oz.) and biuret (2½ oz.) respectively. The non-protein nitrogen groups still retained a weight advantage in April, although a low level of compensatory gain had occurred.

Supplementation from January to October 1970 gave a liveweight advantage in a group of weaners supplemented with urea at 90 lb. over controls. In April 1971, weights of steers from these treatments showed that 61 lb. of this advantage had been retained. The response in the supplemented weaners had commenced as early as April, when the cattle were selecting a diet of 8% crude protein.

The inclusion of phosphorus supplementation treatments in these trials has given no advantage in these young animals, and, in fact, some depression in performance has been recorded. Investigations into this aspect are continuing.

In a further trial the effect of different levels of urea on performance of steers was examined. In a trial extending from July to October 1970 it was found that an increasing response was obtained to increased amounts of urea up to 3 oz. daily. However, most of the advantage, 34 lb., was given by the 1 oz. treatment, while 2 oz. increased the advantage to 39 lb. and 3 oz. to 47 lb. Levels higher than this were not used since the possibility of toxicity is markedly increased at higher levels. In April 1971, advantages of 26, 33 and 45 lb. respectively were still present when compared with a control group grazing only native pasture.

The influence of various types of supplementary feeding on breeding performance of Shorthorn and Brahman cross-bred females on native and improved pasture was the subject of a comprehensive and continuing trial at "Swan's Lagoon" which commenced in 1970. The supplementary treatments include molasses, molasses and phosphorus in wet and dry seasons, molasses and urea, and molasses, urea and phosphorus. The trial is still in the early stages but an effect of urea in reducing time to first oestrus after calving, and advantages in pregnancy rate to molasses, and to other supplemented groups were seen. The time of calving could have been a factor in this result, since cattle commenced calving in June, and supplementation of the lactating cattle over the dry season might be expected to give an optimum response.



### Pests and Diseases

**Cattle tick.**—Continuing and successful efforts have been made to eradicate tick outbreaks from normally tick-free areas and to confine the parasite to its recognized limits.

Following upon representations by this Department, the location of the line dividing Portions S and W in the New South Wales legislation has been redefined in the area between Chinchilla, Bowenville and Cecil Plains, so both the Chinchilla and the Dalby saleyards are now situated in the tick-free area. This has greatly facilitated trade and movements of sale cattle to New South Wales. This action is in keeping with that taken in the previous year, when the line running approximately between Hughenden and Jericho was moved eastwards.

During the past year the Injune and Upper Maranoa Special Areas were repealed following eradication of ticks and nine properties were released from the Warrego Special Area. Only four holdings now remain in the Warrego Special Area, whereas originally it consisted of 28 properties.

The position on the Darling Downs is better than it has been for many years. Only 24 properties remain under quarantine, compared with 46 at the end of May 1970.

The voluntary tick control programme was continued in the Currumbin Valley in conjunction with the New South Wales Department of Agriculture. To date, 9 of 50 properties (involving 2,572 cattle) remain infested after 11 treatments (average) since September 1970. The control was generally better this year as cattle were subject to close crush inspection whereas in the previous year visual yard inspection was relied upon. In this area, there are a number of Biarra resistant properties which require the use of Dursban (at double strength), Nexagan and Prolate. Excessive rain, flooding of the Currumbin Valley and ephemeral fever during January and February caused considerable interference to the dipping programme.

There is continuing support from the industry for the requirement that travelling cattle be free from tick infestation. All permits for movement of cattle other than for immediate slaughter within tick-infested areas are issued on the condition that the cattle are free from ticks and treated within 72 hours prior to movement. Where ticks have been found on travelling cattle, insistence on treatment prior to subsequent movement has usually resulted in improvement in control on the properties concerned.

Resistant ticks continue to become more widespread. Additions to the previously known locations of the various types include the following:—

**Biarra resistance.**—New foci were detected at Gayndah, Biggenden, Mount Perry, and Rossmoya (near Rockhampton), where several properties in a group are involved. An outbreak was detected at Mena Creek near Innisfail. These ticks are believed to have been carried to that area in fodder or on travelling cattle.

**Mackay resistance.**—Two additional properties were found at Gladstone, making a total of five there, and two were found at Rockhampton. Apart from these, this type of resistance is limited to the Mackay area.

**Mount Alford resistance.**—In last year's report, reference was made to resistance to Dursban on properties located at Pimpama, Beaudesert and Lamington. This is now referred to as Mount Alford resistance. This tick is resistant to diazinon, dioxathion, carbaryl, coumaphos, Ethion and Dursban. Mount Alford resistance has been confirmed as far north as Gympie. A total of 33 properties is known to be affected.

**Gracemere resistance.**—This type differs from the Mount Alford type in having Dursban resistance superimposed on Ridgeland resistance. It is limited to a few properties in the Gracemere area.

The number of properties on which resistance of one or other type was confirmed during the year, together with the total number of properties with resistance, is set out in the following table:—

Type of Resistance	Number Confirmed (1970-71)	Total for State
Mount Alford .. .. .	9	31
Biarra .. .. .	222	928
Mackay .. .. .	17	79
Ridgeland .. .. .	163	865
No resistance diagnosed ..	157	1,264
TOTAL .. .. .	578	3,167

In addition to the activities of stock inspectors at permanent centres throughout the State, four officers are engaged in full-time tick control extension activities with headquarters at Laidley, Maryborough, Rockhampton and Townsville. Their services are being more widely sought than at any previous time.

During the year, these officers made 1,202 visits to properties to investigate and discuss tick control measures in relation to property management. They take part in extension activity such as meetings of producer organizations, discussion groups, television and radio and submission of articles to the local press. They are also responsible for field trials relating to tick fever vaccinations and studies of tick larval survival on pastures throughout the State.

Reference was made in last year's report to the problem of degradation of dipping fluids, which is distinct from control failure due to tick resistance. It has become more widespread and investigations to date suggest that it is associated with a high pH: this can be controlled by the addition of superphosphate or phosphoric acid.

Chlorphenamide is now marketed commercially and has been generally effective in controlling all of the resistant strains of ticks. It is unstable and tends to strip quickly at pH levels above 5.5 to 6. This can be overcome by the addition of 1.5% superphosphate. Because relatively small quantities of the chemical are needed, considerable care is necessary when adding the chemical to the vat. To be effective in the long term, it will require a higher standard of dip management than was previously the case.

An experiment designed to compare the immunity produced by re-vaccination at 6-monthly intervals with homologous strains of *Babesia argentina* with that produced by such re-vaccination with heterologous strains of *B. argentina* is under way at the Animal Research Institute.

Three attempts have given negative results for generation-to-generation transmission of *Anaplasma marginale* by the cattle tick infested with the parasite.

The advent of the potent babesicide, imidocarb, has enabled studies to be made of acquired immunity to babesiosis in the absence of infection. It has been accepted for many years that, in protozoal infections, immunity is at least partially dependent on a persistent infection. Results of work at the Tick Fever Research Centre have indicated that immunity to *B. argentina* did not decline in the absence of infection. The results of further work at the Centre provide strong evidence that a persistent infection is not necessary for immunity to *B. bigemina* infection.

A Biochemical Branch study of the residue characteristics of representatives of the new school of acaricides under development indicates that while pesticide residues in tissues of meat animals are satisfactory, the levels in some samples of milk are aesthetically excessive.

**Pleuropneumonia.**—The National Sub-Committee for eradication of bovine pleuropneumonia agreed that restrictions be removed from the remaining 32 properties as from the beginning of 1971, so there are now no properties in Queensland under restriction of any kind for this disease. It is 4 years since the last confirmed lesion was encountered (this was in a slaughter beast) and 11 years since the last field outbreak of the disease. Monitoring of the position by palpation of lungs of slaughter cattle will be continued for some time, but it is hoped by 1972 to enlarge considerably the present nationally recognized pleuropneumonia-free area of this State.

**Tuberculosis and brucellosis.**—The campaign to eradicate tuberculosis and brucellosis in Queensland as part of a nationwide scheme commenced in November 1970. Protected areas embracing those shires situated along the eastern coast and its hinterland were gazetted initially. Contact tuberculin testing of dairy cattle has continued at triennial intervals under the dairy cattle compensation scheme which has been in operation since 1946. The testing of beef cattle, however, is organized on a different basis. Owners in protected areas were asked to contact a veterinary practitioner to undertake the necessary testing and results are reported to Divisional Veterinary Officers. There is no compensation for testing under the national scheme.

Although participation by beef cattle owners in the scheme was somewhat slow at the outset, there has been a steady increase in demand and since the inception of the scheme approximately 500 beef cattle herds have been tested, involving 152,114 head of cattle, in which 217 reactors have been found. This low incidence of infection in beef herds is most encouraging. As the full details of inspections of reactors at slaughter are not yet to hand, it is not possible at this stage to express the incidence of lesions as a percentage. However, it is estimated that this figure is approximately 0.08%.

As a result of the increasing interest in testing, 13 additional Shires have been included in the protected areas.

Statistical information from slaughter cattle over a period of some 15 years has indicated that the most severely infected herds are located in the far west of the State. These herds run under extensive conditions and eradication of the disease from them presents problems which are unique to this country. A number of herds are being tested on an experimental basis to ascertain the most effective means of dealing with them.

Strain 19 vaccination of dairy heifers is being widely practised and the intention is to vaccinate as many as possible each year for some years. In beef areas, on the other hand, vaccination will be undertaken on a more restricted basis and in general will be confined to herds known to be infected and possibly those adjoining them. Surveys will therefore be undertaken to ascertain which herds are infected.

*St. George disease.*—Studies on St. George disease have established that the condition is a plant poisoning caused by species of *Pimelea*. *P. trichostachya* has been incriminated in inland Queensland. In the Maranoa district the disease often has a high incidence when the plant is no longer prominent. The evidence suggests that old plant particles are toxic and that the toxic principle is often absorbed after inhalation of plant particles.

*Helminths.*—A potentially important nematode (*Setaria* sp.) has been found in the Mackay district.

*Ephemeral fever.*—Two virus isolates have been identified as ephemeral fever virus. Sera are being collected at regular intervals from cattle which were exposed to ephemeral fever during the 1967-68 outbreak to determine the duration of neutralizing antibodies.

*Infertility.*—A survey of genitalia from 581 beef cattle from 29 properties in North Queensland and 3 in the Northern Territory suggested that vibriosis and trichomoniasis are significant causes of infertility in the area.

#### Extension

The reorganisation of the Beef Cattle Husbandry Branch was taken a step further during the year with the closing of centres in the predominantly dairying areas and the redeployment of staff into the major beef areas not formerly adequately serviced by the Branch. Officers were appointed to Biloela, Bowen, Richmond, Goondiwindi, Dalby and Mareeba. Branch officers in the western Downs/Maranoa have played a leading role in major extension programmes relating to fodder conservation. Among the group activities in the beef industry in which field officers participated were three beef cattle schools and numerous field days.

#### SHEEP

Research studies on reproduction, nutrition and range management are in progress at "Toorak" Sheep Field Research Station, near Julia Creek.

High ambient temperatures are a factor adversely affecting reproduction in tropical Queensland. A trial to examine the effects of high temperatures on some endocrine aspects of reproduction has been commenced. Another trial studying high temperatures in relation to seminal degeneration in the ram has indicated marked variability in the response of individual animals to high temperatures.

Physiological investigations into blood constituents, body temperature and efficiency of water utilization are being made on groups of plain and wrinkled bodied ewes selected from the nucleus long-term trial on lambing performance and wool production.

Following work which indicated that significant fertility responses could be achieved in pen-fed weaners with adequate growth rates between 6 and 12 months of age, a similar trial is being conducted under field conditions.

Fertility and wool growth are being studied in a trial in collaboration with the Department of Animal Physiology of the Waite Agricultural Research Institute, in which South Australian strain ewes were transferred to Toorak and Toorak ewes transferred to Adelaide. Results to date suggest that the effects of severe strain early in life (high temperatures and poor nutrition) appear to be permanent and are not removed by change to a more favourable environment. Previous work at Toorak has indicated that fertilization failure is the major cause of reproductive wastage, post-fertilization losses being relatively small. Fertilization failure and the relative contribution of the ewe and the ram to this factor were investigated. Comparison is being made of performance in relation to oestrus, conception, lambing and wool production of two groups of ewes, one group joined in spring and the other group in autumn.

A drought-feeding trial to evaluate further the responses to urea/molasses supplementation by ewes grazing dry Mitchell grass pastures was conducted during spring and summer until useful grass-producing rain fell early in 1971.

In a 1969-70 drought-feeding trial, no significant differences in wool growth and body-weight responses were found between a treated group and controls when sheep were fed wheat or grain sorghum treated with formalin to protect the protein content from digestion in the rumen. A similar trial is being conducted using more critical control of treatment levels.

A trial has commenced which will investigate botanical changes of pastures in the North-west throughout the year, quality and quantity of the diet selected by sheep on these pastures and the effects of any changes in pastures on weight, condition and wool production of the grazing animals.

The nutritive value of hoop pine (*Araucaria cunninghamii*) sawdust for sheep was determined at the Animal Research Institute. Dry-matter digestibility was zero and the sawdust made no contribution to production as evidenced by no growth response during the 100 days' trial.

The examination of the value of different mating procedures on conception and lambing performance of maiden ewes in the low rainfall mulga country west of the Paroo has indicated after 2 years' investigation that the age of the ram and "withdrawal" mating techniques had no influence on the reproductive performance of maiden ewes. As yet the data are not complete, but results indicate a very high neonatal loss.

At Charleville a mulga utilization trial indicates that phosphate supplementation of sheep gives a response only in the presence of an energy supplement. Sheep supplemented with energy in the form of molasses maintained a higher body-weight than those not receiving molasses. Energy supplements also appeared to influence reproduction.

Digestibility studies on mulga-fed sheep showed a relationship between faecal nitrogen and digestibility. The establishment of this allows estimation of the daily intake of mulga-fed sheep. These data have not yet been fully analysed. Other mulga trials included investigation into the toxicity of sodium monophosphate supplements.

At Mitchell a urea/molasses trial has been completed. It would appear that under the grazing conditions of this trial there was no effect on the body-weight, wool growth or reproductive performance of sheep.

At Cunnamulla a strain comparison trial terminated prematurely owing to labour problems and the current low values of wool.

Two grazing trials, one on the Darling Downs and the other in the central-west, are still in progress. A new grazing trial was commenced in the desert country south of Barcardine to observe utilization of *Dactyloctenium giganteum*.

An infertility investigation was commenced on the western Darling Downs. The supplementation trial at "Merino Downs", Surat, is continuing.

During the year outbreaks of blowfly strike gave indications of the difficulties of control under field conditions and laboratory studies confirmed the wide geographical distribution of flies resistant to available insecticides. Laboratory studies also showed that under insecticide pressure the development of higher resistance will evolve. The early application of the Mules operation as early as at lamb-marking has been demonstrated and is advocated where practical in the sheep area in the south of the State. The outlook for future control of flystrike is not bright and an insecticide which will control resistant flies and give a reasonable period of protection following jetting is urgently required.

A total of 412 fungal toxins (143 in the past year) has been examined at the Animal Research Institute for evidence of biological activity against *Lucilia cuprina*. Of these, 28 showed some activity against the blowfly larvae. Further investigations are being carried out on one of the toxins of a strain of *Trichothecium roseum*.

An outbreak of footrot in sheep introduced from New South Wales occurred at Warwick. *Fusiformis nodosus* was isolated. This State remains free of the disease, probably on account of the less favourable conditions.

A farm management accounting service is being provided by Economic Services Branch to small groups centered on Muttaborra, Dirranbandi and Karara. An additional group is to be established in the Charleville-Cunnamulla region following the appointment of an Agricultural Economist to Charleville early in 1972.

#### PIGS

Experiments were continued by the Husbandry Research Branch with grower/finisher pigs on the comparison of the cereal grains, the optimal levels of protein concentrates in these grain diets, the partial replacement of protein concentrates with synthetic amino acids, and the biological evaluation of protein concentrates.

Diets containing 80% barley resulted in superior average daily gains, efficiency of conversion, efficiency of energy utilization and carcase characters when compared with diets containing 80% sorghum (both grains crude protein 12.5%). The major part of the improved performance was in the early growth period 18-50 kg. liveweight. Diets containing 80% wheat produced superior production to the other two grains but gave poor carcase quality. On these cereal diets a standard feeding scale (maximum appetite to 50 kg. then restrictive) was compared with a feeding scale of 3½% liveweight (restrictive early but then liberal). The standard scale resulted in increased liveweight gain to 50 kg. bodyweight and less satisfactory gain between 50 and 80 kg. liveweight but better carcase quality.

A comparison of four protein concentrates supplying 6% crude protein in 80% cereal grain diets was made. Up to 50 kg. bodyweight the ranking of the concentrates on performance was fishmeal, soybean meal, combined soybean-whale solubles, whale solubles. From 50 to 80 kg. bodyweight the whale solubles were inferior to the other concentrates, which gave equivalent performance. Fishmeal gave the best quality carcase, then soybean meal, combined soybean meal-whale solubles and whale solubles.

In wheat-based diets production increased as soybean meal content was increased in stages from 0 to 15%. Above this level performance was not increased. Diets with levels of soybean meal of 3, 6 or 9% supplemented with synthetic lysine and methionine calculated to be equivalent in these amino acids with 15% meal resulted in performance equivalent to that obtained with 15% supplemented diet.

Biological assay of protein concentrates in rats evaluated meals in the following descending order, with small differences: soybean meal (full fat), soybean meal (solvent), fishmeal, soybean meal (expeller), whale solubles.

Studies by the Biochemical Branch on the amino acid content of sorghum grains indicate a reasonably standard distribution of amino acids in 18 commercial and pre-release varieties. However, most samples were high in total protein content and comparison with representative samples of lower protein content is desirable before the concentration of each amino acid is expressed in terms of total protein.

Studies by Husbandry Research Branch on the pig herd at Hermitage Research Station changed from nutrition to experimental breeding. Breeding programmes applicable to the commercial industry and based on selection for production have commenced.

At the boar testing station, Rocklea, the breeding value of boars are assessed on growth rate, feed conversion efficiency and carcase quality. The best 50% of boars are approved and the remaining 50% are slaughtered. During the year 139 boars were tested and 70 were approved, of which 46 were Large Whites, 21 Landrace and 3 Berkshires. Only one of 14 sons of tested boars was not approved. This indicates that the superiority of boars approved in the test is being passed onto their offspring. Since June 1970 the number of boars constantly in the station has increased from 30 to 70, mainly as a result of the increased support of the Large White breed.

A widespread infertility problem of sows has been under investigation in south-eastern Queensland, more particularly in relation to highly intensive commercial piggeries. Investigations have failed to reveal any infectious agent and it is thought that high prevailing temperatures during the summer mating period may be involved. Investigations are continuing.

There has been a significant reduction in the incidence of lesions of Battley tuberculosis in pigs reared at a Toowoomba piggery since the changeover from the deep litter to the cement and slatted floor system of intensive housing.

Trials were undertaken at the Animal Research Institute in association with the Department of Health to investigate factors likely to be responsible for the lowered pathogenicity of the *Mycobacterium intracellulare* serotype VI strain used in earlier trials with pigs.

In a study of joints (mostly stifle joints) obtained from pigs showing evidence of arthritis at slaughter, *Erysipelothrix insidiosa*, the causal organism of erysipelas, was isolated from 14 of the 55 joints examined. *Mycoplasma* sp. was not isolated from any of the joints.

Requests to the Pig Branch for advice and technical assistance both from producers and from commercial organisations working with the industry continued at a high level. Producers generally sought advice on methods of increasing efficiency rather than assistance with plans for expansion. This trend was modified toward the end of the year, following the successful sorghum harvest, but the excellent export market for this crop curtailed a number of planned expansion projects.

Advice in depth on problems of ration formulation was frequently sought and continued to be approached with the assistance of the computer. Least cost rations were calculated on a district basis at regular intervals and as a result better use was made of the less usual ingredients when their price



A district adviser and a producer discuss pig husbandry matters.

was favourable. A number of commercial organizations sought similar advice and found the approach of considerable benefit. One outcome of this work, supported by research results, was the expanded use of cottonseed meal.

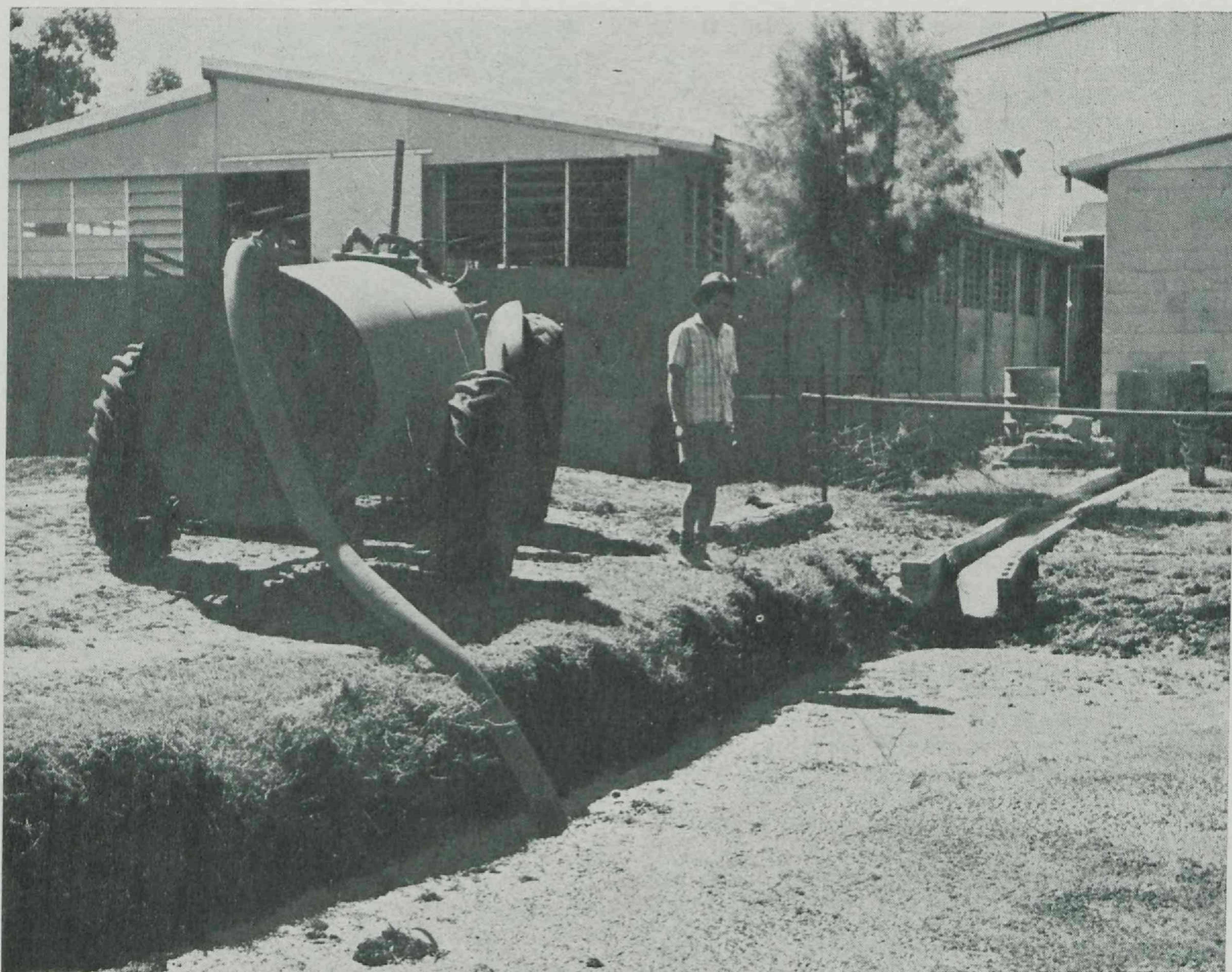
The efforts made in the previous year to stimulate interest in litter and management recording schemes were successfully continued. Results from litter recording were published; some 4,500 litters in 71 herds averaged 9.9 pigs born alive per litter, with 8.4 being weaned. Additional results, from a proportion of the co-operators, indicated an average age at weaning of 40 days and a farrowing interval of 175 days. These results compare favourably with many published overseas and suggest that both the genetic material and managerial ability are comparable in these respects.

A pig management recording scheme is under way on the Atherton Tableland to provide an assessment of piggery efficiency in terms of profit margin over feed costs per sow. Some very good performances were recorded, with one grower returning a margin of over \$400 per sow with an average turnoff of 24 pigs per sow. However, the average number of pigs reared per sow was as low as 10.4 on one farm. The wide range between this figure and 24 per sow illustrates the potential for improvement.

A report on a small group of specialist pig producers in south-eastern Queensland recording in the Farm Management Accounting Service was published for 1969-70. Results to date indicate that to survive in this highly competitive industry, farm records are vitally important and it is planned to expand this group. This is desirable to establish performance standards on key factors such as feed conversion ratios and costs per sow as a guide for improvement in managerial efficiency.

Interest in herd improvement has increased, and officers have assisted a number of producers with the on-farm performance testing of gilt replacements, using a mechanical probe to determine backfat thickness. The Northern Pig Marketing Board purchased an ultrasonic probe which will be donated to the Department for use by the officer of the Pig Branch in the area under a somewhat similar on-farm testing scheme.

Factors contributing to the various disease problems have been investigated by officers of the Veterinary Services and Pig Branches. These are generally aggravated by insufficient attention to good husbandry, especially the provision of adequate warmth in farrowing quarters. Temporary infertility, apparently of seasonal incidence, is a particular problem which is being studied.



Removing effluent from a manure pond with a vacuum pump for spreading on cultivated land for fertilizing purposes.

Extension through discussion groups has proved successful. A number of new groups, generally structured as branches of the Queensland Pig Industry Producers' Association, were formed. The mass media have been well supported by staff who have also assisted in co-ordinated extension programmes in districts. Despite the apparent inefficiency of individual farm visits these continue to be a very necessary adjunct to all services as well as being required for specific purposes. It was noted, for example, that nominations for boar performance testing declined when officers were absent from their district for any reason, despite arrangements to nominate direct. Producers wanted to discuss their proposals on the spot and sought support from the district officer concerned.

#### POULTRY

Studies on the management and nutrition of layers in cages and layers on litter were continued by the Husbandry Research Branch.

Experiments with caged layers to examine the effect of the relationship between bird density and initial body-weight on production resulted as follows: (a) heavier hens laid more eggs, survived better, ate more feed and remained heavier than lighter hens, (b) cage populations of mixed body-weights gave inferior performance to those of uniform body-weight, (c) as stocking density increased hen day production decreased for lighter hens but not for heavier hens.

The level of dietary phosphorus did not affect the egg production of layers in cages or of layers on litter. The dietary phosphorus levels ranging from 0.4 to 1.1% were those that occur in commercial diets containing meat-and-bone meal. The high levels of phosphorus reduced egg shell quality and the effect of the phosphorus level was dictated by the calcium: phosphorus ratio in the diet.

On diets containing either 0 or 6% tallow, the production of caged layers was not affected by varying the calcium levels in the diets from 2.5 to 4.5%. Increasing the dietary calcium level, however, improved egg shell quality but the degree of improvement to the additional calcium declined as the hens aged.

The addition of 0.3 or 0.6% sodium bicarbonate to commercial-type layer diets did not improve egg production or egg shell quality.

Debeaking pullets at either 5 days, 12 weeks or 20 weeks of age did not affect the subsequent production of the pullets when they were housed in single-bird or multiple-bird cages.

In formulating diets, nutritionists in Australia rely mainly on tables of components prepared for feedstuffs in other countries. Information on locally grown feedstuffs is being accumulated. During the year the metabolizable energy content was determined for 18 sorghum grains and 22 maize grains for which detailed agronomic information was available.

Studies by the Biochemical Branch on the amino-acid content of the sorghum grains indicated a reasonably standard distribution of amino acids. However, most samples were high in total protein content and comparison with representative samples of lower protein content is desirable before the concentration of each amino acid is expressed in terms of total protein.

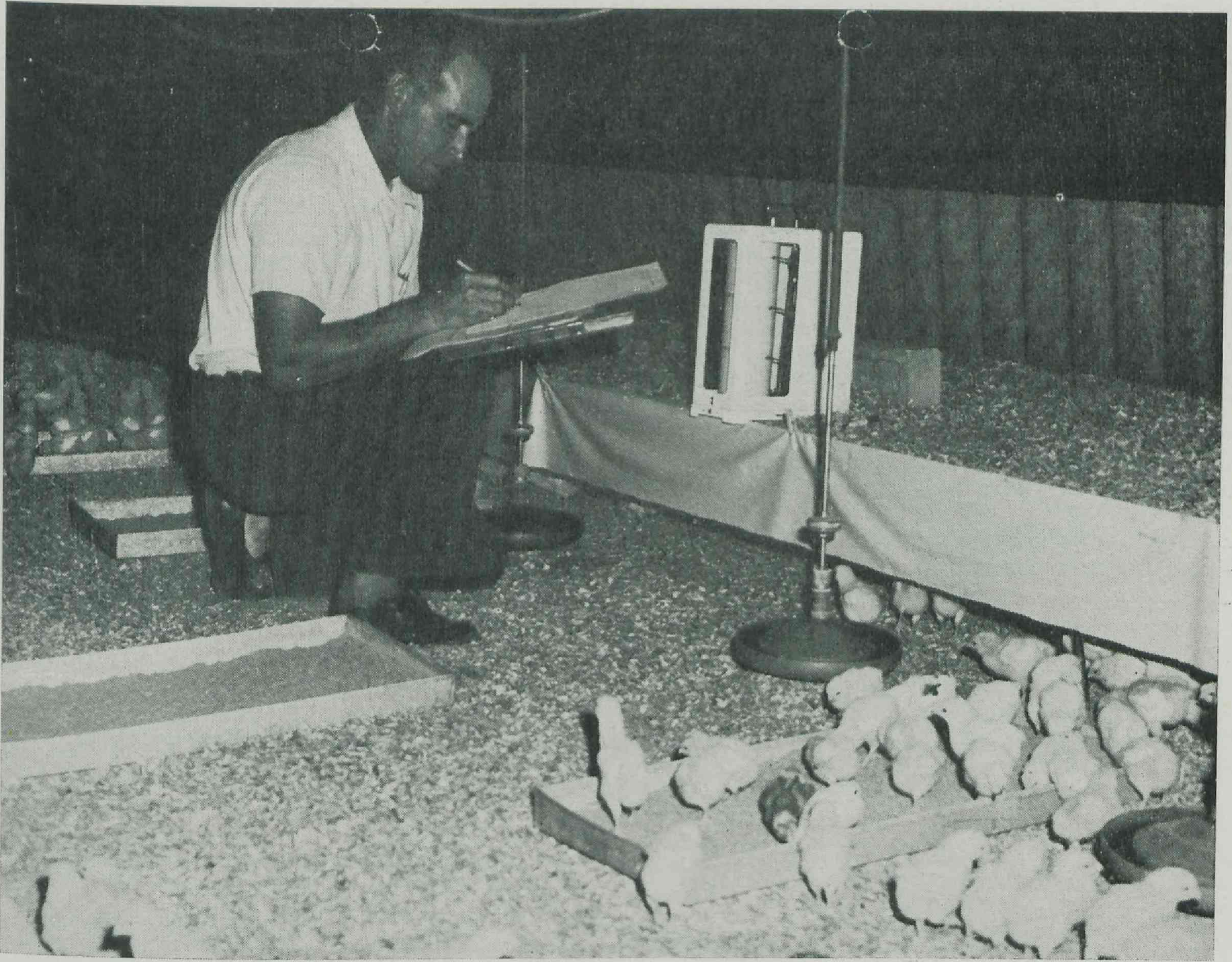
The Husbandry Research Branch found that a gene which causes the red-blood cells of birds to react with Kahn's antigen reduced the hatchability of Australorp eggs by an average of 9.5% in two generations. The gene acts through a reduction in the fertility of cockerels.

Eighteen outbreaks of infectious laryngotracheitis were recorded in the Brisbane area, the overall mortality amongst broiler chickens on outbreak properties being about 5%. Vaccine was administered via the drinking water in three affected flocks at 6 weeks of age or older. Results were quite satisfactory as all clinical signs of the disease disappeared within 10-14 days after dosing. Similar results were achieved in an outbreak involving 50,000 birds in north Queensland.

A local strain of *Mycoplasma* involved in avian mycoplasmosis was isolated and identified as *M. gallisepticum*.

The testing of extracts of fungi as toxic agents to chickens has been continued with no conclusive evidence of toxicity.

Temperature recordings made by the Poultry Branch have shown that some brooding systems fall far short of providing the optimum brooding environment, particularly during the winter months, when heat losses from uninsulated, over-ventilated sheds can be very high. On the other hand, temperature records obtained in properly designed "whole room" brooding systems have demonstrated the superiority of this system in providing the ideal brooding environment regardless of prevailing weather conditions. These investigations have been largely responsible for the strong trend towards this system of breeding for broilers and for large-scale pullet raising.



A broiler grower checks brooding temperatures under his hot-water brooding system with the aid of a thermograph supplied by the Poultry Branch.

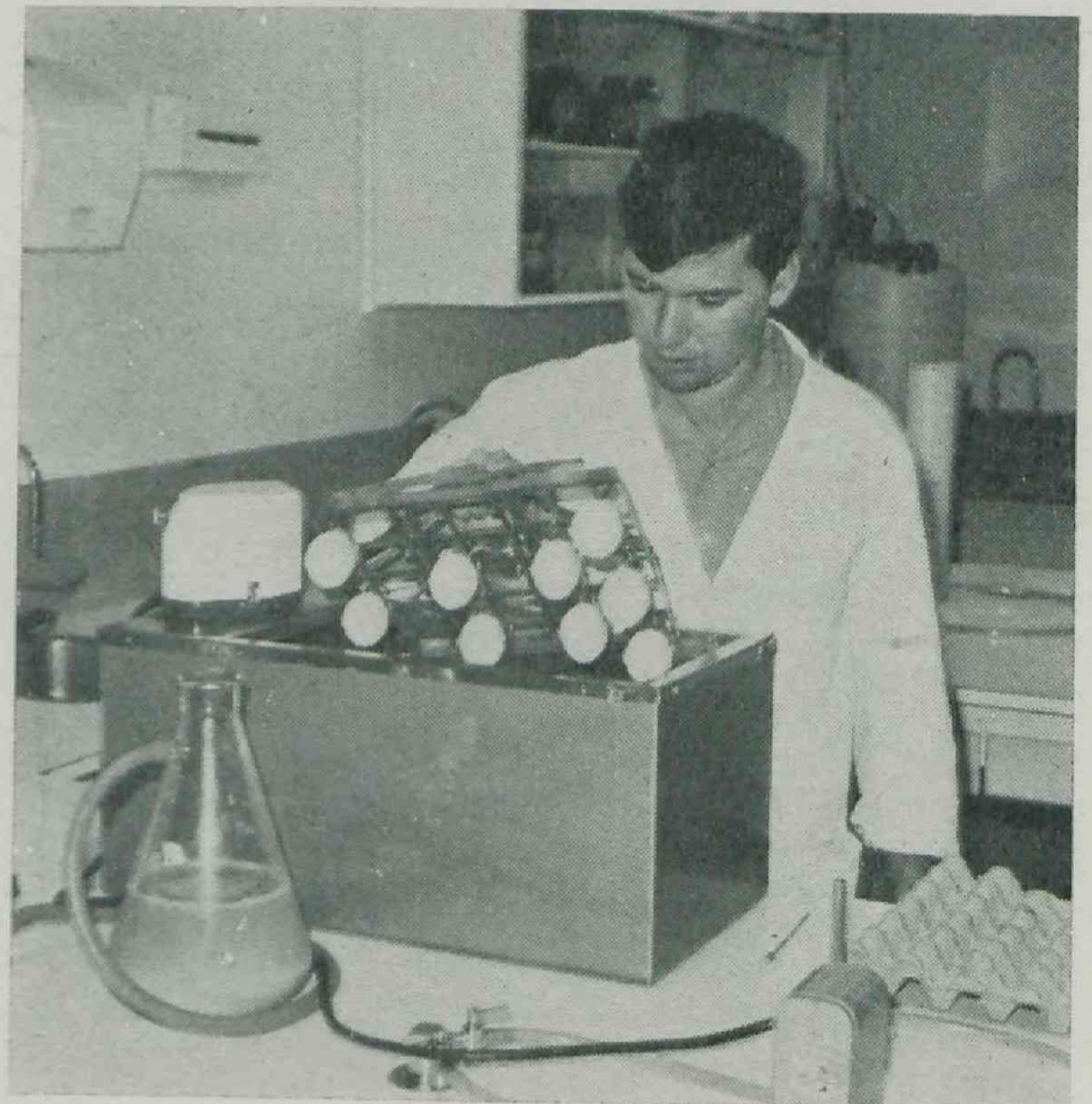
The Poultry Branch in co-operation with the Pathology Branch began a programme of investigations of the hygiene status of a number of Queensland hatcheries during 1970-71. Assessment of hygiene is based on microbial counts obtained from samples of hatcher fluff. Hygiene ratings of "satisfactory," "could be improved" or "unsatisfactory" are given, depending on the counts obtained. Where fluff counts indicate that hygiene needs to be improved, a detailed check is made of the complete hatchery hygiene programme and suggestions are made for changes in the programme where necessary. Repeat sampling is carried out to check whether fluff counts have been reduced. The investigation has generated a great deal of interest amongst Queensland hatchery operators because of the obvious benefits to be gained from improved hatchery hygiene. It is anticipated that all hatcheries in the State will have had fluff sampling carried out by the end of 1971.

In the laboratory of the Egg Marketing Board a major investigational project has been commenced to study methods of egg treatment to minimize numbers of shell-borne micro-organisms. The aim of this project, financed by the Poultry Industry Research Fund, is to find the most efficient way of destroying bacteria on and within the shell of eggs prior to the production of egg pulp and various egg products which involve breaking of eggs. The efficiency of chemical and heat treatments is being evaluated; in the first phase of the project the germicidal efficiency of two chemicals, Chlorosan and Hysan, using various chemical concentrations and egg immersion times, was evaluated by means of a wide variety of bacteriological tests. This work is continuing.

On the recommendation of the Poultry Advisory Board, Egg Grading and Marking Regulations under the Poultry Industry Acts were gazetted to become effective as from January, 1, 1971. The main purpose of these regulations is to ensure that all eggs offered for sale in South and Central Queensland are graded correctly and marked according to their grade. Altogether some 242 identification symbols have been issued to Egg Marketing Boards in South and Central Queensland and persons producing eggs for sale in this State. The marking of eggs has been well accepted by the public and the Egg Marketing Board reports no slackening in sales. The bulk of the inspectorial work has been carried out by Egg Board Inspectors who were appointed Honorary Poultry Inspectors for the purpose of these regulations.

The Downs poultry accounting scheme was continued to obtain information on actual rearing costs of pullet replacements on egg producers' farms. Detailed cost figures have been obtained for some 37 flocks of pullets reared on 16 farms. The most recent report on the Scheme indicated that producers in the region are able to rear pullets for \$1.24 per bird. To this figure must be added an opportunity cost which takes into account the return which could be obtained if capital invested in rearing facilities had been invested elsewhere. This return could be as high as 25%, in which case an additional amount would have to be added to the above figure.

#### Experimental treatment of eggs for the elimination of shell-borne micro-organisms



Another poultry accounting scheme was commenced, in the Brisbane district. The aim of the scheme is to assist producers to more accurately assess costs and returns for both the rearing and egg production phases of their farm operation.

To meet the demand by farmers for specific technical information it is planned to further develop the specialist-consultant aspect of the activities of the Poultry Branch in such fields as nutrition, economics, agricultural engineering, hatchery hygiene, environmental physiology and product quality control. Specific extension programmes conducted during the year were aimed at improving the effectiveness of artificial lighting programmes, reducing production losses due to brooding problems, lifting the hygiene status of hatcheries, improving information flow to broiler producers, and encouraging producers to keep accurate costing information.

A Poultry Industry Festival and a Poultry Information Exchange held in 1970 were well attended.

#### BEEKEEPING

A survey conducted by the Department along the Bulloo River, west of Cunnamulla, to determine the value of the eucalypt yapunyah as a major honey-producing plant resulted in 5,000 bee colonies being migrated successfully to that area. Following the appointment of an apiculturist to Warwick, an exploratory project on dwindling in honeybees has been commenced.

#### MEAT INSPECTION

The Slaughtering and Meat Inspection Branch provided full-time inspection at abattoirs and part-time inspection at country slaughterhouses. Considerable capital expenditure was outlaid in maintaining and improving facilities at abattoirs, but few improvements to slaughterhouses were undertaken. New requirements relating to the wholesomeness of material used in the manufacture of margarine has stimulated renovation of rendering premises and the installation of new machinery.

The standards of construction and hygiene in butchers' shops are being adequately maintained.

Trials undertaken in several smallgoods factories have shown that revised cleaning methods can greatly reduce microbial contamination.

Competition from large processors is reducing the number of poultry slaughterhouses. A survey of poultry diseases evident at slaughter showed a low disease incidence.

Grading of beef was undertaken at Brisbane, Toowoomba, Ipswich and Townsville. Cattle slaughtered at Townsville were of lower quality than those killed in the south. Lamb and hogget classifications marking was carried out at several centres.

A swine brucellosis survey at 13 meatworks over 3 months showed 21 positive samples from 13 owners.

Inspection of meats introduced into Abattoir Areas was carried out. Surveys indicated that this is a necessary service, as considerable contamination can and does occur before and during transit, requiring trimming of carcasses.

### III. Dairy Research and Services

The dairying industry is serviced in one way or another by most Branches in all Divisions of the Department.

The three Branches of the Division of Dairying are concerned specifically with feeding and herd management, herd recording, artificial insemination, the hygienic production, handling and manufacture of milk and milk products, and utilization research. The Agriculture, Agricultural Chemical Laboratory, Entomology, Plant Pathology and Botany Branches are involved in pasture and fodder matters. The Veterinary Services and Pathology Branches cover animal health problems. Marketing Services, Economic Services and Standards Branches also have responsibilities to the dairying industry.

#### FIELD SERVICES

The Field Services Branch continued its advisory and inspectorial activities in the field and carried out various field surveys and field and factory investigations.

Despite the decline in numbers of dairy producers and the adverse seasonal conditions, the number of farm visits completed by staff was maintained at a satisfactory level. This service has been strengthened by the broadening of the subject-matter areas in which field staff assist primary producers. A total of 397,000 miles was incurred in this service, which embraced 22,000 farm visits. In detail, 10,000 visits were of a routine inspection nature, 6,000 farm contacts were concerned with quality problems, 4,000 were associated with implementation of the Dairy Pasture Subsidy Scheme and 1,300 were concerned with advice on dairy cattle nutrition—a new field for officers. Specialized assistance with dairy building programmes was provided in 536 instances, most of these being concerned with conversion of bulk milk installations. Totals of 128 new buildings comprising 65 walk-through, 49 high-line herringbone and 14 low-line herringbone and 408 renovations were undertaken.

Continued examination of milking machine operation efficiency was provided on a request basis. A disappointing total of 884 machines was field tested and faults listed for producers.

Supervision of market milk distribution in all major areas of the State was satisfactorily co-ordinated by Field Services Branch staff. The area in which the Dairy Produce Act operates was extended with the inclusion of Mount Isa in June 1971 as a consequence of the issue of a franchise to the Atherton Tableland Co-operative Butter Association for distribution of pasteurized milk in Mount Isa.

The pilot-scale programme for handling dairy registrations by electronic data processing techniques was successful and this programme will be implemented in all districts of the State in the coming year.

On a State-wide basis field officers undertook a wide range of extension activities. The following table indicates the specific activities in this regard and the estimated number of producers contacted.

	Number Held	Total Attendance
Departmental staff meetings ..	203	1,173
Farm walks .. .. .	23	629
Field days .. .. .	30	2,464
Tours .. .. .	22	783
Method demonstrations ..	32	208
Film illustrated talks/lecture evenings .. .. .	89	2,193
Project Clubs .. .. .	17	719
Rural Youth meetings .. ..	14	236
Farmer schools .. .. .	69	1,590
Displays and show exhibits ..	13	1,860
D.E.A.C. Discussion Group meetings .. .. .	113	1,572
Producer contacts—Office ..	..	12,423
—farm visits .. .. .	..	20,549
TOTALS .. .. .	625	46,399

It will be noted that there were a considerable number of staff meetings concerned with co-ordinated extension. This activity is a result of an implied Departmental policy of increased inter-Branch co-ordination and planning in extension activities and significant benefits are evident.

Special surveys and investigations undertaken during the period are summarized below.

Two studies of recirculation cleaning of farm bulk milk vats are being evaluated. Although bacteriological counts have been generally good there has been some staining of vat surfaces in inaccessible locations.

The field investigation of the influence of choked pulsation with machine milking on the incidence of mastitis commenced in November 1969 was concluded in December 1970. It is considered that external factors such as management, unstable vacuum pump operation and reverse flow introduced variables.

A recording milk meter has been developed in association with the Works Department by the adaptation of the American Milk-O-Meter with a moving paper chart and pen recording unit. A transient voltage instrument for detecting low levels of A.C. voltages in milking machine installation operation was developed in association with the Brisbane City Council.

A series of analyses of casein samples from three processing plants was undertaken during the year in conjunction with the Dairy Research Branch.

As portion of an Australia-wide survey, regular samples of butter and cheese have been supplied for analysis of pesticide residues. This programme is relevant to import standards imposed by several overseas countries. Support from the Australian Dairy Produce Board Research funds has enabled an extensive series of individual farm creams and milks to be analysed to detect contaminating sources. The offending properties have been visited in an advisory capacity, suspect feed samples analysed and remedial measures proposed. A marked reduction in the incidence of DDT residues has been effected, but HCB and BHC residues continue to pose a serious problem.

Information was passed on to two factories and assistance given in the manufacture of Feta and Denbol type cheeses. Commercial-scale manufacture of cheese of varying pH levels was initiated to clarify the influence on maturing properties.

A series of 12 churnings of butter have been cold-stored at 10°, 0°F. and -10°F. for periods up to 8 months to evaluate the influence of storage temperature on quality.

A new programme directed at demonstrating the relevance of whole-farm development was initiated in 15 districts with the co-operation of selected commercial dairy farmers. The programme is based on the premise that changes in specific practices should not be recommended or introduced until all circumstances are considered. Deliberate attempts have been made to involve local producers in these programmes to capitalize on local experience and to enhance adoption of programmes. It is anticipated that these demonstrations will function for periods of up to 5 years, and use of recognized extension media and evaluation is being undertaken. Limited financial assistance of the order of \$400 per property was offered to initiate programme implementation. Excellent co-operation has been provided by other Departmental staff and there has been a gratifying response from producers. A programme of evaluation will be included in these demonstrations.

In the 10 regions of the State, Field Service Branch officers continued to provide secretarial duties on Dairy Extension Advisory Committees and contributed significantly to the formulation and implementation of extension programmes. This form of Department-industry relationship continues to provide an excellent means of liaison and to enhance effective communication between producers and advisers.

### BREEDING

As from 1971 the quartets of bulls of the A.I.S. and Jersey breeds selected for testing will be sons of sires previously selected in this programme as "A.I. Proven". This situation will also apply to Friesian bulls undergoing testing as from 1972. However, the early batches of Friesian bulls will be sons of "A.I. Proven" sires from the southern States or the United Kingdom. Sons of proven sires for subsequent progeny testing are obtained by contract mating to selected cows in the herds of co-operating stud breeders.

Commencing with the 1971 mating, all inseminations in connection with A.I.S. and Jersey bull proving will be carried out by commercial A.I. distribution centres. This work was previously performed by Departmental officers.

The Friesian scheme commenced in 1965 with inseminations being carried out by commercial distribution centres. Farmer co-operators receive \$20 per head for each heifer producing a first lactation record suitable for calculating sire ratings. The success of this procedure, particularly in reducing the loss between number of inseminations and number of effective daughters, has prompted its adoption for the Jersey and A.I.S. Schemes.

A total of 63,082 cows was inseminated by distribution centres during the 1970 calendar year, compared with 60,691 during 1969. This represented a substantial recovery of the decline in inseminations which had occurred in 1969. The number of inseminations with semen originating from the Wacol A.I. Centre was almost unchanged at 52,748 (53,032 in 1969). Use of imported (overseas and interstate) semen increased by approximately one-third to account for 10,334 cows inseminated, compared with 7,659 during 1969.

The 60-90-day non-return performance to all first inseminations in Queensland with Wacol semen improved significantly for the second successive year to 70.6% (69.1% in 1969). The 60-90-day non-return performance with imported semen also improved to 68.9% (67.1% in 1969).

A total of 113,724 doses of semen was collected and processed at the Centre, with a 92.2% success rate. Of the total, 90,139 doses were distributed, 82,844 in Queensland and 7,295 to interstate and overseas users. Compared with dispatches during 1969-70 (total 96,915, Queensland 81,010 and exports 15,905) the main change was a sharp fall in interstate sales.

The custom freeze service continued to expand, 44,756 doses being processed with a success rate of 69.9%, compared with 39,148 doses the previous year.

Usage of beef semen again declined slightly to 26.7% of total inseminations with Wacol semen, compared with 28.9% in 1969. Use of Friesian semen continued to expand, accounting for 48.1% of inseminations with dairy breed semen (42.8% in 1969).

### HERD RECORDING

Membership of the various herd recording schemes continues to vary with seasonal conditions. At the time when performance information may be of considerable assistance with management decisions, i.e. when seasonal conditions are harsh, farmers tend to withdraw from the schemes, sometimes re-entering as seasonal conditions improve.

During the 1969-70 year of Group Herd Recording a total of 35,276 cows was tested, with average yield figures of 5,402 lb. milk and 228 lb. butterfat. In the Bi-monthly Scheme 3,433 cows were tested, with average yield figures of 5,387 lb. milk and 219 lb. butterfat. Details for the Pure Bred Scheme were 4,390 cows tested with an average yield of 7,027 lb. milk, 300 lb. butterfat.

Towards the end of the year a project was commenced to determine whether lactation production can be estimated with sufficient accuracy from monthly measurements of yield and composition at one milking only or composition at one milking only together with yield at both milkings on the same day. The results of this study are basic to examining the feasibility of modifications in production recording procedures with the use of centralised testing facilities.

Some brake must be placed on the escalation of costs of herd recording services, but it may well be possible to both achieve economies and provide better services.

As the data bank of lactation performance is being accumulated following the introduction of computer processing it is becoming more feasible to produce relevant statistical analyses of interest and use to the industry.



Sahiwal/Friesian crossbreeds bred by the Department are giving high milk production on pangola pastures at Kairi Research Station (Friesian in foreground).



## NUTRITION

The principal study undertaken at Biloela Research Station by the Dairy Cattle Husbandry Branch compared molasses with sorghum grain as the main source of supplemental energy for milking cows with sorghum silage as the roughage component of the ration. Although statistical analysis is not yet complete, it appears that molasses at levels up to 13 lb. per head daily gave equivalent results to sorghum grain as an energy source. A subsequent study of the effects of high-level molasses feeding for whole lactations and to grazing as well as stall-fed cows has been commenced.

The major study by the Dairy Cattle Husbandry Branch at Ayr Research Station has been milk production from fertilized, irrigated pangola grass, with associated work on the same pasture type being weaner growth rate studies, digestibility investigations and projects designed to evaluate heavily stocked pastures for beef production using Jersey and Friesian dams crossed with Sahiwal bulls. Some progress results (incomplete lactations) from the major study are summarized below:—

### JERSEY

	Supplemented		Non-Supplemented	
Stocking rate per acre ..	4.0	3.2	4.0	3.2
Butterfat per acre (lb.) ..	805	777	580	557

### FRIESIAN

	Supplemented		Non-Supplemented	
Stocking rate per acre ..	3.2	2.4	3.2	2.4
Butterfat per acre (lb.) ..	826	598	724	642

The supplement used was a 30:1 molasses/biuret mixture fed free choice. The production levels recorded so far in this experiment compare more than favourably with production per acre reported from experiments in the temperate regions.

A major 3-year investigation of milk production from rain-grown tropical (green panic-glycine) pastures at Kairi Research Station was completed. It was established that properly managed tropical pasture is capable of providing sufficient nutrients for individual production of 11,000 lb. of milk and 400 lb. of fat in a 300-day lactation. This performance was achieved at a stocking rate of 1 cow per 2 acres.

However, it is considered that the upper limit of production per acre from these pastures has not yet been reached. A subsequent experiment is accordingly studying the effects of a series of stocking rates ranging up to 1 cow per acre and limited grain supplementation during early lactation. It is interesting to note that the production per head achieved in this trial exceeds the levels reported from rain-grown tropics elsewhere in this State and in New South Wales.

An experiment designed to study the changes in milk composition which occur with cows grazing glycine-green panic pastures, and to observe the effect on these changes of feeding grain and hay alone and in combination, validated the belief that supplementary grain feeding can readily increase milk production. However, the offering of hay as a fibre supplement did not prove to be an economic solution to the problem of low butterfat percentage under the conditions of this experiment.

## DISEASES

The incidence of leptospirosis in dairy cattle in the Brisbane division increased markedly during the last quarter of the period. As leptospira require moist conditions for survival, it appears that cattle raised during the drought were susceptible to infection when the organism became prevalent following heavy rain. An unusual outbreak of mastitis due to *Leptospira hardjo* occurred in the Brisbane division.

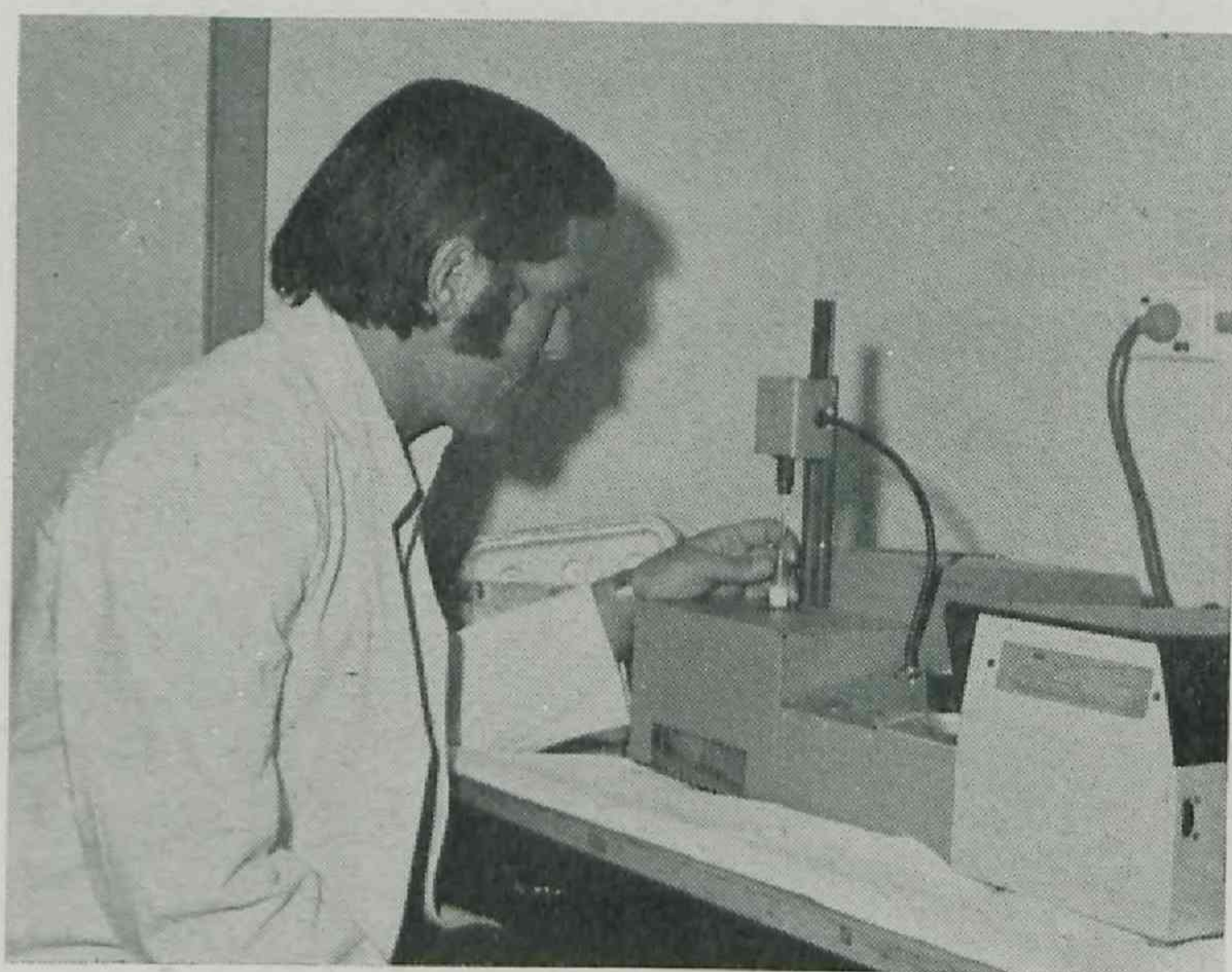
A rapid test on bulk milk known as the "milk ring test" has shown that approximately 70% of herds supplying milk to the Brisbane metropolitan area are infected with brucellosis. These results indicate the need for strain 19 vaccination to be used more extensively in dairy herds. This will be effected under the new national eradication scheme for tuberculosis and brucellosis.

A programme of mastitis studies was continued among selected production recording herds. The survey was of 2-year duration to investigate the incidence, effects and control of mastitis in Queensland dairy cows. A recording of milking management practices was incorporated to assess their relative influence on incidence. At the same time, a series of pilot recordings on herd milks at receival factories was initiated using the Wisconsin Mastitis Test. Initial studies indicate this to be of practical value and a useful index of cell count. The programme will be expanded and results used for advisory purposes by field staff initially using a cell count standard of 1 million per ml.

Investigations of milk enzyme levels by the Dairy Research Branch have been extended to determine changes in enzyme level associated with bovine mastitis. Catalase from bovine milk was purified and its properties compared with catalases from other sources. It appears that the activity in milk is due to a number of catalases from different sources. Mammary gland cells contain relatively high activity and would contribute most to the overall catalase level in milk. Mastitis could cause an increase in the level of catalase from the other sources.

## PRODUCTS RESEARCH

At the Otto Madsen Dairy Research Laboratory, work progressed on the development of new bacteriological quality assessment tests for refrigerated milk in keeping with current production and storage conditions. An essential basis to this programme is a study of the actual deterioration of the milk under refrigerated conditions. One aspect of the project is concerned specifically with the breakdown of protein in the milk, particularly as brought about by *Pseudomonas* spp., the most common psychrotrophs in raw milk. Work continued on the assessment of a test designed to indicate bacteriological quality of the milk in terms of accumulation of proteolysis products. Electrophoretic techniques have been employed to monitor protein degradation in commercial milk samples and to study proteolysis products formed during storage of commercial milks and from the action of *Pseudomonas* proteinase on milk proteins. Other methods for determining the quality of refrigerated milk are being investigated, e.g. the modified nitrate reduction test at 30°C, using penicillin with the non-carcinogenic alpha-naphthol as one of the reagents.



Checking adulteration in milk using the modern thermister-cryoscope.

Additional studies carried out during the year have included an investigation into the reliability of the spoilage organism test in assessing pasteurized milk spoilage. The recovery of heat-damaged cells was shown to have little significance in the spoilage organism test. Thermoduric resistant organisms present in a number of farm milks originated from machines and equipment on farms, but were sensitive to normal farm cleaning methods. Work so far indicates that there is no relationship between spoilage organism counts and organoleptic grades of pasteurized milks.

Preliminary investigations have been commenced to determine the effect on thermoduric micrococci of heat, detergent-sterilizers and short-period UV-radiation. In addition, the relationship of cell and cell wall composition of the organisms and their ability to withstand pasteurization are being examined. Large numbers of gram-positive, coagulase-positive micrococci have been isolated and identified for the purposes of this work.

During the summer months in recent years the problem of "bitty" cream has recurred in milk supplies in various parts of the State. The identification of this problem and the study of its causes have shown that a sporing organism, *Bacillus cereus*, is responsible for the defect and in consequence it would appear that this defect is identical with that reported in other parts of the world.

The occurrence and importance of enterococci in dairy products are being studied. These organisms are of faecal origin and are thermophilic. Consequently they will withstand pasteurization and will cause spoilage. In addition, their importance as an indication of faecal contamination is under examination.

Detection of residues of penicillin and other antibiotics in milk is a matter of some importance and work has been completed on an assessment of various methods of performing an assay for these substances. A method involving the use of *Bacillus calidolactis* evolved recently by Dutch workers has been found the most sensitive of methods so far developed. In consequence this method has now been brought into general use in Queensland.



Testing for antibiotic residues in milk samples.

Laboratories of the Dairy Research Branch situated at Brisbane, Toowoomba, Murgon and Malanda have continued to participate in a State-wide investigation into the composition of milk. Analytical results for 1970, when drought conditions existed in many dairying areas, have been summarized, and examination of milk from the same sources is being continued for a further year.

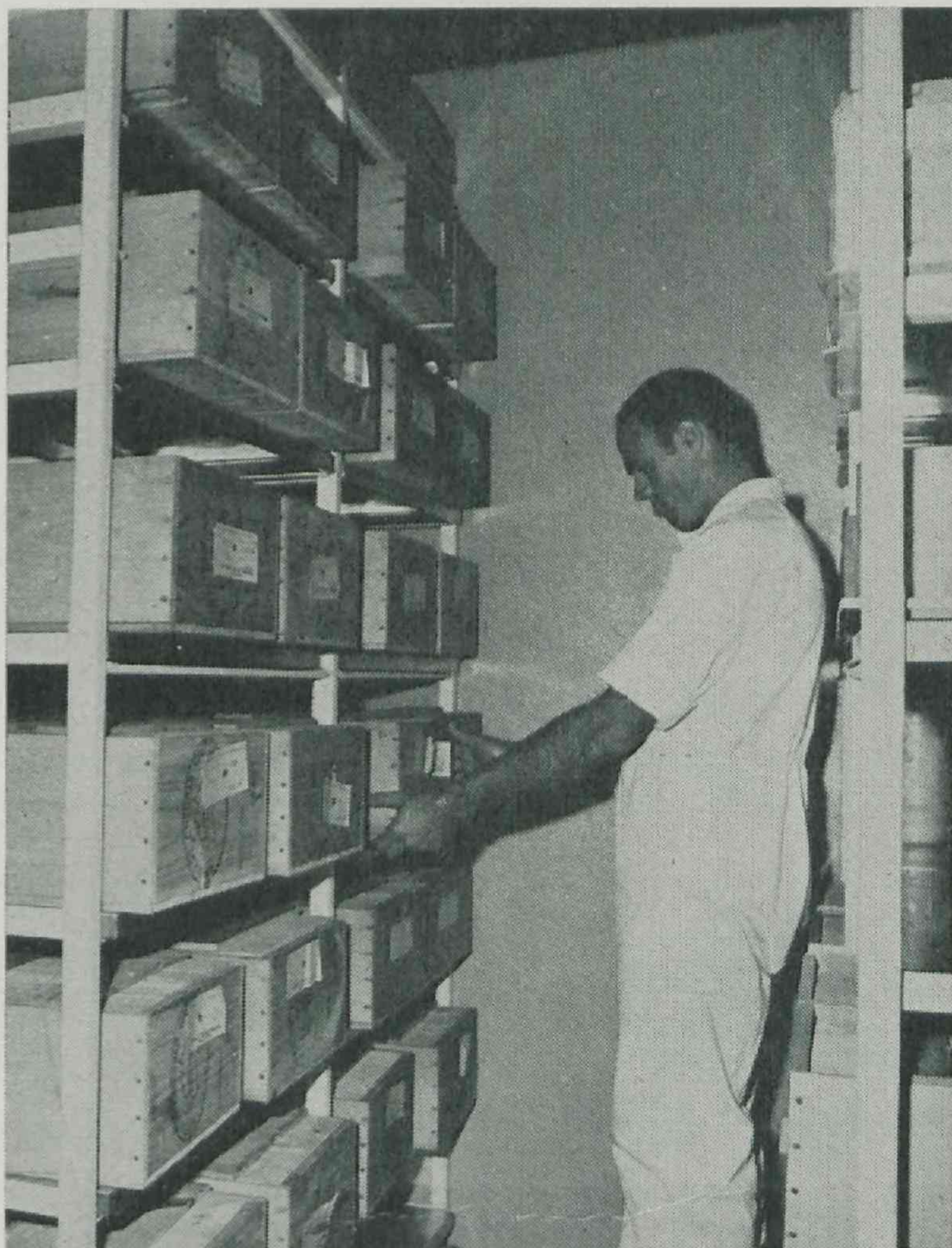
A survey of acid degree values, peroxide values and thiobarbituric acid values has been commenced to obtain data suitable for chemical assessment of milk fat quality relative to use in a number of dairy foods.

There has been continued co-operation with the Division of Tropical Pastures Division of C.S.I.R.O. in examining the processing and tainting characteristics of milk produced from various tropical pasture species. Following production from pure stands of particular species, milk is examined for taint before being pasteurized, regraded and made into cheese. It has been shown that pasture species vary quite widely insofar as the yield and quality of cheese produced are concerned.

A survey has been commenced in order to keep the quality of salt used in butter and cheese factories under continued surveillance. Many samples have been found which have given excessively high results for insoluble material and some samples were found to contain excessive quantities of iron.

Further work has been carried out on development of the Major UHT Non-Vacuum Cream Pasteurizer. A number of these plants are now in commercial operation and requests have been received from industry for design specifications covering plants with capacities as high as four times the original model. In order to handle these large capacities drastic changes in the design of the equipment have been required, resulting in a considerable amount of investigational work to prove the efficacy of such modifications as are necessary to reduce treatment time in the equipment and thereby produce greater processing rate, eliminate product dilution and improve the filming of the product throughout processing.

In response to requests from industry for butter-oil fractions tailor-made for specific markets, investigations have commenced into various methods for fractionating milk fat and then recombining the fractions into various foods. In addition, preliminary work has been carried out at the request of the Butter Marketing Board to study some aspects of the manufacture of recombined butter in Asian countries.



Experimental cheese in store at the Otto Madsen Dairy Research Laboratory awaiting enzymatic analysis.

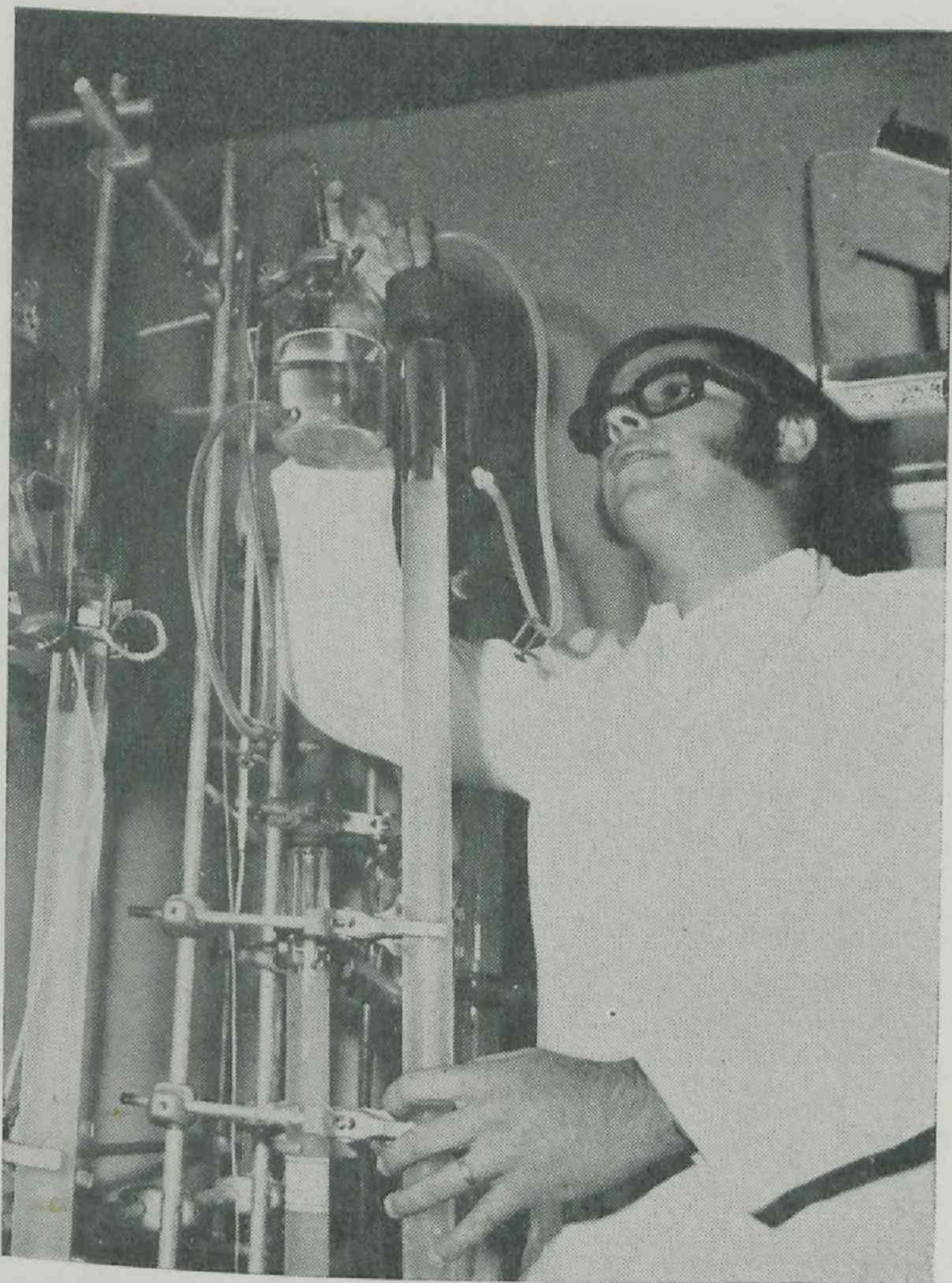
Cheddar cheese in Queensland is manufactured from milk which is H.T.S.T. pasteurized at 162°F for 15 seconds. It was thought possible that thermophilic pre-pasteurization flora might play some part in flavour development of cheese in addition to the starter and contaminants during manufacture. It was found in experimental cheese that massive inoculations of cultures of selected thermophilic organisms into cheese milk could affect resultant cheese flavour. Under normal conditions of manufacture and ripening, thermophilic organisms had no effect on cheese grade.

In the Toowoomba laboratory, investigations into coliform organisms occurring in cheese are continuing. Cheeses known to contain these organisms were selected, and sampled at regular intervals to determine levels of coliforms and *E. coli* I at different ages. Large numbers of purified and identified cultures are being utilized.

A number of aspects of milk and bacterial enzymology which are related to cheese ripening have been studied. Arylesterase from bovine blood plasma was isolated and its molecular weight studied. This enzyme appears very similar to the esterase from bovine milk which has been implicated in cheese ripening. Milk esterase is present in cheese in only very small amounts but it could have significance in flavour development over long ripening periods.

The naturally occurring proteolytic enzyme from bovine milk was also purified. It appears to originate in the mammary gland and to be secreted with the milk. Its properties were studied and these showed that it withstands pasteurization and is precipitated with casein. Therefore it is present in cheese but its activity under conditions of cheese ripening is low.

Studies have continued on the properties of milk lipase, with emphasis being placed on the mechanism whereby the enzyme is activated by agitation and similar treatments leading to the development of rancidity in milk. It has been found that whereas in normal milk virtually all the lipase is associated with casein, in activated milk up to 50% of the activity is either bound to the fat globules or is present in soluble form. The data indicate that induced lipolysis occurs in two stages, the first being solubilization of the



Milk enzymes being purified by column chromatography.

enzyme and the second involving absorption of the lipase onto the fat globules. This work is important in regard, not only to the ripening of cheese, but also the development of adverse flavours in milk and milk products other than cheese.

A large number of experimental batches of cheese have been manufactured in the pilot plant in the course of investigations into enzymology of cheddar cheese. Such experimental cheese is being cold stored in the laboratory for continued assessment of the role of certain enzymes in the production of full cheddar cheese flavour.

Worthwhile progress has been made by the Dairy Research Branch in the development of new forms of dairy foods, particularly in the form of milk/fruit drinks. Acceptable formulations for banana and mango milks have been developed. A number of other tropical fruit/milk mixtures have been examined and some promise to lead to useful development. In addition, attention has been given to a number of fermented products making use of whey and fruit and some vegetables. It has been found possible to manufacture a number of types of wine using whey as a basic fermentable product. However, the production of beer from whey has posed a number of problems.

New uses for quarg and other special cheeses have been developed and new products such as dairy custards and new types of yoghurt have been produced. Commercial interest in these new products is increasing.

Trials were carried out to investigate inhibitory properties of citrus oils against various bacterial organisms capable of causing food spoilage. Although a number of oils from different sources were examined, none were actively germicidal even at concentrations producing objectionable taints.

A number of dairy products, including milk and whey, have been concentrated by using a freeze concentration process on an experimental scale. To date the work has been limited largely to the initial operation involving crystallization and freezing. The quality of concentrated products has been very high and has encouraged further work to develop this process to a pilot plant scale. At the same time attention has been given to the development of new equipment designed to facilitate crystallization and removal of ice by centrifugation. Attention is also being given to the economics of this process.

### ECONOMICS

A survey report was published on the economic implications of a change from cream and pigs to wholemilk on southern Queensland dairy farms. At current price and cost levels, the returns from wholemilk in the absence of market milk quotas appear insufficient to induce cream and pig producers to change their existing system of farming.

Analysis of survey data on future trends in dairy production in south-eastern Queensland is proceeding using distributed lag multiple regression techniques. Sixteen years' data from 35 factories have been aggregated and deseasonalized for 13 factory districts, three regions and the area as a whole. Time series for factors affecting supply have been collated.

Further work has been undertaken in developing a model to facilitate the economic assessment of a changeover to bulk milk in the Gympie region at the individual farm level.

### DAIRY PASTURE SUBSIDY SCHEME

As shown by the following figures, the number of applications for subsidy made in the past year was well below the previous year's figures.

Year	Initial Applications
1966-67	2,354
1967-68	1,852
1968-69	999
1969-70	772
1970-71	305
TOTAL	6,282

The decrease was due mainly to weather conditions. Early in the year near-drought conditions prevailed over most dairying districts and this was followed by the extended wet season which prevented land preparation for some time. Inundation or waterlogging of pure lucerne stands and lucerne-based pastures in most southern Queensland districts resulted in many replanting applications over the last quarter of the year.

Central Committee approved submission of an additional application where summer and autumn applications already had been made, to enable replanting of rain-damaged pastures.

Following a request from Queensland Dairymen's State Council, compounding of subsidy was again conceded, where approved plantings had been carried over from 1969-70 on account of drought conditions. This meant that a maximum of \$800 in subsidy could be paid to assist in establishing larger areas under pasture. This concession was made under similar conditions last year.

Some large individual areas of pasture have been sown, particularly in Central Queensland, as a result of lifting the area restriction of 100 acres and substituting the limit of \$2,000. The greatest area sown following approval of a single application was 255 acres at Biloela and another in the Monto area exceeded 200 acres.

Two major policy changes were made during the year. The first resulted in the elimination of irrigated pastures as a separate category under the scheme. It became apparent after 2 years of drought in many areas that very few farms could be considered to possess permanent water supplies for irrigation. Under the Scheme, irrigated pasture carrying capacity was assessed at a cow per acre. Where water was not available as required, carrying capacity of these pastures was reduced to that of raingrown species, while limiting the farmer's area entitlement as irrigated pastures.

The second change concerned deferred subsidy when a farm carrying entitlement was sold. Previously the deferred balance owing when a farm changed hands was paid to the new owner provided he was in possession of the property on July 1. This procedure resulted in some anomalies and also increased administrative difficulties.

As from July 1, 1971 deferred subsidy outstanding when a farm is sold will revert to the Fund but the new owner will be entitled to establish pastures to the maximum entitlement based on cow numbers, less the amount already paid as subsidy on the property. No extra funds will be involved.

Further modifications include payment of subsidy on contoured pasture furrows and also on limited rebuilding of contour banks where pastures are being established on old damaged contoured land not previously under the Scheme.

The degree of participation of various districts in the Scheme is shown in Table 1, and figures showing the progress of the Scheme are given in Table 2.

It will be noted that total subsidy paid or approved for payment is in excess of \$2,380,000 and the total area planted under the Scheme (this includes the area on which subsidy payment has been deferred) now amounts to 196,093 acres.

TABLE 1  
DISTRICT PARTICIPATION IN SCHEME

District Committee	Number of Registered Dairies at 31-5-71	Number of Subsidised Farms	Percentage Participation
Malanda ..	343	320	93.3
Ayr ..	..	..	..
Mackay ..	94	56	59.4
Rockhampton	139	47	33.8
Gladstone ..	124	42	33.8
Biloela ..	160	62	38.7
Maryborough	178	83	46.6
Bundaberg ..	147	56	38.0
Monto ..	231	161	69.6
Central Burnett	192	36	18.7
Kingaroy ..	126	60	47.6
Nanango ..	224	180	80.4
Wondai ..	207	134	64.7
Murgon ..	259	190	73.4
Gympie East ..	295	273	92.5
Gympie West..	265	183	69.0
Cooroy ..	370	298	80.5
Maleny ..	256	194	75.8
Nambour ..	226	167	73.9
Brisbane ..	195	73	37.4
Southport ..	166	115	69.3
Beenleigh ..	166	70	42.2
Beaudesert ..	294	206	70.0
Caboolture ..	225	134	59.5
Ipswich North	257	159	61.9
Ipswich South	221	146	66.1
Esk ..	185	125	67.6
Gatton ..	204	103	50.5
Laidley ..	191	116	60.7
Boonah ..	299	219	73.2
Toowoomba ..	300	122	40.6
Goombungee..	227	87	38.3
Crow's Nest ..	217	111	51.2
Oakey ..	200	88	44.0
Pittsworth ..	152	50	32.9
Warwick ..	479	301	62.8
Dalby ..	229	66	28.8
Chinchilla ..	88	12	13.6
TOTAL ..	8,131	4,845	59.6

TABLE 2  
PROGRESS OF THE SCHEME

Total no. applications .. .. .	15,844
Total area involved .. .. .	286,554½ acres
Average area per application .. .. .	18.086 acres
No. of claims paid .. .. .	12,165
Total subsidy paid (excluding deferred payments)	\$1,949,034.69
Total area paid (excluding deferred payments) ..	160,571 acres
Average subsidy per acre .. .. .	\$12.138
Total subsidy paid (since inception of the Scheme)	\$2,304,431.24
Total area paid (approx.) (since inception of the Scheme)	189,850 acres
Subsidy held in deferment at 30-6-71 .. .. .	\$75,782.84
Area held in deferment at 30-6-71 (approx.) ..	6,243 acres

## IV. Pasture Research and Extension

The main responsibility for pasture research and development rests with Agriculture Branch, but Branches such as Agricultural Chemical Laboratory, Beef Cattle Husbandry, Dairy Cattle Husbandry, Dairy Field Services, Sheep and Wool, Husbandry Research, Biochemical, Economic Services, Standards, Botany, Entomology and Plant Pathology have pasture production, management and evaluation projects of various types under way.

The main research centres are Parada Research Station, Walkamin Research Station, Kairi Research Station, South Johnstone Research Station, Millaroo Research Station, "Swan's Lagoon" Cattle Field Research Station, Ayr Research Station, Biloela Research Station, Brigalow Research Station (Moura), "Brian Pastures" Pasture Research Station (Gayndah), Coolum Research Station, Gatton Research Station, Queensland Wheat Research Institute (Toowoomba), Charleville Pastoral Laboratory, Animal Research Institute (Yeerongpilly) and various entomology and plant pathology field stations.

Extension work on pastures is conducted in all the main dairying and pastoral areas, primarily by Agriculture Branch officers.

The Dairy Pasture Subsidy Scheme (reported in section III of this report) is administered by a committee comprising representatives of various Divisions and the Queensland Dairymen's State Council.

Adequate coverage of the State's different climatic and soil situations is achieved through research projects located at some 200 sites. More detailed experiments are conducted at 16 research centres. All other trials are conducted on farming and grazing properties, where the interest and co-operation of landholders do much to ensure success. A healthy problem-solving partnership has developed between the pasture worker and the man on the land.

The overseas plant collection surveys carried out during the sixties in Africa, Asia and Central-South America have provided valued acquisitions to the store of pasture plants available for testing. In every region in the State species evaluation trials are in progress. The aim is to develop new pasture plants that will overcome the deficiencies of the native ones, or improve on some of the older and less satisfactory introduced species.

Studies in plant nutrition go hand in hand with species evaluation. The fertilizer requirements for particular plants for the major soil groups are being determined.

Planting methods and establishment techniques are being studied in areas where germination or seedling survival has been a problem.

Pasture management and pasture productivity have been investigated in order to determine the usefulness of selected sown pastures. Output data are a prerequisite to rational widespread adoption of sown pastures and the management techniques required for their continued productivity.

Fodder crops and irrigated pasture studies continue because of the recognition that, even at best, tropical and temperate species still fail as milk-producing pastures when moisture is limiting.

Native plant communities, so important to the arid and semi-arid grazing lands, are receiving attention. Optimum animal production consistent with conservation of the natural resources of the area is the objective.

### PASTURE SPECIES EVALUATION

Promising species selected from the Charleville Pasture Laboratory were planted in swards on the mulga master site in December 1969. Of the annual grasses, giant button, *Cenchrus pilosus* and *Anthephora* spp. gave the best results. There was little difference in performance between the perennials, including a buffel grass selection from Ethiopia. The legumes and herbage plants performed poorly.

In the south-east on the traprock soils west of Warwick, growth of all species under test was poor. However, persistence was satisfactory for the buffel grasses, panic grasses, *Digitaria smutzii* and Hunter River lucerne. On the granites in the same region rose clover and lucerne were the persistent species. Geraldton and Mt. Barker sub clovers, cluster clover, *Trifolium globosum*, and Cyprus and Harbinger medics showed drought resistance and ability to set seed for survival.

In Central Queensland the tall Biloela buffel, Makari-kari grass and *Urochloa mosambicensis* (through regeneration from seed) were most tolerant to flooding. *Urochloa* has superior establishment ability on the heavy texture clays. On the alluvial clays of the Mackenzie River flood plains the legumes Tinaroo glycine, siratro, phasey bean and *Phaseolus bracteatus* established readily. On the lighter texture duplex soils the buffels, blue panic, green panic and *Urochloa* established readily and persisted under drought conditions.

The eminent suitability of *Urochloa mosambicensis* to the sandy yellow earths south-west of Charters Towers has been well demonstrated. It spread away from the introduction plots during a year when only 6 in. of rain was recorded. *Stylosanthes mucronata* from the Sudan not only survived in a 6 in. rainfall year but seeded well and spread into adjacent land. Seed of this plant is being multiplied. It will be regionally tested. Fertilizer and companion grass studies will be undertaken.



Townsville stylo treated with superphosphate in a grazing trial at "Swan's Lagoon" Cattle Field Research Station.

In the Normanton district, on a yellow podsolic soil initially fertilized with 60 lb. phosphorus and 30 lb. nitrogen per acre, *Urochloa mosambicensis*, *Dactyloctenium giganteum* and the buffel grasses have persisted into their third year with dry-matter yields of 100 lb. and 1,600 lb. for the associated Townsville stylo. Perennial early-flowering strains of *Stylosanthes guyanensis* established as well as Townsville stylo but yielded only 5% as much in their first year.

The need for regional testing was graphically illustrated at "Meadowbank", via Mareeba, when Townsville stylo behaved as a biennial and both Townsville stylo and the perennial *Stylosanthes* yielded more at the end of their second growing season than at the end of their first. It was clear that all newer introductions had flowered and set seed, in contrast to Schofield stylo, which is too late for areas where frost occurs.

The plant breeder at Parada has been able to select a more erect line of *Dolichos uniflorus*. A line earlier by 4 weeks has also been selected from a previous introduction.

Two hybrid *Desmodium* selections tested at Cooroy out-yield and show better late-season growth than greenleaf desmodium.

Two tropical legume cultivars developed at the South Johnstone Research Station will be released in July 1971. One is an early-flowering, perennial *Stylosanthes* while the other is a *Centrosema*. The stylo cultivar establishes more rapidly, makes earlier spring growth and has shown double the post wet and cool season yield of Schofield stylo at South Johnstone. The new centro cultivar has been selected for tolerance to low defoliation, disease and insect resistance cool season growth and its seed-producing characteristics.



A pasture of Schofield stylo in the Peninsula which carried 1 weaner to the acre for 11 months in 1970.



A tropical pasture of Colonaio grass and puero.

with temperate species without soil disturbance, only white clover established successfully. It dominated the pasture during the cooler months.

In Queensland's dairying districts, even the most favoured tropical and temperate pastures fail as milk producers when moisture is limiting. Water use efficiency is an important economic criterion. Experiments showed that in winter and spring water use efficiency was higher for temperate species whereas tropical species were more efficient during the summer and autumn months. In both pasture types nitrogen-fertilized grasses were more efficient in water use than the grass/legume mixture.

At Emerald, Hunter River and Siro Peruvian lucernes using some 40 in. of irrigation water in addition to 21 in. of rainfall outyielded other summer-growing legumes. Of the grasses, pangola, Kazungula setaria and paspalum were consistently high yielders during summer. Temperate grasses did not survive the severe summer water stresses. Annual self-regenerating medics produced 2-3 tons of dry matter between June and November. For the new irrigation area a pattern for irrigated fodder emerges. Commercial forage sorghums can yield up to 16 tons of dry matter between September and May. Annual medics will supply a winter-spring protein component beside spring-summer perennial grasses.

A detailed study of the characteristics of native plants which can germinate and grow in the arid and semi-arid south-west is providing a guide to the type of plants required to revegetate the area. Only twice during the year did conditions for germination occur. At both times seedling survival

Two new forms of guinea grass and one of *Desmodium heterophyllum* which should prove valuable in the wet tropics are also being proposed for release.

In the Moreton district progress has been made in selecting plants for poor sandy podsollic soils. Two introductions of *Panicum coloratum*, pangola grass, Callide Rhodes and Gatton panic show promise. To date legume suitability has been restricted to siratro and lotononis.

Further testing of cool-season species to improve dairy cattle feed during the critical period of winter and spring is in progress in the Wide Bay and Moreton districts. Narok setaria produced well in summer and showed good cold tolerance in a particularly severe winter, when it produced twice the yield of Nandi setaria. Of the temperate grasses, only Australian phalaris and Ronpha showed any real promise and they are prone to invasion by other species. When the aim was to extend the productivity of tropical pastures by including temperate species in the planting mixture, only white clover has persisted and produced. Further, where the existing tropical pasture was oversown

was very low. Germination was improved on patches of soil with sandy surfaces. It was better where there was some form of ground cover, either natural mulga or native grass.

#### PASTURE NUTRITION

Plant nutrition deficiencies in Queensland's pastoral soils continue to present problems, pointing to the need for continuing investigations. Molybdenum and zinc applications enabled lucerne to be grown on Broughton River soils, near Charters Towers. Zinc and phosphorus deficiencies were found to be limiting the growth of Townsville stylo on a yellow earth in the same district.

Phosphorus applied to Townsville stylo near Normanton has increased the plant stand 20 times in 5 years and doubled the mineral content of the plant tops in the same period. On "Kalinga", in the Peninsula, sulphur deficiency has been recognized and corrected.

On the wet tropical coast between Ingham and Innisfail, mineral deficiencies can be related to easily recognizable soil-vegetation units. It is now possible to predict in this area the fertilizer required to establish sown pastures. The results of this work are applicable in the Hinchinbrook Shire. On certain soils in the Cardwell and Johnstone Shires a wide range of deficiencies have been recognized and rectified by correct fertilizer application.

Phosphorus restricts the growth rate and drought resistance of seedlings on the mulga soils at Charleville.

On the Stanthorpe granites, maximum lucerne yields have been obtained with an initial dressing of 4 cwt./ac. of superphosphate followed by an annual maintenance application of 1 cwt. of superphosphate.



Cattle fattening on guinea grass sown on ridge country on the coast.

#### PASTURE MANAGEMENT

For 3 successive years female sheep have been grazed at 2 sheep/acre, 1 sheep/acre and 1 sheep/2 acres on a Gayndah buffel grass pasture. Supplementary feeding for survival was necessary at the heavier stocking rate. There was no deterioration in the stand of buffel at any stocking rate. At 1 sheep to the acre, yields and performance were satisfactory.

Chisel ploughing of native grasslands in the autumn at Texas consistently increased the yield of naturalized winter-growing annual medics. This result is part of an experiment aimed at predicting medic behaviour in various environments from 30 in. mean annual rainfall areas in the east to 18 in. rainfall areas in the west.

#### PASTURE PRODUCTIVITY

Irrigated fertilized pangola pastures at Parada near Mareeba continue to top world beef production figures. The bodyweight gains on the different treatments ranged from 1,774 lb. to 2,625 lb./ac. per year. This is equivalent to 900–1,300 lb. of dressed beef per acre. Dry-matter yields of grass have been as high as 41,000 lb./ac./year and the grass actually consumed was as high as 70% of the total available. Practical application of this work is seen in the current developments in the Arriga soils west of Mareeba by Peninsula cattle producers.

Near Marlborough the productivity of spear grass-Townsville stylo pastures has been studied in detail. At a beast to 4 acres liveweight increases have been lifted from 30 lb. to 76 lb./ac./year.

In the Central Burnett, studies continue with supplemented weaner steers. Steers fed cottonseed meal at 1.5 lb./day had a liveweight gain by November of 112 lb. per head. The work is continuing with breeders. Reproductive performance and bodyweight changes are being studied.

#### FORAGE CROPPING

At the Richmond shallow water storage, under irrigation, three hybrid grain sorghum varieties produced an average yield of 2,200 lb./ac. Planting, establishment and irrigation strategy experiments were continued. After withdrawal of water, 85 acres of a number of crops were grown on the ponded area of the dam.

On the flood country along the Mackenzie River, fodder crops were a relative failure due to drought in 1970. However, cattle grazing fodder sorghums at one beast to 1½ acres gained 1.7 lb. liveweight per day over 84 days between March and June.

At Brigalow Research Station, where the water usage of forage sorghums is being studied, the crop used less water at the heavier stocking rate and produced similar daily gains.

#### NATIVE PLANT STUDIES

The integration of the results of a number of trials in the mulga scrub areas has shown that the pattern in mulga communities is related to clearing. Clearing for instance leads to an increase in the sandalwood and turkey bush components of the communities. Control measures for turkey bush are being worked out. Present conditions and subsequent changes in the vegetation are being recorded by ground measurements and remote sensing aerial photography.

#### PESTS

The development of laboratory rearing methods for pasture webworms is a break-through in biological studies on this type of soil-inhabiting pest with a long life-cycle. This has allowed detailed investigations to be undertaken on their life cycles, the distinction between the various larval and other stages and the determination of food and temperature requirements of these insects. In conjunction with field studies to determine the pasture yield reduction due to webworms, the laboratory data will allow precise estimates of the economics of control operation to be made for varying larval populations. A population of only one webworm larva per sq. ft. per acre can result in a loss of 250–300 lb. of dry matter over the 6 months of spring and summer. Populations of 10 larvae per sq. ft. per acre, common on the Northern Tablelands, therefore result in a pasture dry-matter reduction of 2,500–3,000 lb. per acre, which is more than most pastures produce in this period. Non-chlorinated hydrocarbon materials such as trichlorphon and carbaryl have been proved to provide suitable control of these pests.

#### ECONOMICS

An economic assessment of Townsville stylo pastures in North Queensland indicated that preference should be given to male cattle on an integrated breeding and fattening property. To be comparable with fattening male cattle, breeders on Townsville stylo would need to have an increase in branding percentage of approximately 20%.

A technical bulletin was published to demonstrate the application of discounted cash flow analysis in assessing the profitability of gidyea scrub clearing and buffel grass establishment on beef properties in central-western Queensland.

## V. Field Crop Research and Extension

Research and extension on field crops (i.e. crops except fruit, most vegetables and ginger) is a major responsibility of Agriculture Branch, but various other Branches and Sections, including Agricultural Chemical Laboratory, Botany, Entomology, Plant Pathology, Economic Services, Marketing Services, Standards, Soil Conservation, Development Planning, Beef Cattle Husbandry, Sheep and Wool, Pig, Poultry, Husbandry Research, Biochemical, Biometry and Research Stations, are engaged to a lesser extent on various aspects of production and marketing.

Field crop research is conducted on research stations at Southedge, Walkamin, Kairi, South Johnstone, Millaroo, Biloela, Theodore, Gatton and Hermitage, and at numerous field investigation centres. Wheat research is centred at the Queensland Wheat Research Institute at Toowoomba, built and financially supported largely by the Queensland Wheat Research Committee and staffed mainly by the Department. Sugar cane production research and extension are conducted by the Bureau of Sugar Experiment Stations, which is controlled by the sugar industry.

### WHEAT

Only five rain-grown trials survived the drought of 1970. Of these two were at Hermitage Research Station and one each at Biloela Research Station, Jondaryan and Goondiwindi. Average yield for the six commercial varieties common to each trial were Gamut and Gatcher both 826 lb./ac., Gamenya (820 lb.), Mendos (803 lb.), Spica (743 lb.) and Timgalen (640 lb.). The performance of Timgalen was disappointing under the harsh conditions experienced. It yielded at an overall rate 18% below the average of the six varieties in the five trials. On the other hand, in an irrigated trial at Emerald, Timgalen (3,632 lb./ac.) yielded 5% above the average for the same six varieties. These results reinforce the evidence which suggests that this variety responds to favourable environments but is definitely suspect under adverse conditions.

In irrigated varietal trials at Emerald in 1969 and 1970 the high yield potential of the Mexican dwarf type wheats was clearly exhibited. W.W. 15 (4,494 lb./ac.), Mexico 120 (4,141 lb.) and W.W. 80 (3,877 lb.) yielded 29, 19 and 12% respectively higher than Timgalen in the two seasons. These high-yielding varieties do not produce good quality grain but they are being used to advantage by wheat breeders to produce high-yielding crossbreds of high quality, some of which are currently undergoing tests in Queensland and other States.

In the study of fallowing and wheat production on the Darling Downs, commenced at Hermitage Research Station in 1968, the superior performance of zero tillage as against mechanical cultivation in terms of moisture accumulation during the fallow period was outstanding in 1970. These soil moisture differences were reflected in the crop yields. Also worthy of note is the yield response due to retaining stubble as against burning, under conditions of mechanical cultivation (Table 1).

TABLE 1

FALLOW TREATMENTS AND WHEAT YIELD

Treatment	Available soil water 0-4 ft. (in.)	Yield (lb./ac.)
Mechanically cultivated, stubble burnt .. .. .	2.35	932
Mechanically cultivated, stubble retained .. .. .	3.29	1,228
Chemically cultivated, stubble burnt .. .. .	3.52	1,421
Chemically cultivated, stubble retained .. .. .	5.21	21,057

Trials designed to test the effect on wheat of drought-hardening of seed prior to planting resulted in an average yield increase due to the treatment of 12.4% over 3 years of tests. In order to evaluate the commercial possibilities of the technique in the winter of 1971, 50 semi-commercial field trials are planned in a farmer-State Wheat Board-Barley Marketing Board-Queensland Wheat Research Institute co-operative effort.

A further 11 soils were field tested in the Queensland Wheat Research Institute's project on nutrient screening of Queensland cereal soils. All 11 were in south Queensland and phosphorus deficiencies of varying intensity were indicated at eight of the sites. Molybdenum and sulphur deficiencies occurred at three sites, while copper, zinc and potassium deficiencies were indicated at one site each.

Studies of the effect of seeding rate of wheat on incidence of Mexican poppy (*Argemone ochroleuca*) infestation were continued; a seeding rate of 60 lb./ac. seems necessary to suppress the weed seedlings. Further work is needed to define the critical seeding rate levels more accurately.

Five additional varieties—Gluyas Early, Reliance, Mexico 234, Transfer and Koolizie—have been found to possess a reasonable level of field tolerance to crown rot (*Gibberella zeae*). Early glasshouse testing indicates that the variety Marfed, reported overseas to be resistant to a similar disease cause by *Fusarium culmorum*, shows promise against crown rot.

Though stem and leaf rusts were generally at a low level, a large number of varieties under irrigation were examined in the search for generalized resistance to stem rust. Varieties showing promise were selected and are included in a detailed replicated trial sown in 1971.

Some leaf rust was reported in the varieties Gatcher and Timgalen. No variety at present being grown commercially shows resistance to the causal fungus of this disease (*Puccinia recondita*). A previously unreported race of the stem rust fungus *P. graminis* f. sp. *tritici* was detected in the new wheat variety U.Q. 115.

### BARLEY

The average yield of nine varieties over six trials conducted in 1970 in the south-west Border district, Darling Downs, Ipswich, South Burnett and Callide districts was 1,244 lb./ac., a creditable result considering the poor seasonal conditions. The varieties Beka, Bussell and W.I. 2197, none of which is grown commercially in Queensland, each yielded 11% higher than the overall average, while Weeah, Prior, Clipper, Zephyr, Baldrick and Dampier yielded 2, 2, 3, 8, 9 and 11% lower than the overall average. The performance of Clipper was disappointing as it yielded only at approximately the same rate as Prior, which it is replacing as the standard commercial malting variety. In the 1968 and 1969 seasons Clipper outyielded Prior by 27 and 7% respectively.

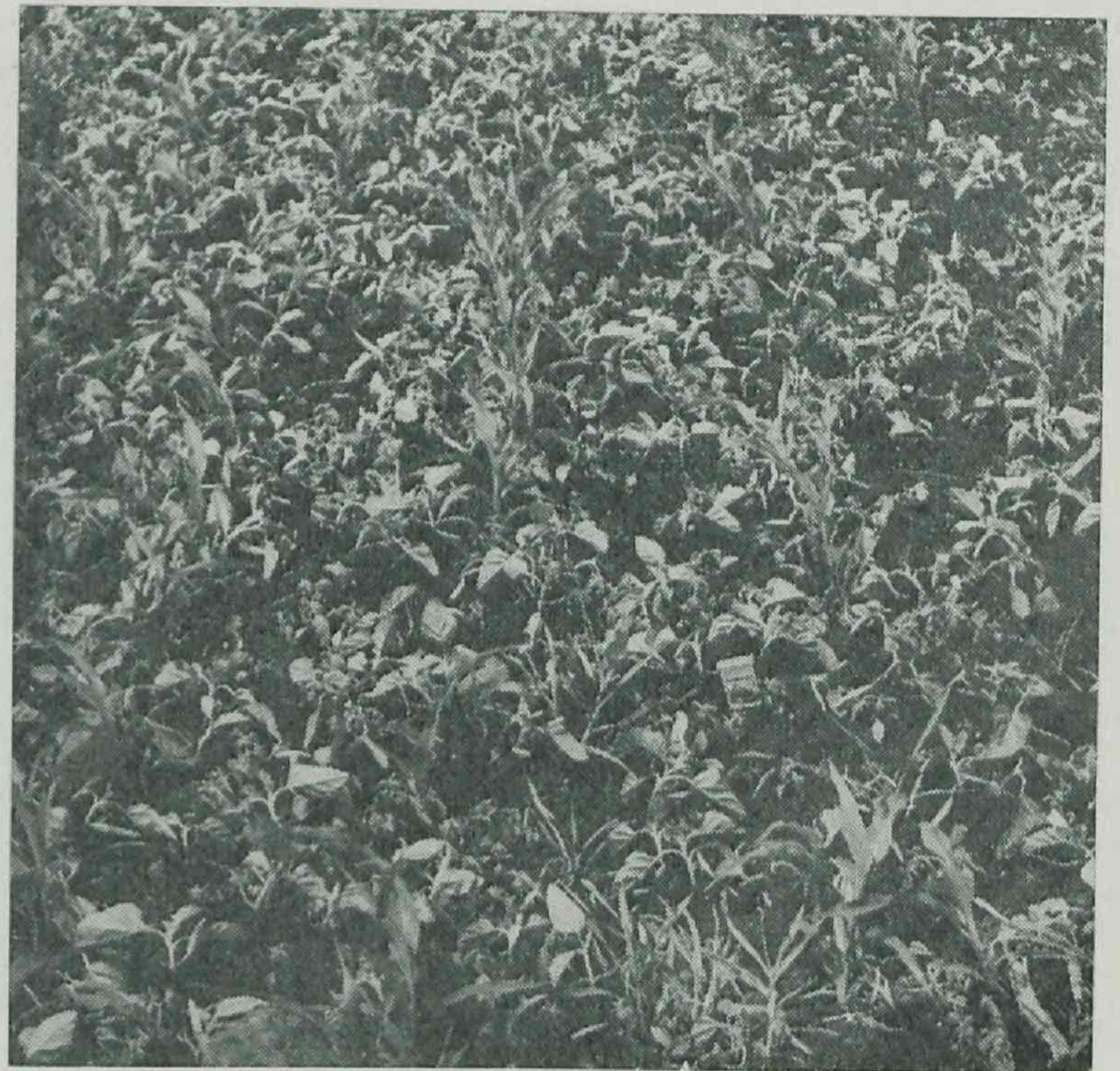
In the Goondiwindi trial, which also included a wider range of released and unreleased material, Ketch, a recent release in South Australia, showed much promise. This variety together with Beecher (6-row type) and several crosses from the Waite Agricultural Research Institute displayed good yield potential. Grain sprouting was evident in all varieties. Prior, with a seed dormancy of approximately 3 months, had 13% shot grains, while Clipper with almost no dormancy had 87%.

A survey of the incidence of barley stripe mosaic, recorded for the first time in Australia in the Kingaroy area last year, has been completed by the Pathology Branch. Of 28 seed samples of the variety Cape examined, 25 were found to be carrying the virus. No seed of any other variety was found to be infected. In a detailed field survey in the Warwick-Killarney area, all of the plantings of Cape were found to be infected to some extent. This is a pollen-transmitted virus and as little cross pollination occurs with barley the chances of spread to other varieties by this means is low.





Irrigated Clipper barley which yielded 90 bushels to the acre following high nitrogen fertilization.



A heavy infestation of thorn apple in the first stage of destruction following spraying with a weedicide.

### GRAIN SORGHUM

Alpha, a non-hybrid variety, still accounts for 85% of the area sown to grain sorghum in Central Queensland. It is more popular there mainly because it does not lodge to the same extent as nearly all hybrids under adverse conditions. One hybrid, DeKalb E57, has shown resistance to lodging, so this variety and Alpha were included in comprehensive population x row spacing studies at Emerald and at Brigalow and Biloela Research Stations. For each variety, row spacings of 14, 28 and 42 in. were tested at populations of 15,000, 35,000, 55,000 and 75,000 plants per acre. In four of the five successful trials little useful rain occurred following planting, so the crops depended heavily on stored moisture for production. Lodging occurred to a significant degree in only one trial and then only at the higher populations. Over the five trials, DeKalb E57 (2,758 lb./ac.) outyielded Alpha (2,154 lb.) by 28%. The average yield of stubble produced by Alpha (1,763 lb.) was only 6% above that produced by DeKalb E57 (1,666 lb.). The best grain yields were produced at 35,000 and 55,000 plant populations. Overall, there were no differences in row spacing treatments.

The trial series indicates that, provided good subsoil moisture is available at planting, a significant yield advantage may be gained by planting DeKalb E57 in preference to Alpha, with little risk of lodging provided populations in excess of 35,000 plants per acre are not used. The series also indicates that the best yield stability can be achieved by using 35,000 plants per acre in combination with 28 in. row spacing.

Grain sorghum emergence studies were conducted with grain sorghum on cracking clay soils at Emerald and at Brigalow Research Station in 1969-70. These studies showed quite conclusively that, in situations of questionable soil moisture in the seed zone in these soils, the emergence of grain sorghum plants can be improved significantly by increasing depth of seeding and by compacting the soil around the seed. Sowing to depths of 4 in. and use of a press wheel to compact seed in the row resulted in the attainment of an acceptable percentage of emergence for up to 6 days after commencement of planting in the Brigalow Research Station trial. In the Emerald trial fair germination was obtained with 4 in. planting depth and use of a press wheel for up to 4 days after planting would normally have commenced. These findings are likely to be of considerable commercial significance.

Preliminary studies involving production of sorghum grain silage at Emerald have been encouraging. Grain harvested at 30% moisture content placed whole in plastic bags and evacuated had been converted into a free-running pleasant-smelling silage when the bags were opened 5 months later.

Trials continued using atrazine as an early post-emergence herbicide to control seedlings of black pigweed (*Trianthema portulacastrum*) 7 days after emergence in grain sorghum crops. Good control of black pigweed seedlings was again achieved by atrazine, but no increase in grain yield was recorded and in some cases yields were reduced.

Sugar cane mosaic was particularly prevalent in sorghum crops. Standover fodder sorghum crops are an important source of infection and this was particularly evident in the Monto and Biloela districts. The red leaf reaction was

particularly prevalent on susceptible genotypes this year and segregates producing the mild mosaic reaction only are being selected by the Plant Pathology Branch at Indooroopilly. The field resistance of Q7539 stood up well this year and steps are being taken to have this resistance incorporated into breeding lines.

The part played by parasitic organisms in lodging is being investigated.

The heaviest and most widely spread field infestation of the sorghum head caterpillar (*Cryptoblabes adoceta* Turner) occurred in the above-average plantings of grain sorghum extending from the central districts to the southern border. Greatest damage was in the Callide and Dawson districts. In addition to favouring good growth of the crops the climatic conditions favoured the insect. All kinds of grain sorghum were attacked. Infestations commenced at flowering but most severe damage was caused during the milky soft dough stages of grain development. Up to 50% damage occurred in the worst affected heads with overall damage of the order of 5-30% depending on the severity of the infestation. In contrast to previous records of attacks mostly confined to close-headed varieties, both close-headed and open-headed varieties were severely damaged. Late infestations persisted in the heads and larvae passed through the harvesting machinery with the grain causing rejections at receipt depots. Trials by the Entomology Branch tested the effectiveness of DDT and a range of other insecticides. DDT at 16 oz. active constituent per acre was effective but undesirable where stubble was to be grazed. Trichlorphon at 16 oz. was effective on open-headed varieties.

Increased use of irrigation for grain sorghum production has greatly accentuated the importance of the sorghum midge (*Contarinia sorghicola* (Coq.)). With rain-grown crops, planted early to avoid flowering during the wet months from January onwards, midge damage generally was light. Irrigated crops are grown throughout the season. In this way the wet soil conditions constantly present in some part of a district provided a continuity of midge emergence both from diapause and from crops in flower. Rapid population build-up early in the season with crops suitable for oviposition ensures a continuous high population level of midge through the season. DDT, the standard control, has become undesirable and trials were directed to finding suitable non-residue alternatives. U.L.V., maldison and diazinon were shown to be promising, and other materials are under test by the Entomology Branch.

The record sorghum crop in the Central Highlands over-taxed existing grain storage facilities and the Agricultural Economist at Emerald has been involved in assessing costs of alternative methods of on-farm storage.

### MAIZE

The hybrid maize varietal testing programme was extended in 1969-70 to include experimental hybrids produced by this Department, the New South Wales Department of Agriculture and the commercial seed producers Arthur Yates and DeKalb Shand. Because of difficult weather conditions, only the trials at Kairi Research Station and at Kingaroy were successful. At Kairi the experimental hybrid Yates V (3,480 lb. or 62 bus./ac.) yielded best, 33% above the standard hybrid QK37. At Kingaroy, K202 bred at Kairi Research Station topped the trial with 5,746 lb. (103 bus.). In this trial Yates V lodged along with many other hybrids.

One disadvantage with QK37, which has performed well on the Atherton Tableland, is its pale and variable grain colour. Several yellow grain hybrids also resistant to tropical rust have been bred. Of these, KTW217 was best in two recent trials. It equalled QK37 in one trial and outyielded it by 15.5% in the other. A total of 160 introduced varieties test-crossed to the parent KSC10 at Kairi Research Station is being tested there and at Kingaroy and Hermitage Research Station.

In other varietal trials very good yields were achieved with irrigation at St. George by DS601 (8,029 lb.), PQ301 (7,369 lb.), PQ300 (7,075 lb.), XL361 (7,065 lb.); and, considering the adverse seasonal conditions, reasonable results were achieved at Warwick where PQ301 (2,392 lb.), PQ300 (2,357 lb.), XL45 (2,169 lb.) and DS28 (2,157 lb.) yielded best. The Kairi material, which is very slow maturing, was not included in these trials.

Interesting yields which reflected the good seasonal conditions were obtained in the third trial in a Kingaroy population study in which different plant spacings were used in 36 in. row spacings with the following results:—

Plants every 12 in. or 3 per 36 in. . . . .	105.1 bus./ac.
Plants every 18 in. or 2 per 36 in. . . . .	98.8 bus./ac.
Plants every 24 in. . . . .	95.5 bus./ac.
Plants every 36 in. . . . .	89.5 bus./ac.
Plants every 42 in. . . . .	82.9 bus./ac.

Continuing studies aimed at comparing three land use systems at Kairi Research Station on the Atherton Tableland in 1970 have produced remarkably similar treatment differences to those occurring in 1969. Continuous maize produced 26.2 bus./ac. while continuous maize fertilized with 60 lb. nitrogen per acre produced 45.0 bus. Maize grown in the first and second year after 4 years of green panic/glycine pasture and in the third and fourth year after 3 and 2 years' pasture respectively yielded 46.2, 49.1, 41.8 and 32.5 bus. respectively. The increase in yield due to fertilizer application was similar to that where maize was grown first or second year after pasture.

In another land-use trial at Kairi, continuous maize was compared with maize grown following varying periods of pasture. Continuous maize yielded 39.8 bus./ac., compared with 62.8, 59.8, 66.2, 61.2, 60.3 bus. for maize preceded by 6, 5, 4, 3 and 2 years of pasture respectively. The proportion of diseased grain increased as the period under pasture decreased.

Seasonal conditions were conducive to disease development in this crop. Tropical rust (*Puccinia polysora*) has been no problem in North Queensland due to the widespread planting of the resistant hybrid QK37. However, leaf blight (*Helminthosporium turcicum*) caused considerable defoliation in many crops in both northern and southern Queensland, while head smut (*Sphacelotheca reiliana*) was prevalent on the hybrid QK37 in paddocks where the disease had occurred in previous seasons. Sugar cane mosaic virus caused considerable losses in maize crops from widely separated geographical areas of the State. The wet seasonal conditions were apparently particularly suitable for its spread.

## TOBACCO

The importance of the Department's continual evaluation of tobacco varieties introduced from overseas has been emphasized following the incidence of black shank disease (*Phytophthora nicotianae* var. *nicotianae*) in tobacco during the 1969-70 season. In the trials the introduced variety N.C. 2326 has shown moderate tolerance to black shank disease and ready adaptation to growing conditions in Queensland. Because of its satisfactory performance, action is being taken to register this variety for commercial production. Departmental co-operation and technical assistance are also being given to the C.S.I.R.O. plant breeding programme aimed at producing commercial varieties with improved resistance to such diseases as blue mould. Varietal material from this programme is being compared with current commercial varieties in field trials in North and South Queensland.

Black shank was not as prevalent as in the 1969-70 season. There has been a reduced acreage sown to the variety Sirone and this could be a contributing factor to this lower incidence. Screening of a collection of varieties both in the glasshouse and in the field indicated that the varieties NC95 and NC2512 were highly resistant to black shank while Sirone was highly susceptible.

Variety x nitrogen trials have been carried out in the Bundaberg district for three seasons. N.C. 2326 has performed well in all trials over a wide range of nutrient levels. This is an important attribute in a district subject to heavy leaching rainfall during the tobacco growing season. Nitrogen-potash nutrition studies have been continued at Mareeba in an attempt to resolve the leaf mottling that occurs when tobacco is subjected to water stress during active growth. Upper leaves from such plants have been found to contain higher than normal amounts of nitrogen and to be leathery in texture. The programme is being continued to establish what type of crop responds to potash side-dressings.

Spray-on desuckering agents have contributed to reducing labour requirements in tobacco and their use has also enhanced yields per acre. Investigations over a number of years have compared the relative efficiencies of available desuckering agents in controlling sucker growth. Studies initiated in 1970-71 are examining the effect of desuckering agents on total alkaloid production and re-distribution within the plant. This work will contribute towards a knowledge of the extent to which total alkaloid production and distribution can be modified by desuckering practices.

Blue mould (*Peronospora tabacina*) was more severe in 1970-71 than in any season since 1964-65. Early outbreaks in the seedbeds were followed by field outbreaks encouraged by frequent showers during the growing season. In bacterial wilt (*Pseudomonas solanacearum*) trials, a series of soil fumigants had little effect on incidence of the disease and resistant varieties offer the only practical means of control. The variety NC95, which shows a high resistance to this disease, is being affected to some degree by a previously unimportant disease caused by Potato Virus Y. This illustrates one of the real difficulties facing plant breeders endeavouring to produce varieties resistant or tolerant to disease disorders.

Biological studies on budworms by Entomology Branch have disproved some previously well established conceptions on pest occurrences on young tobacco plants. It has now been shown that both eggs and young larvae on plants up to 15 in. high occur on the lower surface of the basal ends of leaves 4 to 6. Later the larger larvae move up the plant to the growing point and destroy the bud; hence the name budworm. For this reason many growers have erroneously believed that these pests can be controlled by spraying only the bud of the plants. In practice this is difficult to achieve, especially in windy weather, because the larger larvae are both harder to kill and well protected in the bud.

Spray applications of DDT or methomyl directed to the lower surface of the lower middle leaves of the plant will kill the larvae in the young stages and before they commence to damage the leaves. This emphasizes the importance of a strategic spraying programme. Such a programme is now provided by a Departmental pest prediction service to the tobacco industry in North Queensland based on field counts of larvae and light trap catches of moths. Growers following the prediction service acclaim its value in reduced insecticide usage and cheaper pest control while maintaining maximum leaf quality.

Three trials were conducted at Southedge Research Station to evaluate the efficiency of a number of insecticides against the stem borer, which has in recent seasons been of greater concern in seedbeds. Results indicated that spraying with endrin 0.05% or methomyl 0.025% will prevent stem borer damage if used in a weekly schedule. Attempts at control of this pest by drenching the beds with insecticide caused retarded germination and seedling distortion.

A small group of tobacco farmers in the Mareeba-Dimbulah area has commenced recording in the Farm Management Accounting Service of the Economic Services Branch.

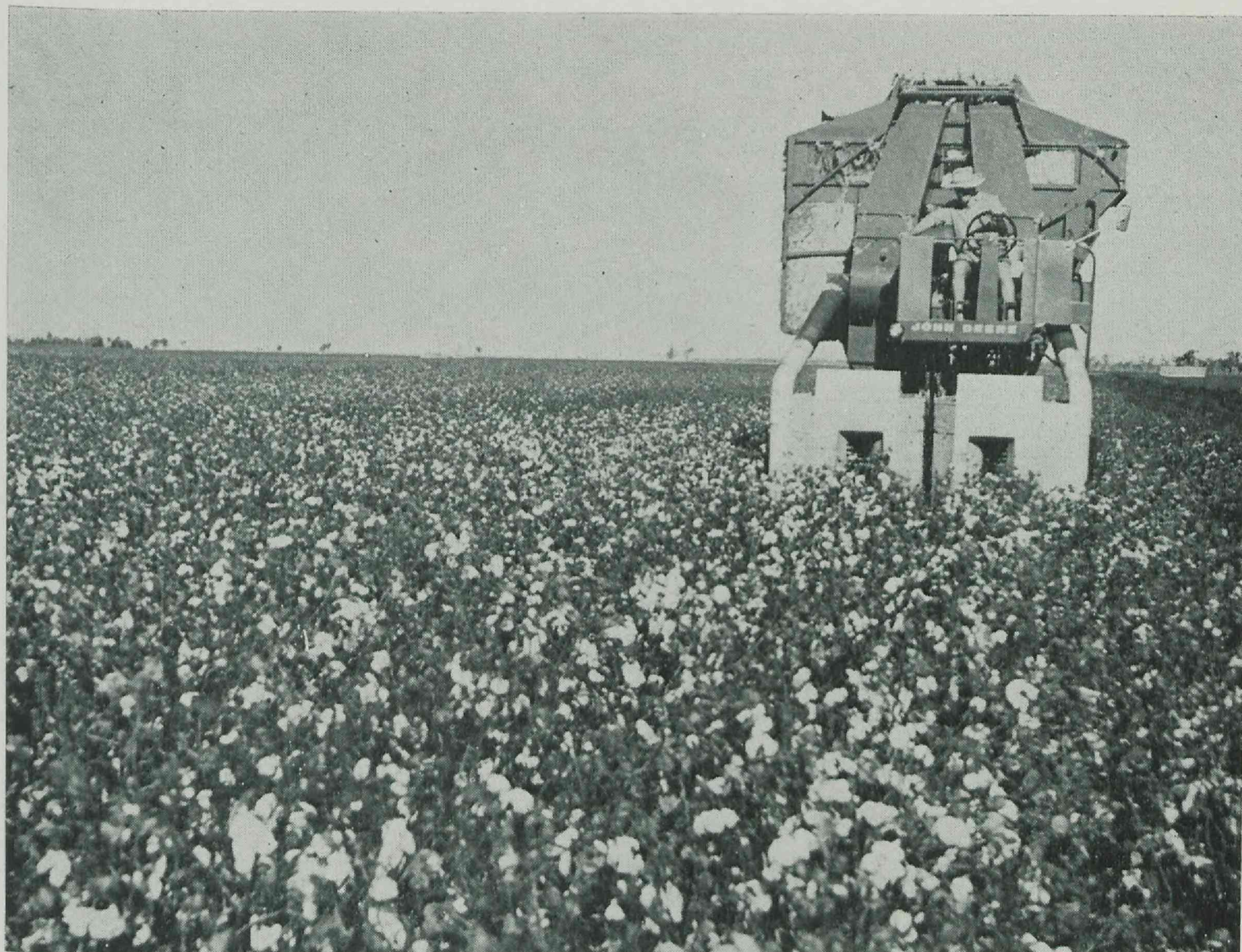
A regimen of costs was prepared, at the request of the Australian Tobacco Board, to show movements in tobacco costs in all major tobacco-producing areas in the eastern States over the period from 1965 to 1969.

## COTTON

At Gatton Research Station the growth suppressant CCC was tested on cotton at rates of  $\frac{1}{2}$ -1 lb./ac. at three stages of crop development. Yields were reduced severely by applications at square commencement, but were not affected by early applications (3 weeks after emergence) or by late application (early flowering period). Height, number of internodes and boll weight were similarly most affected by application at squaring, the height being reduced from 44.5 in. in the control to 21 in. at the higher rate applied at squaring. Another effect of CCC is to delay maturity.

The cotton-breeding programme on the Darling Downs is aimed at producing material with an earlier maturity than current commercial varieties, and at improving fibre quality in respect of strength and micronaire, and at the same time, at least maintaining yield at the present high commercial level. The cooler conditions on the Darling Downs during the ripening period can lead to cotton with low micronaire in the present commercial varieties. The major aim of the Central Queensland breeding programme is higher fibre strength. It appears, however, that associated with gain in fibre strength some reduction in yield occurs. Use of CCC as a breeding aid reduces cross-pollination to a very low degree when applied at squaring. It will be useful in pure seed production, but has the drawback of reducing yield of the treated plants.

The programme to find a satisfactory post-emergence herbicide for control of specific weeds in cotton has continued. Although data have not been fully examined as yet, MSMA appears to fill the long-felt need for such a



Cotton being harvested in the St. George Irrigation Area.

herbicide when the cotton is about 3 in. high. Commercial formulations appear to be showing some differences in phytotoxicity.

Light-trapping operations by the Entomology Branch at Biloela Research Station have extended the knowledge of the seasonal incidence and history of the major lepidopterous pests of cotton, particularly towards a policy of strategically timed insecticide applications instead of the current one of regular preventive sprays. Moths of the rough bollworm (*Earias huegeli* Rogen.) were present as a peak in early June, with moderate numbers continuing until mid September. The peak resulted from continued activity which had built up over the previous two months. Apart from slight activity during March, moth numbers were low for the remainder of the year. *Pectinophora scutigera* (Hold.) numbers were low for the whole year. Moths of both the cotton bollworm (*Heliothis armigera* (Hubn.)) and the native budworm (*Heliothis punctigera* Wall.) first appeared in the second week of August and flight activity continued until late November. The two species were in approximately equal numbers except for a few weeks early in September, when *H. punctigera* was dominant. The proportion of females which were physiologically mature and which had mated once was never less than 60% for each species. These studies will enable the compilation of patterns of seasonal incidence and likely population increase so as to assist in planning control programmes.

The fungicide benomyl was used widely last season for the first time and gave a high level of control of leaf spot (*Cercospora personata* and *C. arachidicola*). As the disease was serious, the advent of this fungicide was of considerable importance to the industry.

#### PEANUTS

Peanut mottle, which had not been reported for two seasons following an eradication programme, reappeared in the 1970-71 season in widely scattered areas in the South Burnett in the Virginia Bunch variety. The possible explanation for this is that one of the seed sources used last year was carrying a level of infection with the virus.

#### OILSEEDS

Considerable impetus has been given to the oilseed crops research programme, particularly with sunflower and soybean.

Irrigated sunflower population trials conducted on the Darling Downs have given widely differing general means of 2,948 lb./ac. in 1968-69 and 1,213 lb. in the 1969-70

trial. The yields in the latter trial were reduced by moisture stress. In both trials the wide 42 in. row spacing produced lower yields and in 1968-69 the 28 in. row spacing also produced less grain. In 1968-69 there were no significant differences between yields of various populations. In 1969-70 the 20,000, 40,000 and 60,000 plants per acre treatments significantly outyielded the 80,000 and 100,000 treatments. These results combined with other agronomic findings suggest that populations of 40,000 plants per acre could be combined with 14 in. row spacing to give satisfactory results. If these recommendations do not suit management practice, results to date indicate that there would be little disadvantage in using 40,000 plants per acre in 21 in. or 28 in. rows.

Rain-grown sunflower population trials, again conducted on the Darling Downs, have also given variable results. In 1968-69 adverse conditions resulted in an average yield of only 122 lb./ac., compared with 1,064 lb. obtained in 1969-70 under better seasonal conditions. A recommendation for planting populations in the range of 15,000 to 25,000 plants per acre is indicated from results obtained so far.

On the Darling Downs in a time-of-planting study the November planting (1,610 lb./ac.) significantly out-yielded the October (1,208 lb.), December (962 lb.) and January (299 lb.) plantings. In a similar study at Emerald, the high oil content variety Sunfola 68 outyielded the birdseed variety Polestar at four of five planting dates. Overall, Sunfola 68 yielded 2,014 lb./ac., compared with 1,511 lb. for Polestar. Yield differences of this order between these two varieties are unusual. For Sunfola 68 the December planting (2,345 lb.) produced the best yield, followed by October and March plantings (both 2,092 lb.), February (1,932 lb.) and September (1,609 lb.). Oil quality determinations showed that the proportion of highly unsaturated fatty acids, which medical research indicates have value in preventing artery disease, increased considerably with the February and March plantings.

The newly appointed sunflower plant breeder has tested some 120 lines of sunflower introduced from the major sunflower-producing countries and in 1970-71 helped to organize the largest regional sunflower varietal testing programme yet attempted. The varietal picture with sunflower remains confused, with no one variety consistently outyielding any other. There are, however, a number of varieties bred in Russia the grain of which possesses significantly more oil than the older Polestar birdseed type. Use of these Russian varieties results in more oil per acre being produced. One of the immediate aims of the breeder will be to breed a hybrid variety adapted to local conditions which produces a high oil yield and possesses other desirable agronomic characteristics.



A non-irrigated crop of Wills soybean on the Darling Downs.

In the meantime, three years of testing at Walkamin Research Station have resulted in an average yield of 2,027 lb./ac. from Peredovik, one of the consistently good varieties included in all three trials. Again on the Burdekin Barratta soils, sunflower is emerging as a promising crop, as yields of 1,488 and 1,480 lb./ac. from VNIIMK6540 and Sunfolia 68-1 respectively indicate.

Soybean research and commercial production both benefited from splendid seasonal conditions in the summer of 1970-71. In South Queensland, varietal trials at Brookstead, Dalby, Hermitage Research Station and Swanfels, all on the Darling Downs, and at Buaraba Creek in the Brisbane Valley produced exceptional results. The best average performance was given by Semstar (2,263 lb. or 37.7 bus./ac.), Davis (2,242 lb.), Bragg (2,236 lb.), Semmes (2,203 lb.), Leslie (2,150 lb.), HRS 68/3 (2,073 lb.) and Dare (2,045 lb.). At the higher yielding sites intended as irrigated trials, Brookstead (one irrigation) and Buaraba Creek (no irrigation), Bragg (average 3,269 lb.), Davis (3,109 lb.) and Dare (2,938 lb.) achieved respectively first, second and third positions in both trials, although Semmes (2,807 lb.), Leslie (2,717 lb.), HRS 68/3 (2,645 lb.) and Semstar (2,615 lb.) also turned in good performances. In another detailed variety x time of planting x row spacing study at Hermitage Research Station, the varieties Hill, Hood and Leslie yielded better when sown in 14 in. rows (1,846 lb.). This result was to be expected under the good conditions experienced. The mid-November planting date (2,373 lb. average for all varieties) was superior to mid-December planting (2,152 lb.), mid-October (1,931 lb.) and mid-January (1,334 lb.).

In a separate soybean adaptation study being conducted in southern Queensland by the recently appointed soybean plant breeder, the yields of some early-maturing varieties will exceed 50 bus./ac. at most of the five sites. These results are supported by equally good results at Biloela Research Station with Hill (2,628 lb.), Wills (2,367 lb.) and Leslie (2,294 lb.) in 1969-70, and at Emerald with Wills (2,302 lb.) and Semstar (1,770 lb.). In addition, soybeans appear a promising crop for the difficult Barratta soils of the Burdekin. ECR973, yielding 1,761 lb., and Bellaire (1,286 lb.) were the best varieties. Soybean yields in the Walkamin region of North Queensland were seriously depressed this year when plantings become badly infected with soybean rust (*Phakopsora pachyrhiza*). In these conditions improved Pelican (1,732 lb.) and Daintree (1,535 lb.) performed best.

#### RICE

The transfer of two agronomists to the Burdekin area has led to an increased emphasis on rice trial work at Millaroo Research Station and in the district. The variety Starbonnet is being compared with the current commercial variety Bluebonnet. It gives similar yields (6,000-7,000 lb./ac.) but is not as tall (6-8 in. shorter) and this could mean that Starbonnet is more resistant to lodging and may consequently respond to higher rates of nitrogen than Bluebonnet is able to do without lodging.

In the last 2 years some 97 different selections of rice bred at the International Rice Research Institute have been introduced through plant quarantine for testing at Millaroo. The first 22 were tested in a trial in the 1970 summer, and although yields and other plant characteristics of some of these strains are good, grain quality is poor and these varieties are unlikely to be suitable for the present industry in Queensland, which is based on high-quality, long-grain rice.

#### TEA

The introduction of high-yielding clones as well as tea seeds from New Guinea, India and Africa has continued. Some strains do not survive the introduction procedures but the remainder are being grown as a source of planting material for the clonal evaluation programme. Early evaluation of these clones at South Johnstone Research Station now awaits the completion of the tea-manufacturing laboratory with the connection of a stable electricity supply.

The 10 clonal hedges already established grew well during the year and have now closed completely. Plucking continued during the year, with 29 pluckings on an average plucking round of 13 days. No tea was manufactured, but dry tea yields have been calculated using an average outturn of 23%. On this basis dry tea yields of the clones range from 1,569 to 2,622 lb. dry tea per acre per annum.

The tea observation plots on the Atherton Tablelands and in the Ingham district have been maintained. The two Tableland plots are progressing satisfactorily, but are being damaged by insect pests and diseases, which have not been important to date in the Ingham plots. The hot dry conditions of the previous summer necessitated considerable replacement of tea seedlings in the hedges in the Ingham district and these, with more favourable seasonal conditions in the 1970-71 season, have made good growth. Some shading of these plots to aid tea seedling establishment has been attempted by using hessian and this protection has been beneficial.

Shade trees (*Adenanthera* sp.) have been planted on two of the four remaining plots. There is little doubt, however, that irrigation facilities are required for successful tea establishment in the Ingham district.

### MISCELLANEOUS CROPS

The wet conditions experienced during the summer caused heavy losses in lucerne stands in south-eastern Queensland. Root rot (*Phytophthora megasperma*) played a major role in these losses. In a survey conducted in the Beaudesert area not one farm visited was free of this disease.

The rough brown weevil (*Leptopius corrugatus* Pascoe) is a major pest of a wide range of legumes grown on the Atherton Tableland, particularly those grown for seed. Complete loss of mature stands of legumes can result from larval attacks on the roots. Loss of roots otherwise can result in smaller leaf size, wilting, yellowing and shedding. Adult weevils are a problem only in new seedling stands. Infestation commences with egg-laying in late December and can continue during the 6-9 months life of the adults. Populations build up over a number of years in susceptible perennials or with continuous cropping with susceptible annuals. Control measures are aimed at preventing this build-up either through the use of one strategic application of insecticide or by crop rotation. Dieldrin or azinphos-ethyl at 0.05% active constituent may be applied in November following emergence of the adults. Dieldrin should not be used where the crop is to be grazed directly, or if the residue after seed harvesting is to be used as fodder.

### IRRIGATION PROJECTS

Research on crops and pastures for the Emerald Irrigation Project has proceeded on the two pilot farms, covering cracking and non-cracking clays, duplex soils and red earths, and on the small leased area of open downs type soil.

After some 4 years of experimental work and a similar period of compilation of production data from the commercial cropping on the pilot farms, some of the basic problems of the major annual crops originally proposed for the project, namely cotton, grain sorghum and wheat, have been resolved.

Varietal work with grain sorghum has shown that while yields have not been spectacularly high, varieties are available which are capable of producing yields in excess of 80 bus./ac. from both October and January plantings. Texas 610, Texas 671 and Pioneer 846 were outstanding for both times of planting.

In a 1969 wheat variety x nitrogen x irrigation trial the use of a preplant, preflower and grain-filling irrigation schedule was compared with a schedule incorporating an additional irrigation at mid-tillering. Responses to the extra irrigation were Timgalen 50 lb./ac., Mendos 220 lb. and W.W. 80 370 lb., but for yields about 3,000 lb./ac. the economics appear doubtful. All varieties responded to increased nitrogen applications up to the maximum used—64 lb./ac. In a similar trial in 1970 detailed observations showed that the yield differences resulting from the irrigation treatments were due to an increased number of fertile spikelets set on each head.

With the changed situation in both the wheat and cotton growing industries in recent years the work on some of the alternative crops which could be grown at Emerald takes on a new importance.

Maize trials and commercial plantings have been somewhat disappointing. Top yield in the 1969-70 variety trial planted in mid-January was only 3,008 lb./ac. (Q1280), with Q23, K216, K37 all yielding over 2,800 lb. Rain following irrigation at germination had caused waterlogging and reduced plant stands.

Irrigated soybean varietal trials on the alluvial cracking clay soil and the red earth showed that this crop has some potential for the area. Actual yields of the top varieties range from 1,288 lb. on the red earths to 2,302 lb. on the cracking clay soils.

For the 1969 and 1970 seasons safflower yielded 1,822 and 1,162 lb. respectively. Time-of-planting studies indicate that April-June plantings give highest yields. Studies with sunflowers suggest a planting date from October onwards with grain yields of 1,800-1,900 lb., oil 31-39% and protein 10-12.5%. Yields of barley have reached 62 bus./ac., with a grain protein content of 13-14%.

In anticipation of expansion of irrigation in the Lower Burdekin, two agronomists have been transferred to Home Hill. Although work is being concentrated on the rice research programme which has been current at Millaroo Research Station for several years, some preliminary studies are being commenced on sorghum, maize, sunflower, safflower and soybeans on flood plain, delta and levee soils. It is planned to extend the research programme on irrigated crops onto the black earths and red-brown earths of the South Bank (Koberinga and Dalrymple), as these soils are an important part of the proposed irrigation development.

Maize variety trials on Barratta soils planted in September and November gave only mediocre yields. The watering technique gave a poor plant stand in the first planting and the trial was a failure, but individual plot yields of 80, 74 and 73 bus./ac. were measured for DeKalb 805A, PQ500 and DeKalb XT664 respectively. The second trial had a satisfactory stand but yellow peach moth after flowering reduced yield considerably. Some yields were: KL361 65.8 bus./ac., Dekalb 848 58.4 bus., XL45 56.6 bus. and GH128 54.2 bus.

In a maize fertilizer trial planted in November, yields increased spectacularly with addition of superphosphate but again a severe infestation of yellow peach moth occurred and the highest yield was only 39.6 bus.

Atrazine applied at 2, 3 or 4 lb./ac. gave very effective weed control in a grain sorghum herbicide trial on Barratta soil. In two grain sorghum variety trials planted in September and November respectively, Pioneer 846 gave top yields of 83 and 25 bus. respectively. The second trial matured in the wet period and yields were reduced by mould, grain shooting and birds. Yields of a sunflower variety trial replanted in November were disappointing, the top yield being 1,488 lb. These trials have emphasized the difficulty of readily obtaining a reasonable plant stand on Barratta soil.

### EXTENSION

Planned extension programmes, designed to meet farmers' needs, have become accepted policy in Agriculture Branch. This has led to a much closer working relationship with groups of farmers and with industry organisations. A further benefit has been to strengthen working relationships between officers of different specialities.

In the Roma-Miles region, following programme activity, 88 producers have conserved some 62,000 tons of silage. A further 22 have stored 40,000 bales of hay, and an estimated 25,000 bus. of grain have been stored underground. An estimated 30,000 acres of pasture were sown with prepared seedbeds in the same area.

In the Tara Shire, five discussion groups have been set up and four new groups are preparing to meet. The programme is educational in nature and based on the integration of all aspects of rural management through economic decision making.

The Near North Coast extension group has worked with groups of farmers to produce management strategies for dairymen.

The programmes in the coastal Burnett districts have been concerned with sown pastures for beef cattle producers. Members of the Miriam Vale and Rosedale discussion groups have provided leadership and sponsored at least three field days.

On the Central Coast at Mackay the extension group has been active in an educational programme aimed at the establishment and management of tropical pastures.

At Bundaberg and in North Queensland tobacco yield and tobacco quality continue to improve largely as a result of industry-extension officer co-operation. In the Bundaberg district yields have progressively increased from 770 lb./ac. in 1965 to over 1,300 lb. in 1970. In Mareeba the Co-operative Extension and Advisory Committee has done much to rationalize the use of pesticides and reduced the confusion caused to farmers by conflicting advice from the various sources that service the industry.

In the grain-growing areas of southern Queensland extension staff have worked closely with the Queensland Graingrowers' Association to foster the use of alternative crops, particularly soybeans. Bus tours and field days have been arranged for farmers on the Darling Downs. In the South Burnett a school was organized for navy bean growers.

These serve as examples of programmed activities of the extension staff.

In addition they continue to service the Dairy Pasture Subsidy Scheme and the seed certification programme and support through numerous contributions the regional newsletters.

An example of one officer's activities for the year will serve to illustrate the demand for services.

Telephone contacts .. .. .	522
Letters .. .. .	77
Office callers .. .. .	381
Farm visits .. .. .	233
Field days .. .. .	6
Articles .. .. .	10
Mileage covered .. .. .	12,000

Regional Technical Handbooks have now been produced for each region. Shire Handbooks have been produced for the Shires of Gayndah, Wambo, Inglewood, Pittsworth, Kingaroy, Murilla, Jondaryan, Eidsvold, Waggamba, Mundubbera, Nanango, Millmerran, Mareeba, Monto, Fitzroy, Gooburrum, Burrum, Allora and Kilcoy.

## VI. Horticultural Research and Extension

The main responsibility for horticultural research and extension rests with Horticulture Branch, which is concerned with production, post-harvest handling and processing of fruits and vegetables. Cultural research is centred at five Horticultural Research Stations at Applethorpe (Granite Belt), Ormiston (Redlands), Nambour (Maroochy), Cairns (Kamerunga) and Bowen, supplemented by field trials in major producing districts. Post-harvest and processing research is carried out at the Sandy Trout Food Preservation Research Laboratory, Hamilton. Extension services are provided by the Branch in all fruit and vegetable growing districts.

Liaison with industry is maintained through a number of Horticultural Advisory Committees. Within the Branch informal research/extension committees are responsible for the definition of problems in production and handling and assist in the co-ordination of research and extension activities.

Other sections of the Department involved in horticultural research and extension are Entomology and Plant Pathology Branches, which are concerned with pest and disease control, and Agriculture Branch, which handles the production side of some heavy vegetables—pumpkins, marrows, potatoes and onions.

Marketing Services, Economic Services and Standards Branches are concerned with such aspects of horticultural production as marketing, economic surveys, farm management accounting and seed certification.

### DECIDUOUS FRUITS

Work is progressing satisfactorily at the Granite Belt Horticultural Research Station towards an understanding of the interactions of boron, calcium, manganese and soil moisture in the development of apple measles, a widespread disorder in the Granite Belt, and measures for the correction of this disorder are currently being tested.

From trials just completed, measles has been found to be essentially a boron deficiency disorder which can be accentuated by high levels of manganese, which also induce bark splitting. The adverse effect of manganese can be prevented by adequate calcium in the growing medium, and soil moisture plays a considerable part in influencing the availability of calcium. The calcium factor is being investigated in a trial designed to correct measles by soil applications, and indications to date are that measles was eliminated only where the calcium was incorporated in the soil. In this treatment, calcium levels in the tissue were markedly increased and manganese levels greatly reduced.

In the course of varied investigations of bitter pit, it was found that the effectiveness of a calcium chloride dip in preventing bitter pit was greatly improved by the addition of diphenylamine, which has for some time been used to reduce another disorder, scald. A dip containing 1,000 p.p.m. of calcium chloride and 2,000 p.p.m. of diphenylamine was effective in preventing bitter pit provided that the fruit was dipped before it had reached the climacteric stage of maturation.

Investigations are under way on inadequate calcium nutrition which is prevalent in the Granite Belt and is associated with a number of important disorders of fruits and vegetables in the district. Among these are bitter pit and measles of apples, blossom-end rot of tomatoes, rotting and tip burning of Brussels sprouts, and possibly pink end in Williams pears.

The main lines of work are directed towards improving calcium levels in the soil solution, and to the use of sprays to improve levels in the plant tissue. This has become necessary because of the general low levels of soil calcium and the very slow response to surface applications of standard agricultural lime.

In a Delicious rootstock trial which has been established for 19 years at the Granite Belt Horticultural Research Station, Merton 779 is continuing to draw away from all other stocks, including Merton 778, in yield. Merton 793 is falling further behind and Essfour is maintaining its position next to 779. A limited number of Delicious trees budded on Merton 779 are available for release to growers this planting season.

In a pear rootstock trial which has been established for several years on the Granite Belt Station, the new clonal rootstock T7 is beginning to outyield by a considerable margin the currently recommended stock *Pyrus calleryana*. Further information on the relative performance of these stocks will be obtained from a similar trial established some seasons later at the Summit.

Several yellow-fleshed peaches from the breeding project at the Granite Belt Station may help to meet the district's requirements for earlier yellow-fleshed varieties. In their first crop last season they reached maturity 8-10 days before Starking Delicious, the first commercial yellow-fleshed variety in the district. These selections will be further evaluated in coming seasons to determine whether they are good enough to release. However, the appearance of such promising material at this stage is particularly encouraging as the project has been going for only a few years and the number of seedlings which have fruited is comparatively small.

It is necessary to minimize cultivation of the very light orchard soils of the Granite Belt because of harmful effects on water intake and serious damage to tree root systems. At the same time it is essential to control weeds which would deplete the generally limited soil moisture. Trials with herbicides in past seasons indicated that Terbacil and Simazine would be of considerable value in Granite Belt orchards at least under normal to dry conditions. Continuation of the trials last season showed that these herbicides were effective even under abnormally wet conditions.

In contrast to the 1969-70 season, blossom blight (*Sclerotinia fructicola*) caused little concern in stone fruit in 1970-71. The dry spring condition no doubt contributed to this. Benomyl showed out well again for the control of brown rot caused by the same fungus. This disease was bad and the prolonged wet conditions in early February made it difficult to maintain a spraying schedule.

Spore trapping has been initiated to obtain information on infection periods for the apple scab organism, *Venturia inaequalis*. This programme is part of a feasibility study for a spray warning service against this disease.

Insecticides usage for pest control in apple orchards at blossoming time is causing concern to beekeepers. Blossom thrips (*Thrips imaginis* Bagn.) and the dimple bug (*Campylomma livida* Reut.) attack the blossoms and it may be necessary to apply an insecticide against them. Field control trials have proved that the most effective and economical insecticide against either thrips or dimple bug or both together is DDT at 0.1% spray strength. DDT is classified as only moderately toxic to bees, which means that it may be used in the presence of bee colonies but not directly onto the bees in the field or over the hives. The main effect of DDT spraying in the orchard at blossoming is the death of some field bees, but even this can be largely avoided by spraying at times of the day when bees are least active, taking care to avoid drift towards the hives.

### PINEAPPLES

Recent weedicide work with pineapples has given good control of several diuron-resistant weeds such as green couch and crowfoot which had built up to a troublesome extent with the continuous use of this herbicide. These have now been successfully controlled by the combination of diuron and bromacil. Giant paspalum, which is resistant to both bromacil and diuron, can be controlled by the use of dalapon during the pineapple intercycle. While dalapon is harmful to pineapples it breaks down in the soil in several weeks, so its use in the intercycle is quite safe.

A chemical method of controlling pineapple skin colour holds promise of improving juice quality and also of cutting harvest costs by shortening the harvest period.

It is a common experience, particularly with summer crops, that whereas much fruit may be sufficiently ripe internally for picking, the skin remains green. While the flesh of such fruit would be quite acceptable for processing, the green skin would adversely affect the appearance of the juice recovered from the skin. By the use of ethrel sprays on the developing fruit the relationship between skin colour and internal maturity is improved. The effects of ethrel dips on harvested fruit are also under observation.

In a root rot (*Phytophthora cinnamomi*) trial established in the Nambour district, by the Plant Pathology Branch, plots mulched with black polythene yielded the equivalent of 21 tons per acre, while bare-soil plots produced the equivalent of 13 tons. This aspect of control will be investigated further.

## BANANAS

From nutritional studies and soil surveys it has been possible to make some generalizations on banana nutrition in the Wet Tropics.

In the first place, nutrition is not generally a major problem in the area, and in soils of reasonable nutrient status, regularly fertilized with medium to high amount of potassium and nitrogen, it is found that no major changes in yield accrue from slight to medium changes in either rate or timing in the standard potassium fertilizer recommendations.

Marked responses to potassium occur when soil level falls below 0.1 m-equiv.%, some responses occur at 0.2 but none above 0.4. Only a small proportion of the alluvial clay soils in the surveys had less than 0.4 m-equiv.%. The majority of the red loams fell within the 0.1 to 0.3 range, and these soils would be expected to respond more to potassium fertilizers than the alluvial clays. In the red loams potassium fertilizer tends to reduce calcium and magnesium uptake, particularly under dry conditions, and attention must be paid to magnesium nutrition. In the alluvial soils even very high potassium levels had no effect on magnesium and calcium uptake. It has been found that surface applications of potassium readily reach the root zone, and no particular advantage or damage resulted from banding the fertilizer close to the stool.

Several green manure crops were tested for suitability for banana land in the Wet Tropics. Sudax hybrid forage sorghum was by far the most reliable, establishing well under both wet and dry conditions.

A major problem in the marketing of bananas is the arrival of fruit on the market in what is termed a "mixed ripe" condition, fruit in the one container often varying considerably in degree of maturity. A detailed study is being made of the relationship between ambient temperature and fruit maturity in the plantation in order to develop a method whereby fruit may be harvested to meet specific market requirements, and to minimize variation in maturity in the pack.

Three new banana strains originally chosen for their superior performances in trials at Maroochy Horticultural Research Station are being multiplied at the South Johnstone Research Station for eventual distribution to growers. They are growing well and it is expected that 2,000 plants of each will be available within 12 months. It is anticipated that the next stage of multiplication on the properties of selected growers should yield at least 20,000 plants of each variety by the end of 1973. This should permit a really effective distribution to the industry.

In view of the possibilities of establishing export markets for bananas from North Queensland, a storage trial was conducted with fruit from a range of farms representative of the area, this fruit being taken at random from consignments harvested for the Melbourne market. The potential storage life of such fruit held at 55°F was found to vary from 14 to 21 days.

Wet weather conditions have made it almost impossible to maintain spray schedules for the control of leaf spot and speckle diseases in North Queensland. These diseases promise therefore to cause even more serious losses than is usual. In fungicide screening work by the Plant Pathology Branch the new fungicides Daconil and Pennsalt TD5056 showed promise.

On the basis of further trial work, concentrations of 200 p.p.m. benomyl and of 400 p.p.m. thiabendazole have been recommended as post-harvest dips to control black end or crown rot infections in bananas.

Investigations on bananas in North Queensland were undertaken by the Entomology Branch to determine the implication of insects as causes of reddish blemishes called maturity bronzing. This discolouration is the most pressing problem in northern banana plantations and undoubtedly is causing growers considerable financial loss. The blemish is as yet of unknown

origin. A large number of bunches selected at first appearance in each of three banana growing districts were examined regularly until harvest. Collections of all insects likely to be implicated were made at various stages of bunch development. Records of the appearance and increase in skin blemish on the developing bunches showed that all bunches to some degree were affected with maturity bronzing or a similar blemish. The insects associated with the bunches, particularly thrips, are being further investigated to determine the actual causal agent.

Field survey work has been undertaken in a feasibility study of a major expansion in the banana industry in North Queensland for the Japanese market. Estimates of production and transport costs, areas of land available for increased production and costs of establishing and operating centralized packing houses have now been completed. Technical aspects of production have also been studied. Funds are now being sought to examine the Japanese market situation at first hand.

## PAPAWS

Papaws vary considerably from farm to farm and from plant to plant on the one farm, and some fruit are much better than others. It would be very desirable to have production based on a few superior uniform types. A considerable step in this direction has been taken by officers at the Branch's Nambour office. Within recent years methodical selection work has been carried out, initially on the property of a North Coast grower who had a rather superior range of plant types. A good type has been isolated and fixed by repeated selection, and it is now planned to release this variety and make provision for supplying seed. Among the good points of this selection are its attractive appearance, good eating and keeping quality and considerable resistance to ripe fruit rots.

Another important aim in papaw improvement is a variety with fruit sufficiently low in nitrate as to present no problem in canning. Work is proceeding actively towards this end at the Redlands Horticultural Research Station.

An assessment was made of papaw production costs in the Yarwun district of Central Queensland and growers were advised on a system of farm record keeping.

## CITRUS

A nutritional trial is being conducted with Ellendale mandarins at Gayndah, to study the effects of potassium on yield and fruit quality. Half of the plots have received no potassium since the trial commenced in 1969. The soil level in these plots is now 0.3 m-equiv.% replaceable potash, which is 30% less than the level in plots receiving 1½ lb. per year. The level in leaves from fruiting terminals of trees in the no-potassium plots is now 0.7%, which is 17% below that in the plots receiving potassium. To date, however, no reduction in yield or fruit quality has been detected and the trial is being continued.

In a lemon variety trial at Gayndah, three lemon varieties are being compared on six different rootstocks. In the first 8 years from planting, the highest yields have come from Villa Franca, followed by Eureka and then by Improved Lisbon. Of the rootstocks, rough lemon has given by far the greatest yield, followed by sweet orange, Cleopatra and Emperor. The best-yielding varieties and stocks have also produced the highest proportions of their crops at times of the year when prices are highest. There were no important differences in fruit quality.

The citrus leaf miner (*Phyllocnistis citrella* Stainton) recently became established in North Queensland and has spread south to the Queensland-New South Wales border. While occurrences have been reported from commercial orchards, instances of serious damage have been few. The damage appears as distortion and curling of the young and tender leaves only. Older leaves are rarely shed but the old empty mines persist as scars on the leaf surface. Severe infestations have occurred in nurseries, where a control treatment is warranted to ensure clean trees for distribution by sale. Control trials proved that diazinon and azinphos-ethyl each at 0.05% active constituent are effective for use on nursery trees.

A detailed cost study of various methods of handling citrus in the Gayndah district showed that the benefits of bulk handling are not confined to the "big" growers as generally understood.

## PASSION FRUIT

*Phytophthora nicotianae* var. *parasitica* caused extensive damage in North Coast passion fruit plantations. Symptoms included tip and leaf blight, fruit rot and stem lesions. This disease had previously only been recorded as a tip blight in nursery stock. The wet conditions undoubtedly played a major role in the incidence of this disease.



The new papaw variety, Richter, has excellent appearance and eating quality and considerable resistance to ripe fruit rots.

Many specimens of hybrid vines showing fruit woodiness were received for examination by the Plant Pathology Branch. Milder strains of the virus which do not cause these symptoms will give protection against this disorder.

#### STRAWBERRY

The precooling of strawberries and the maintenance of low temperatures by inclusion of dry ice in the container greatly improved the quality of berries on arrival at Sydney and Melbourne by road transport. These findings could appreciably extend the market for Queensland strawberries and greatly improve the quality of Queensland berries on distant markets.

The Plant Pathology Branch again supplied heat-treated potted plants to form the basis of the virus tested planting material scheme operated by the Department.

Grey mould (*Botrytis cinerea*) incidence was low in the 1970 crop but present indications are that it will be severe during 1971. An extensive spray trial is under way to further test benomyl and other new fungicides against this disease. Wilt (*Verticillium dahliae*) was prevalent during the winter period and caused serious losses. It is interesting to record that affected plants recovered with the advent of warmer weather.

Strawberry dwarf or crimp caused by the bud nematode (*Aphelenchoides besseyi*) was recorded in Queensland for the first time.

#### AVOCADO

Root rot (*Phytophthora cinnamomi*) has caused very serious losses following the wet summer period. Further indexing for the viral disease sunblotch has been undertaken. Free material of Jalna, Topa Topa and Duke 6 rootstock is now available.



Ultraviolet light trap for the study of moth populations of macadamia pests.



## MANGO

Over 30 introduced varieties of mangoes and several local selections have been propagated for establishment in an experimental block at the Bowen Horticultural Research Station. Amongst these introductions are the main early and late varieties of Florida and Hawaii, and it is hoped that these will extend the fruiting season, as the main commercial variety of the district, Kensington Pride, matures most of its crop in less than 6 weeks.

Preliminary work is also in progress to improve the level of production of Kensington Pride. Production at present varies greatly from tree to tree and from orchard to orchard. Last season, yields within one orchard averaging 150 lb. per tree ranged from 50 to 860 lb. per tree.

## VEGETABLES

Because of the intensive vegetable breeding work in progress in large centres of production overseas, and the considerable contribution that this work has made to our range of commercial varieties, Horticulture Branch together with leading seedsmen has regularly introduced new varieties of good repute for testing in our main producing areas. During last season 20 cabbage, 20 cauliflower, 20 carrot, 8 lettuce, 20 tomato and 6 capsicum varieties were placed in observation trials, while over 100 bean varieties were put through quarantine. Testing must necessarily take several seasons, and cover the main centres of production before the commercial potential of a new variety can be reasonably well assessed.



**Tight or loose fills cut fruit losses from bruising and save considerable time as compared with the precision pack.**

An economic survey of tomato growing in the main producing areas of the State is nearing completion.

Lima bean is an important vegetable in the United States, but has not yet come into commercial production here, and is known only by a climbing type grown occasionally in home gardens. Commercial production in the United States is based on bush varieties, and last season a number of commercial bush varieties were introduced and seed was increased for testing in the most likely areas in this State.

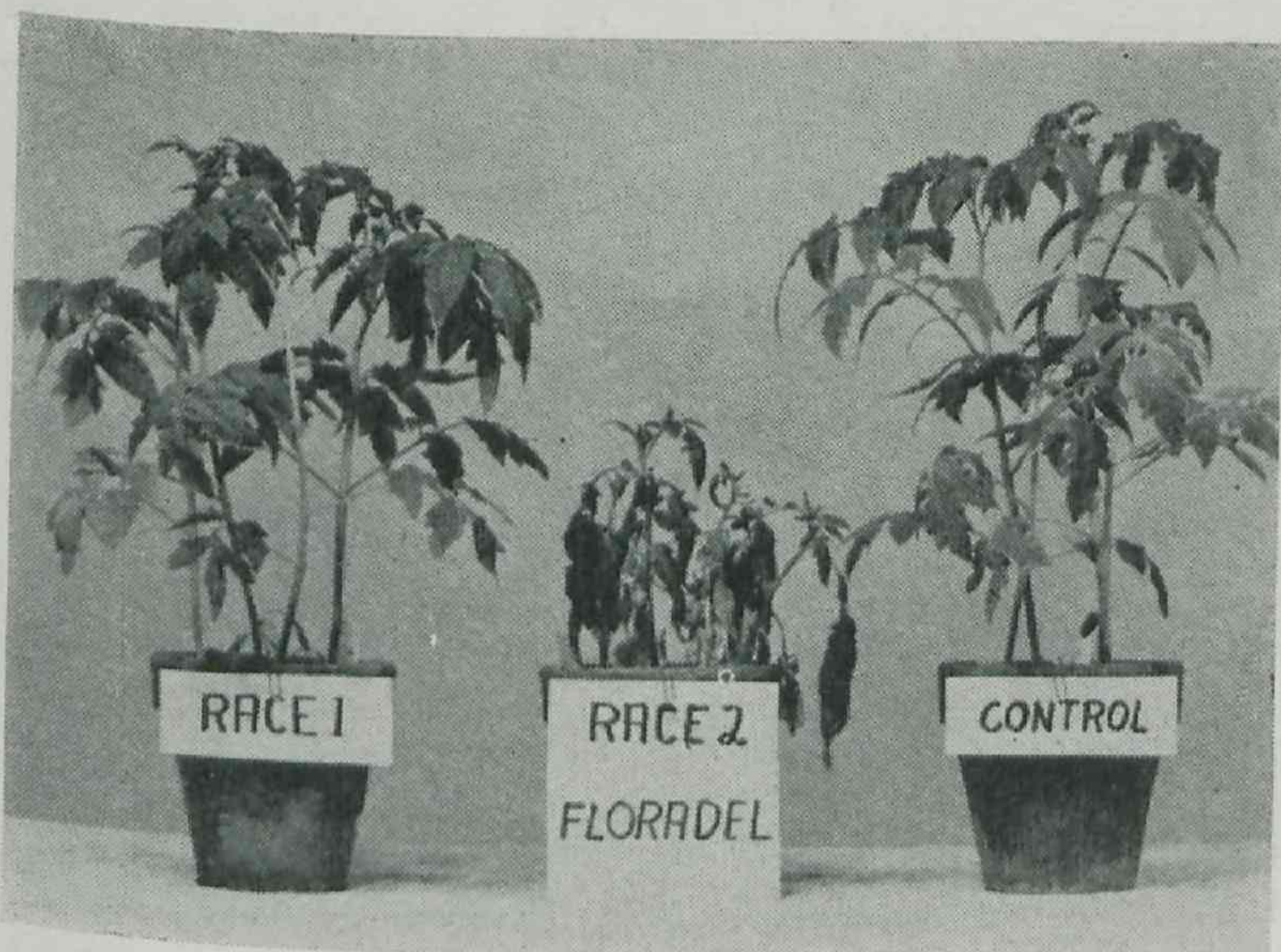
The existence of frost-free slopes in southern coastal Queensland has made it possible to grow beans for the fresh bean market throughout the cold winter months. However, although the areas under crop are frost-free, yields are still severely reduced by the low temperatures. The development of lines more resistant to low temperatures would greatly improve the profitability of winter production of fresh beans and could also appreciably extend the economic production of processing beans. By the use of environmental control chambers an intensive study of cold tolerance is being made with a view to producing good commercial varieties with greater cold tolerance.

The nutritional requirements of french beans were worked out many years ago for the main areas and seasons of production in the State. However, in recent years production has extended to other areas, particularly with processing beans in the Bundaberg and Lockyer districts in the warmer parts of autumn and spring. There have been some indications that in these districts and under warmer conditions the nutritional recommendations were at times inadequate, and recent work in both areas has shown appreciable yield increases with higher levels of nitrogen than those previously recommended. Further work is going on to check these findings and to gain a more complete basic understanding of bean nutrition.

A new race of rust (*Uromyces appendiculatus*) capable of attacking Greenleaf "C" and the bean strain 120-2B occurred during the 1970 winter and is already widespread in south-eastern Queensland. The occurrence of this rust has focussed attention on the possible use of fungicides rather than resistance as a means of control. Extensive glasshouse testing by Plant Pathology Branch during 1970 with the fungicides benomyl and "Plantvax" will be followed in the 1971 season with extensive field tests. Some lines of resistance to the new race have been demonstrated. The summer death disease, thought to be caused by a mycoplasma, has been further investigated and breeding lines are being examined for resistance.

Following complaints about excessive variability in Crystal Apple cucumbers, a number of lines have been grown under test. The variability was considerable and large plantings of the best lines are being made for reselection.

The watermelon varieties Calhoun Grey, Crimson Sweet and White Hope showed a high level of field resistance to Fusarium wilt (*F. oxysporum* f. sp. *niveum*) in a trial on infested soil in the Maroochydhore area. In a glasshouse test seed treatment with benomyl gave complete control of seed-borne Fusarium foot rot caused by *Fusarium solani*.



**Inoculation test for susceptibility to wilt complex with the tomato variety Floradel. Race 2 is a new wilt race reported from Bowen.**

A considerable number of new tomato varieties and breeding lines have been introduced and tested in recent years. Several from Florida are in commercial production and others show considerable promise. As a result of their satisfactory performances in Departmental trials and in commercial production, representative seed lines of the varieties Floradel and Indian River have been established and certified seed of these varieties is being produced. Nuclear stocks of seed of three promising varieties, Walter, Tropic and Immokalee, are being produced against possible certification of these varieties, should their general performance over several seasons be good enough.

At Bowen, Floradel has performed well and with its high yield, tolerance to tobacco mosaic virus and some field tolerance to Fusarium wilt it could well find a place in Bowen production until a suitable variety is found with resistance to the wilt complex of the area. Several lines at present under observation show promise of meeting this need.

In response to increased interest in production of processing tomatoes in Queensland, a screening trial is being carried out to assess the potential of a number of varieties for processing into juice and as whole tomatoes. The varieties commonly grown for the fresh market are not really suitable, and Roma, the variety most commonly grown for processing in this State, is not satisfactory for juice.

Screening for resistance of C1402 x 022 progeny to the new pathogenic race of *Fusarium oxysporum* f. sp. *lycopersici*, the cause of Fusarium wilt, is continuing. This race remains restricted to the Bowen area.

Field control trials conducted by Entomology Branch at Redlands Horticultural Research Station against cabbage pests have shown that diazinon can replace endrin, which has a high mammalian toxicity, for the control of cabbage moth (*Plutella xylostella* (L.)). The recommended spray strength is 0.1% active constituent.

A serious situation arose during the year with winter-planted potatoes in the Lockyer Valley and other areas close to Brisbane when the disease powdery scab (*Spongospora subterranea*), previously only recorded in a limited area around Tent Hill, appeared in many new locations. Wide-spread condemnations occurred with consignments sent to the Sydney and N.S.W. country markets. The disease appears to be restricted to the winter crop and the sudden upsurge may have been associated with the rather severe winter conditions experienced. Control poses a difficult problem but efforts to contain it by thorough inspection of seed supplied is an obvious step to take. A close watch is being kept on seed supplies from other States.

A mixture of chlorthal and ioxynil has again given best weed control and highest yields in onions. Propachlor plus ioxynil has been less efficient in weed control and has reduced yields. In this particular trial the treatment in which weeds were removed by hand at the early cotyledon stage with minimum soil disturbance gave the highest yield, but there was no significant yield difference between this treatment and the three cultivation schedules (scuffling and chipping as

required; scuffling and chipping at the 2-leaf stage and at bulbing; and scuffling and chipping every 4 weeks) and the chlorthal pre-emergence at 7.5 lb. a.i. per acre followed by ioxynil post emergence at the 2-3 leaf stage at 1 oz. a.i. per acre.

#### GINGER

In an investigation of materials for packaging crystallized ginger, it was found that more permeable films should be used under warmer and more humid storage conditions. It was also found that large packs of crystallized ginger should be of the minimum practicable depth, and that ginger should not be held in bulk packs for over 2 months if exudation of syrup is to be avoided.

In exploratory trials with a wide range of preservative solutions, ginger retained its texture and gave a much higher recovery in salt brines than in metabisulphite solutions.

In the same series of solutions, conditions were designed to promote natural and acid-controlled fermentations as well as pure culture *Lactobacillus* fermentations. It was thought that fermentation might produce a desirable distinctive flavour as found in some imported lines. Vigorous natural and acid-selective yeast fermentations were obtained, but brined ginger did not support a lactic acid fermentation. The natural fermentation resulted in less satisfactory colour, texture and recovery of sound ginger than acid-controlled fermentation or no fermentation in salt brines.

## VII. Development Planning and Land Use

The Department has a continuing association with other Government Departments in development planning projects and land-use studies. The Development Planning Branch plays a major role in co-ordinating the activities of the many Branches involved in joint work and in addition undertakes various types of field work associated with land use and development.

The Agricultural Chemical Laboratory Branch carries out much independent as well as joint work by way of soil and water surveys. The Economic Services and Marketing Services Branches similarly have an important role in studies of the economics of production and marketing.

### DEVELOPMENT PLANNING

*Brigalow Scheme.*—The Development Planning Branch continued land-unit mapping of the brigalow lands in Area III. During the year the area mapped increased by some 1,048,000 acres to a total of 2,763,944 acres. Much of this mapping has been at the photo-interpretation level, and field checking will be required to verify particular areas as ballot blocks are made available for settlement. Twenty-three property plans were prepared during the year for an aggregate area of 406,800 acres. Land unit information based on vegetation and soils is of paramount importance when individual property development programmes are prepared for each settler by officers of the Department of Lands and the Department of Primary Industries.

As the original need for a Contact Officer Scheme in Areas I and II now seems to have been fulfilled, some changes have been made in the operation of the scheme.

A 2-day school for new settlers was held in Rockhampton. Speakers from the Department of Lands, Irrigation and Water Supply Commission and Department of Primary Industries dealt with aspects of most concern to settlers in the early developmental stages of their properties.

*Beef industry study.*—The comprehensive study of the beef cattle industry in Queensland, mentioned in last year's report, has progressed. A draft report includes an inventory of physical resources on a regional basis under the broad headings of soils, vegetation, topography, climate, water supplies, livestock population, facilities for transport selling and treatment of livestock and human population. A further section deals with the economics of beef production in terms of productivity by regions under present conditions, relationship to units of production, inter-regional trade and overall productivity, interstate and export outlets and relationships with complementary and alternative enterprises. Aspects which have influenced the historical development and which have a continuing influence are also considered. These include land availability, marketing organization, rural land development projects, rural finance, trends in husbandry methods, research and extension facilities and producer attitudes.

A later report is expected to make some comments on the future role of the industry in the light of the data assembled in the current report.

*Sheep industry.*—A climatological study will be made of the Northern Sheep Zone comprising 1,199 properties in the Shires of McKinlay, Richmond, Flinders, Winton, Longreach, Aramac and Ilfracombe. The study region comprises some 48.3 million acres. A study of the effect of climate on the pastoral productivity and economic viability of the Zone using simulation techniques will be made.

*Northern Australia.*—An assessment of the areas of land with cultivation potential in Northern Australia has been completed. Suitability for cultivation was based on climate, soils and topography.

*Atlas of Resources.*—On behalf of the Geographic Section, Department of National Development, an exercise was undertaken to delineate beef, beef/sheep and sheep properties in northern and western Queensland from Stock Returns.

*Cape York Peninsula.*—A land capability—length of growing season map for the Cape York Peninsula Study Area has been prepared by extrapolating from existing Land Use Survey data and soils map. This basic information is required to assist the Main Roads Department with projections for road requirements for an area comprising some 87,950 sq. miles.

*Land inundation.*—Assessments of the economic consequences of inundating land upstream of proposed domestic/industrial water supply dams at Wolfdene (Albert River), on the Boyne River near Gladstone and at Advancetown (Nerang River) have been undertaken by the Development Planning and Economic Services Branches.

### LAND USE

*Western Arid Zone.*—Land utilization studies were continued in the Western Arid region. Complete land-use assessments were completed for 21 beef properties and 16 sheep sample properties on behalf of the Bureau of Agricultural Economics. Field descriptions for soils and vegetation, and productivity estimates under drought and non-drought conditions, were forwarded to B.A.E. to assist with their financial studies of the sample properties in Western Queensland.

Broad-scale mapping is now being concentrated on 36 million acres in the south-west corner of the State. The purposes of this survey are to describe the existing natural resources (soil, vegetation, water) in the region and the present methods of utilizing them; to evaluate existing practices in terms of environment, location, property size and other characteristics, land tenure, institutions and finance, capital resources and return to capital, husbandry practices, integration with and/or dependence on other regions, and long-term effects on natural resources; and to derive principles of management and social organization capable of maintaining a desirable economic balance consistent with the preservation of the long-term productivity of the Zone.

A multi-discipline team has worked during the year on the nine 1:250,000 areas in the south-west corner of the State comprising approximately 36 million acres. Photo-interpretation has been completed for the area and field work to date has covered 178 detailed site recordings and the collection of 600 soil samples for analyses.

*Isis land-use study.*—The Isis Land Use Report prepared by the Isis Land Use Committee under the Chairmanship of the Director, Division of Land Utilisation, was completed in May 1971 for presentation to the Land Development Committee. The report sets out details of an investigation for the purpose of making recommendations concerning the most desirable future development for 140,000 acres of land in the Childers-Isis Region in south-eastern Queensland.

Soil erosion was shown to be a major factor influencing the production of sugar cane, and the Committee has strongly recommended that adequate erosion control programmes be applied on all areas in the Childers Land System which are used for cultivation.

Irrigation is considered essential for the stabilization and improvement of production on 90% of the assigned sugar lands in the Isis Mill Area which are not now irrigated.

The Committee also found that, in terms of alternative land use, it was in the local and State interest to promote a viable softwood timber industry in the Childers district.

*Condamine-Maranoa.*—An agricultural economist assigned to this research project has been involved in an evaluation of the availability and utilization of resources in the Condamine-Maranoa region. The objective is to ascertain the adequacy of existing research and extension activities in the region and to determine an order of priority for future needs. Other Branches have participated in this project, code-named COMBER.

*Gympie region.*—A survey of dairy/horticulture farmers is currently under way in the Gympie region to study management factors and profitability of this farming system on the Near North Coast.

*South Coast.*—A final draft of the South Coast land-use study report, and the preparation of a land-use map for the study area, are nearing completion. The survey procedure based on a study area of 250,000 acres concerns investigations into climate, geology and soils, vegetation, land use and the economics of beef production on the eucalypt forest lands. The latter activity is based on developments with tropical pastures. Because of the high unimproved capital value of the land, the cost of timber clearing, seed and fertilizer costs, the return to capital is generally low.

## IRRIGATION

*Dumaresq Valley Irrigation Project.*—The Commonwealth Government in December 1970 agreed to provide up to one-third of the funds (amounting to approximately \$4.7 million) towards the cost of a proposal for the joint construction of a dam on Pike Creek by the New South Wales Water Conservation and Irrigation Commission and the Queensland Irrigation and Water Supply Commission. The 1969 Queensland Report, prepared by Department of Primary Industries and Irrigation and Water Supply Commission, indicated that Queensland's half share of the capital cost of the project would be \$7,033,000 and would provide in Queensland for the expansion of existing irrigation between Pike Creek and Goondiwindi from 3,200 acres to 20,700 acres; would result in the annual gross value of rural production increasing by \$1,875,000; would have a benefit-cost ratio based on primary benefits of 1.37 to 1.67; and would provide the opportunity for individual landholders along this section of the Border Rivers to stabilize and increase their annual production on a sound economic basis.

*Urannah Dam.*—A Joint Report by the Department of Primary Industries and Irrigation and Water Supply Commission which was issued in March 1971 sets out the possibilities of constructing a large storage on the Broken River at 22.4 miles (Urannah) with the use of water to irrigate an additional 60,000 to 70,000 acres of land. This amount of irrigation would create a stable annual production of up to \$8.15 million, and could result in increased overall production and population with consequent benefits to the economy of North Queensland. Officers from Economic Services Branch assumed responsibility for the economic evaluation, while Development Planning Branch assumed responsibility for the agricultural assessments in the Report.

Production envisaged from this project is the aggregate out-turn of crops and animals from the areas likely to be irrigated by private diversion along the Bowen and Burdekin Rivers, plus production from farms on the right bank of the Lower Burdekin. Two production plans were adopted for the proposed extension of the Irrigation Area. These plans are based on two levels of rice production—15,500 and 9,100 acres.

*Emerald Irrigation Scheme.*—A reassessment of farm size was carried out in the light of more recent market changes, particularly for cotton. An area of at least 500 acres is considered necessary to provide viable properties in the foreseeable future.

*Gin Gin—Maroondan.*—At the request of the Irrigation and Water Supply Commission, the Inter-Departmental Study Committee is now directing its attention to the Gin Gin—Maroondan area, comprising some 90,000 acres. A reconnaissance soil survey was carried out by officers of the Agricultural Chemical Laboratory Branch and Development Planning Branch to identify and map the principal soil types in the study area. Thirteen different soil types have been identified. The delineation of slope categories has been completed.

*Abbotsford and Givelda Surveys.*—These two small areas, which are to receive water from Phase I, Stage I of the Bundaberg Irrigation Undertaking, have been the subject of special attention. A soil survey of these areas has been carried out, and photo-interpretation of land slope categories has also been completed. Decisions on the re-arrangement of these lands for sugar production will be carried out directly by the Irrigation and Water Supply Commission and the Department of Primary Industries.

## WOODY PLANT CONTROL

*Brigalow.*—During the year several of the experimental projects on the control of brigalow suckers at the Brigalow Research Station were completed. Some points of interest to emerge from these are as follows:

- Delaying of burning of brigalow for up to 17 months after pulling reduced the number of suckers following burning to less than half of those in the control areas. This confirms experimentally the findings of the earlier field survey based on study of data collected from several hundred areas throughout the brigalow belt.
- A comprehensive ploughing trial of 3–4 year old suckers indicated that the best kill with a single ploughing per year for 3 years was approximately 80% with ploughing in February. This result was not greatly different from other late-summer treatments (March–April) but all late summer treatments were much superior to treatments at other times of the year.

A double-ploughing trial on young brigalow suckers showed that good control was achieved by ploughing in October or November with a second

ploughing 16 weeks later, or by ploughing initially in January and ploughing again 8 weeks later. Kills in all the winter ploughing trials were poor.

- Ultra-low-volume spraying. During 1970 and 1971 some commercial firms in Central Queensland publicized and carried out spraying of large areas of brigalow with  $\frac{3}{4}$  lb. 2,4,5-T acid equivalent of ester in about 1½ pints of diesel distillate per acre instead of the usual 2½ gallons of distillate. Many of these areas have been kept under observation but early indications are that the technique is not as effective as the more conventional higher volume. No definite assessment can be made until at least two summer seasons after the initial spraying.

*Dawson Gum or Blackbutt.*—In trials recently completed at the Brigalow Research Station, a proprietary picloram/2,4,5-T preparation (Tordon 105) gave better than 80% kills when used as an injection treatment on virgin trees and saplings or as a cut-stump and swab treatment of multistemmed regrowth. The picloram/2,4-D amine mixture (Tordon 50D) was only slightly inferior at the same rate of application.

An ester formulation of picloram/2,4,5-T (Tordon 255) when used as a basal bark spray or as a cut-stump and swab treatment on multistemmed regrowth also gave an 80% kill.

Time of application appeared to have no influence on results from injection with picloram/2,4,5-T amine but best results with other techniques were usually obtained when soil moisture was high. By itself, 2,4,5-T amine or 2,4,5-T ester was inferior to preparations containing picloram, except as a basal bark spray on multistemmed regrowth, when an 80% kill was obtained with the ester formulation of 2,4,5-T at a concentration of 5% in diesel distillate.

*Sandalwood.*—In an attempt to devise suitable sampling techniques for collecting and collating information on sandalwood and other woody weeds in Central Queensland, a Woody Weeds Data Form was devised in conjunction with the Inter-departmental Committee on Control of Timber and Woody Weeds and with Dr. J. Walker and Mr. D. Ross of C.S.I.R.O. In order to test the usefulness of this form, a pilot study has been carried out mainly in Area III, the present target being to sample about 300 different sites before running a test programme. The form is designed for processing by a computer and a programme for retrieving selected data has been devised by Mr. Ross for use in the C.S.I.R.O. computer at Canberra. Results of this pilot survey, which should be available early next year, will determine whether the form is suitable for collection and codification of data on woody weeds to meet our own objectives of determining factors influencing regrowth of known problem species such as sandalwood and at the same time the objectives of the C.S.I.R.O. Woody Plants Ecology Group in studying changes in the plant communities as a whole.

## FARM MANAGEMENT ACCOUNTING SERVICE

Following the release of the A.C.C.R.A. code in February 1970, it was adopted in the farm management accounting service from July 1, 1970. To accept the code, new computer programmes were written for the quarterly and annual financial accounting statements prepared for farmers and significant improvements were effected in the new formats.

Membership has been maintained at approximately 300 to keep within the limit of the Department's resources. Greater interest is being shown by members in a budgeting service which enables them to use their results as a basis for farm planning.

Increasing representation is being recorded from the sheep and beef industries in the pastoral zone; this will provide much needed factual information for assessing the economics of the current trend to change from sheep to cattle. A new group of grain and cattle men in the Central Highlands has been formed following the appointment of an Economist to Emerald last year.

An additional service is being provided for members in the form of a newsletter in the South Burnett, Gympie and Warwick regions. This service has met with a favourable response.

Group meetings of members on a locality (and industry) basis have been successfully introduced in the Gympie region. Local extension officers also participated in the meetings in order that members could receive both technical and economic advice.

The second edition of "Accounting and Planning for Farm Management", prepared by a Joint Committee on Standardization of Farm Management Accounting, was published early in 1971.

## VIII. Special Field and Laboratory Services

The Department operates a number of services ancillary to its crop, livestock and commodity research, extension and regulatory services. Some of these are recorded elsewhere in this report. This section deals mainly with soil conservation services and various diagnostic services.

### SOIL CONSERVATION

The Soil Conservation Branch continued its advisory and technical service to landholders in conservation farming, including land use planning and the planning and marking out of areas for contour working.

During the year, 3,247 requests for assistance were received and 5,813 property visits made to assist with the development of soil conservation programmes. The total number of requests for the year was about 10% down as compared with the previous year, reflecting the difficult financial conditions in many sectors of the agricultural community. Present economic conditions are not conducive to action by landholders in implementing non-productive soil conservation work such as contour banking.

A further 472 landholders, the lowest total in 6 years, commenced contour farming programmes for the first time, bringing the cumulative total of co-operators to 7,433.

There are approximately 30,000 rural holdings in Queensland with areas between 100 and 10,000 acres. Assuming that three-quarters of these holdings require contour farming and allowing for 7,400 present co-operators, there are still approximately 15,000 holdings which have yet to start treatment programmes.

The Branch is placing increasing emphasis on the assessment of land capability of properties and the preparation of land capability plans and land use plans. Technical guides to conservation land use are helping to give more objectivity and uniformity to this part of the Branch's work. Land use plans covering 51,605 acres were issued to 43 landholders during the year.

Some 129,500 acres of erosion-prone cultivation land was marked out for contour farming, bringing the total area of land worked on the contour in Queensland to 1,180,000 acres. The area treated was 12% less than the area treated last year. There was a decrease of 27,000 acres in contour banking and an increase of 9,000 in other contour measures.

Further exploration of the desirability of Soil Conservation Districts administered by Trusts took place in the year under review. The initiative was taken both by landholders in the parish of Cooyar, South Burnett, under guidance of branch officers, and by local authority officials of the Kingaroy Shire Council. To date this interest has not given rise to any positive steps towards the establishment of Soil Conservation Districts, but all involved have gained a better understanding of the provisions and possible deficiencies of the Act. The general attitude at present is one of caution, particularly with regard to the financial implications of the Act, which is understandable considering the economic climate under which primary producers and rural local authorities are at present operating.

In the meantime, use has been made on several occasions of the provisions of the Act covering the establishment of Soil Conservation Project Areas to resolve runoff disposal problems in small areas. The Haly Creek No. 1 Project area was finalized during the year under review. The Boonyouin No. 1 Project area was, in accordance with sections 74 and 75 of the Act, prepared, advertised and made available for inspection in April of this year. An application by the Kingaroy Shire Council for the constitution of yet another Soil Conservation Project area within the Boogie Road catchment is at present under investigation.



Contour strips of buffel grass on a property north of Roma prevented soil movement during the 1970-71 wet season.



Pasture furrows 17 years old on a Roma district property. Photograph taken just after rain at the end of the 1970 drought.

During the year new applications for advances were received from five landholders and applications for additional finance were received from two previous applicants. The total of effective applicants now stands at 41. The Agricultural Bank granted approvals totalling \$10,502.

With 2 years of testing of the initial stubble mulching machinery complete, it is evident that some of the principles under investigation have a definite application under Queensland conditions. Some action on the part of manufacturers to capitalize on current interest would seem appropriate.

A pilot trial on minimum tillage was conducted in the Kingaroy district during the year on an escarpment area of poorly structured soils. Mouldboard ploughing significantly reduced weed population in comparison with chisel ploughing. The rougher tilth created persisted but decreased through the crop growth period and some reduction in runoff and soil loss was observed.

The fallow moisture accumulation study was continued during the year.

Interpretation of data to date indicates that the short summer fallow stored, on average over the 4-year period, 36% of the incident rainfall. The March-April period, with generally low rainfall and high evaporative conditions, was not conducive to storage. The May-June period, the time of "planting" rains, had good low intensity rains with subsequent low evaporative conditions. Storage efficiency was therefore high, even without cracks and with a fine seedbed condition.

As the length of fallow increased, to a summer-winter or summer-winter-summer fallow, the efficiency of rainfall storage during the later parts of these fallows decreased to extremely low or negative levels. This low efficiency of storage could be attributable to a number of factors, such as (a) the generally fine soil surface conditions inducing high runoff, (b) the lack of surface cracks as a means of infiltration, (c) the low permeability of the zone of soil already wet up.

Work has continued throughout the year on the production of the "Eastern Downs Technical Guide", covering 19 land systems. Work commenced early in 1971 on the production of a technical guide for the Southern Border Region, to cover an area of approximately 9.5 million acres.

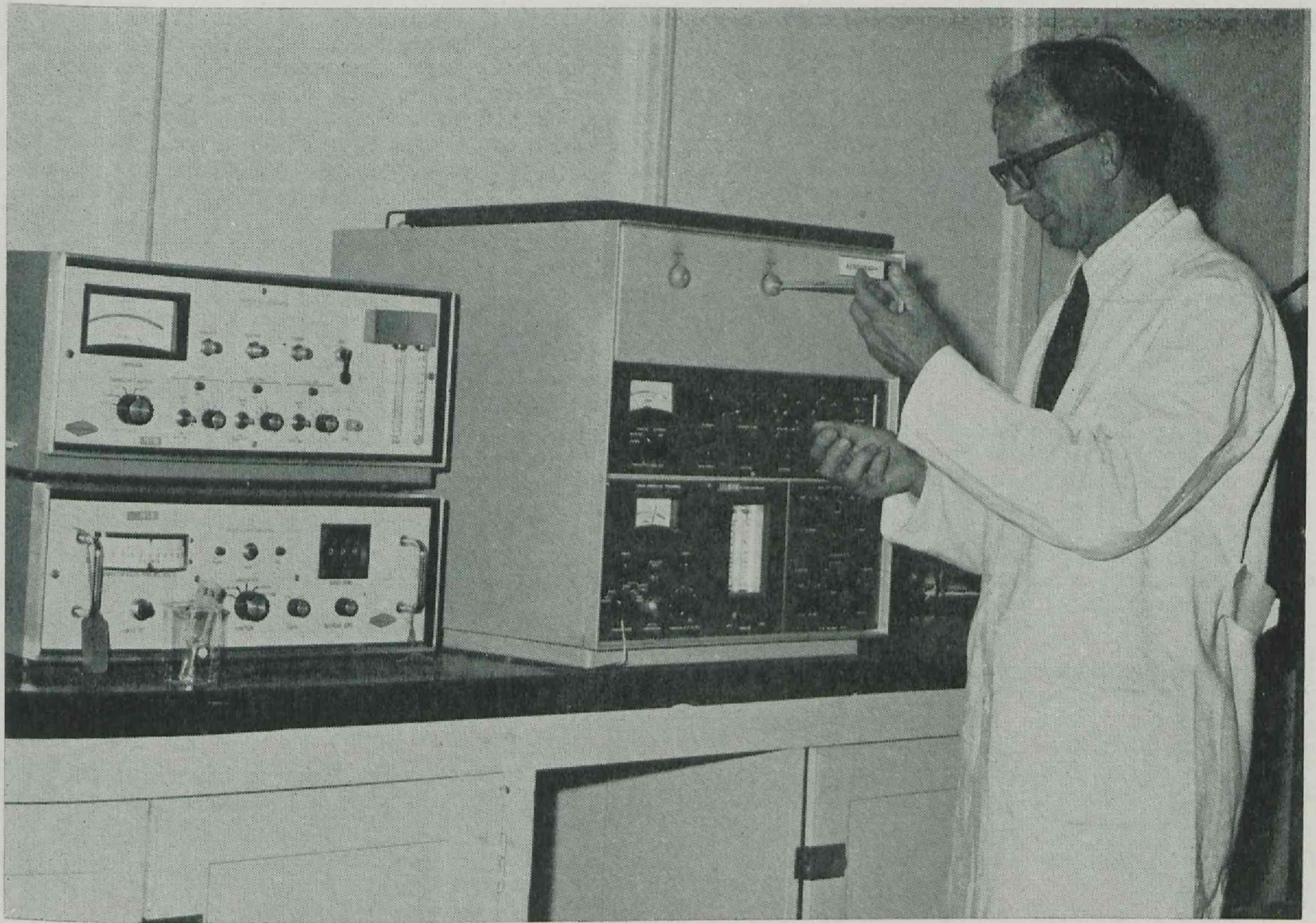
Some general observations based on the results of preliminary soil erodibility studies are:

- (a) For rainfall at 1 in./hr. the brigalow soils have consistently lower infiltration rates than black earths.
- (b) The black earths have much lower infiltration rates at high-intensity than at low-intensity rainfall, while the infiltration rates of the other soils remains essentially the same.
- (c) The black earths examined have infiltration rates in excess of 1 in./hr. but this rate drops once the soil becomes saturated.
- (d) The infiltration rate of a brigalow soil at 1 in./hr. decreases with increasing clay content while for black earths it increases with increasing clay content. This reflects the importance of aggregate size and aggregate stability in infiltration rate of these soils.
- (e) The infiltration rate of all soils at high intensities of rainfall increases with decreasing clay content (i.e. stability of all soils is low and infiltration thus depends purely on the total clay present).

An economic assessment of the effect of land use changes for erosion control in part of the Pittsworth Shire was made by Economic Services Branch. Following this preliminary investigation, a long-term soil conservation project on the Darling Downs is now proposed. Limited physical data have also been obtained in the South Burnett to assess the economic benefits of soil conservation measures through comparing with and without situations.

#### DIAGNOSTIC AND IDENTIFICATION SERVICES

A feature of the year's work by the Agricultural Chemical Laboratory Branch was research on the chemical detection of spray drift of agricultural chemicals, particularly of herbicides. A very sensitive method of analysis for the measurement of hormone-type herbicides was developed. This method has been acclaimed by other workers in this field in Australia. Test analytical runs on crop material damaged by drift of herbicide spray from normal agricultural operations have enabled the Branch to refine procedures for sampling. While progress has been achieved for one group of herbicides, the problems arising from the numerous other groups still await complete solution.



Determination of pesticides in the Agricultural Chemical Laboratory using gas chromatography.

Other pesticide investigations included residue determinations on soils and crops to which pesticides had been applied for experimental purposes and included fungicides, insecticides and herbicides.

The Branch has collaborated with the U.K. Ministry of Agriculture, Fisheries and Food in their work to establish standards for dithiocarbamate fungicides, and in tests conducted by the Citrus Wastage Laboratory, Gosford, N.S.W., to determine residues in citrus after anti-fungal treatment.

The laboratory has tested fumigation chambers operated by the C.O.D. and the Brisbane Cold Stores Ltd., and used for treatment of citrus fruit for export. This testing is important because of the strict quarantine rules relating to the prevention of plant disease.

The crude protein content of stockfeeds has been a yardstick for feeding values for many years. In recent times increasing attention has been given to the quality of protein in feeds, particularly in the intensive pig and poultry raising industries. The quantity of the amino-acid lysine present in the protein has a great effect on the food value and in the case of processed feedstuffs the amount of available lysine is important. Determinations of available lysine have been made by the Biochemical Branch in a number of commercially prepared pig feeds.

Soil surveys associated with important land development projects are a major Agricultural Chemical Laboratory Branch activity. Work continued in the Emerald Irrigation Area. Some 5,000 acres of Crown land in the Isis district were surveyed for irrigated cane production and an area in the Gin Gin-Maroonan district was surveyed in connection with the Kolan Irrigation Scheme. Other areas examined were in the Logan River and Kingaroy districts.

A fertility survey of the Dawson and Callide Valleys is under way, together with a salinity investigation of the latter. Indications are that salt concentrations in irrigated cotton soils are markedly reduced by gypsum applications.

A variety of other studies in the field included the effect of irrigation waters of suspect quality on soils and crops on the Western Darling Downs, the nitrogen and phosphorus requirements of Darling Downs soils, the fertilizer maintenance requirements of tropical pastures, and the effect of various soil improvement procedures on the productivity of flood plain soils in the Lower Burdekin Valley.

Laboratory studies included relationship of soil nutrient status and the foliar analyses and yield data for an orchard crop at Stanthorpe, minor element contents of tobacco leaf, critical level of phosphorus in a tropical legume, the mineral nutrient status of the major soils of the Emerald Irrigation Area, the mechanisms of soil aggregation in swelling clays, and the quality of tobacco leaf as related to alkaloid content.

The number of specimens identified by the Botany Branch was about 15,000, and 174 samples of stomach contents were examined for the presence of poisonous plants. No new naturalized plants were recorded during the year.

Three popular articles on the wildflowers of south-eastern Queensland were prepared for publication in the Queensland Agricultural Journal. The preparation of a Handbook to the Flora of Queensland moved into a new phase with finalization of a definite plan for the work. Writing of the chapter on ferns is in progress and should be completed in about 18 months. Work is also proceeding on the Gymnosperms and some families of Monocotyledons.

In the herbarium considerable progress was made in revisions of genera of grasses, accounts of the *Neurachne*, *Schizachyrium* and *Paspalidium* being well advanced. New species were described in the genus *Digitaria* and a review was prepared of the genus *Plinthanthesis*. Contributions from the Queensland Herbarium No. 9 contained a complete revision of the genus *Plectranthus* in Australia.

A field expedition to the Blackdown Tableland in Central Queensland made a fairly large collection of specimens, including some fruiting material and a living plant of the very rare *Macrozamia platyrhachis*, which is known to occur only in this area.

A description of the plant communities of Cape York Peninsula and accompanying map, prepared some time ago in association with C.S.I.R.O., was published.

As part of a joint project with the Beach Protection Authority of the Department of Harbours and Marine, synecological studies of plant communities on coastal sand dune systems and autecological and cultural studies on sand spinifex (*Spinifex hirsutus*) were continued. The synecological studies have been concentrated on the relatively simple dune systems between Currumundi and Point Cartwright. Germination studies on sand spinifex, carried out in co-operation with Standards Branch, have yielded information of immediate

practical importance in replanting denuded frontal dunes. The seeds of this grass were found to germinate best in total darkness and germination under conditions of fluctuating temperature was significantly greater than under constant temperature. A simple peg-tooth roller was developed for breaking up the large, unmanageable seed-heads of this species without damaging the seeds and mechanical sowing of these seeds is now possible. At least one sand-mining company is already using this technique successfully.

The insect identification service provided by Entomology Branch made more than 2,000 insect identifications. The service to quarantine is increasing in volume and usefulness. The ready identification of the fire ant *Solenopsis saevissima richteri* Forel from the hold of a ship unloading in Brisbane was of major importance.

Taxonomic research with economic implication has been directed to the development of morphological means of identification of immature stages of pest species. The study of all stages of the orange fruit borer (*Isotenes miserana* (Walker)) has been completed and permits its distinction from the larvae of the several major lepidopterous pests of macadamia nuts. Larval morphology of the several armyworms (*Spodoptera* spp. and *Pseudaletia* spp.) and cutworms (*Agrotis* spp.) now enables readily larval identification.

Because of the important consequences which quite small residues of chlorinated hydrocarbon insecticides in animal products can have on trade in overseas markets strenuous efforts have been made by Entomology Branch to find alternative pest controls on forage crops and pastures. Resulting from this work recommendations of materials other than

chlorinated hydrocarbons are now promulgated to cover insecticide requirements in most of the crops in which residue problems have been encountered. These include the following replacements for DDT or its close relative TDE: dimethoate at 2 oz. active constituent per acre for jassid control in lucerne; carbaryl at 12 oz. for leaf roller control in lucerne; trichlorphon at 8 oz. for armyworms and cutworms in pastures and cereals; diazinon at 4 oz. or U.L.V. maldison at 6½ oz. for sorghum midge; azinphos-ethyl or methidathion at 8 oz. for blue oat mite control in cereals; trichlorphon or carbaryl at 8 oz. instead of DDT for corn earworm and native budworm control in a number of crops; and trichlorphon or carbaryl at 8 oz. for webworm control in northern dairy pastures.

The nematology field programme consisted of trials with citrus, grape, pineapple, ginger, tobacco, banana, apple and stone fruit. Promising results were obtained from a number of non-fumigant nematocides which can be applied to established plantings.

#### FAUNA

Research work on native fauna was continued from the centres of Warwick, Brisbane and Townsville. A number of district surveys of fauna were undertaken. Zoologists at Hermitage Research Station continued to monitor the kangaroo populations from selected sites throughout the State. Populations of all native fauna are in good to excellent condition.

Two fauna rangers were appointed to assist with the policing of regulations under the Fauna Conservation Act.



## IX. Agricultural Standards

The Department is concerned in many ways with the maintenance of standards of primary produce, both raw and manufactured, intended for local consumption or export. It is also concerned with standards of certain agricultural requirements, mainly agricultural chemicals, and with standards of usage of certain materials. Where standards have statutory force, the Department polices them, in appropriate cases as an agent of the Commonwealth Government.

The Standards Branch is the Branch most involved in regulatory control of standards, though Dairy Field Services Branch and Dairy Research Branch have prime responsibility for standards control of dairy produce, and Slaughtering and Meat Inspection Branch for meat and meat products.

### AGRICULTURAL CHEMICALS CONTROL

Considerable preparatory work was carried out by members of the Agricultural Chemicals Distribution Control Board and staff of Standards Branch in anticipation of the proclamation of the Agricultural Chemicals Distribution Control Act. The Act will control the aerial distribution of agricultural chemicals except fertilizers and the ground spraying of weed killers in important areas of intensive agricultural production in Queensland. This mainly involves areas east of the Great Dividing Range and the Darling Downs, western inland areas being exempt. A number of investigations have already been made following complaints of spray damage to crops.

A major problem solved related to the examination of the numerous weed control operators in the State by the limited existing staff. State Government Departments, the largest employer of weed control operators, nominated permanent staff to act as examiners on behalf of the Board and a Course of Instruction was held in February. This Course provided a nucleus of examiners with an understanding of the Act to examine orally some 1,000 weed control operators.

### SEEDS

Total production of seeds certified under the Queensland Seed Certification Scheme increased markedly, as follows:

Seed	Increase (%)
Hybrid maize .. .. .	71
Grain sorghum .. .. .	138
Hybrid forage sorghum .. .. .	426
Cowpea .. .. .	315
Oat .. .. .	283
Pasture species .. .. .	3,884

For the first time in 3 years, quantities of certified sweet sorghum seed and certified tomato seed were produced.

The first releases of certified seed of a pasture legume, Townsville stylo, cultivars Lawson and Gordon, were made and the first seed lines of Narok *Setaria sphacelata*, a pasture grass, were certified.

### FRUIT AND VEGETABLES

Condemnations of apples, pears and stone fruit in Brisbane increased considerably over those of the previous period. Many consignments of apples showed internal breakdown, possibly due to overstorage. A considerable proportion of faulty apple consignments was produced in southern States. Consignments of pears showed a high incidence of breakdown or rot and many consignments of stone fruit were condemned for brown rot or storage rot. The total number of vegetable consignments condemned decreased.

In the Rockhampton district heavy condemnations of fruit and vegetables occurred in February following excessive wet conditions in growing areas. Condemnations of fruit and vegetables at Townsville trebled. Plums were the most troublesome of the stone fruit. Because of an oversupply, dumpings of soft and over-ripe bananas were heavy. There was an increase over the previous period of condemnations of fruit and vegetables on the Darling Downs.

### STOCK FOODS

To permit more positive action on stock foods, particularly hay and chaff, coming from southern States, certain impurities previously prescribed as "harmful ingredients" were re-designated "prohibited material" by an amendment to the Agricultural Standards (Stock Foods) Regulations. This meant that the entry to the State of hay and chaff containing impurities such as skeleton weed, poppy and saffron thistle

could be dealt with without waiting for a sale to take place in Queensland. This resulted in the interception, return or destruction by Standards Branch Inspectors of many consignments of poor quality.

A large number of requests were received by the Standards Branch Inspector stationed at Toowoomba to inspect stock food, hay and grain of questionable quality. Considerable extension work on this problem was carried out in this area with the aid of television, radio and newspapers.

### EXPORT INSPECTIONS

Containerization is being used increasingly for the export of fruit. Apart from the need for the inspection of containers and inspections at country centres where containers were being filled, there was need for increased export inspection services during the current year. Lines which showed a marked increase since the previous period in the number of packages exported were apples, bananas, plums, onions and potatoes.

Supervision of ethylene dibromide fumigation of citrus fruit sent interstate and overseas and methyl bromide fumigation of potatoes and onions for export was previously centred mainly in Brisbane. This work has now been extended to include a new fumigation chamber erected at Brisbane Cool Stores, Eagle Farm. The construction of other fumigation chambers in country areas is anticipated.

### DAIRY PRODUCTS

The Dairy Research Branch continued to conduct quality control services for dairy products, with the throughput of samples increasing considerably during the year. Some of this work has been carried out for Government purposes, some on behalf of commodity boards, while an increasing amount represented analyses towards issue of certificates under the National Association of Testing Authorities required mainly for export purposes.

A total of 59 samples of milk was found to contain extraneous water in quantities ranging from 3 to 11% and a further 352 samples contained extraneous water in trace amounts. Contamination of milk with penicillin was also at a higher level than that recorded for previous years: 37 tanker milks, 1 bulk milk, 4 bottled milks and 27 farm milks were found to contain penicillin. The percentage of butter samples with unsatisfactory extraneous matter content was 14 and of cheese samples 37.

During the year 21 pasteurized creams, 13 milks and 21 fortified milks failed to meet the respective standards for chemical composition; 87 butter samples and one margarine sample were found to contain excess moisture; and salt percentages were high in 26 samples of butter. Results for cheddar cheese samples showed that 38 exceeded the relevant standard for moisture, 26 were substandard for fat and 171 export cheeses were outside the recommended range for salt.

Detailed investigation of milk composition, coupled with vigorous extension, has shown spectacular results, highlighted by an overall improvement in the compositional quality as well as improved production on the farms concerned.

The Otto Madsen Dairy Research Laboratory at Hamilton has continued to carry out all control work on the quality of milk and cream on behalf of the Brisbane Milk Board. In addition, aided to a considerable extent by the regional laboratories, the quality of all pasteurized milk in the State has been kept under close observation. Pasteurized milk quality throughout Queensland continues to be of a high standard. The quality of pasteurized cream and flavoured milks is less satisfactory.

Bacteriological quality of butter examined under the Butter Improvement Service showed a slight deterioration. This is attributable to the very low butter production in most factories with consequent small throughputs on each manufacture day.

A very high percentage of all samples of cheese intended for Japan complied with standards demanded for this trade with respect to coliform organisms and coagulase positive staphylococci. Cheese hygiene services were carried out routinely at all cheese factories, and trouble-shooting phage surveys conducted when required.

A scheme of regular sampling of cultured milk products has been instituted both for locally produced items and for those imported from southern States.

The Dairy Research Branch continued to play an important role in the development by the Standards Association of Australia of standard methods for the examination of dairy products.

### EGG QUALITY

Officers of the Dairy Research Branch stationed at the South Queensland Egg Marketing Board analysed more than 13,600 samples of egg pulp. This doubling of sample numbers is largely attributable to new legislation requiring pasteurization of all liquid egg pulp for local sale. Another result of the amended legislation is that three poultry farmers have now purchased and installed small plants for pasteurization of egg pulp, enabling them to sell pulp in direct competition with the Egg Marketing Board.

The bacteriological quality of liquid whole egg sold to the Egg Marketing Board by producers deteriorated during the year. The decline could be associated with the quality of eggs used, the standard of hygienic control during breaking operations and conditions during subsequent handling and storage. It seems likely also that many hatcheries are disposing of "incubator clear" eggs as bulk egg pulp to the Egg Marketing Board. Line-run surveys to pinpoint contamination have demonstrated that vacuum extractors are

mostly responsible for high bacterial counts on liquid whole egg. Bacteriological quality of liquid egg pulp for export has been thoroughly screened. All was of a high standard and no Salmonella were detected.

### AGRICULTURAL ENGINEERING

The agricultural engineering activities of the Branch have again followed the three main lines of service—an advisory service on farm mechanization problems and practices; design and construction of experimental equipment for field research programmes; and liaison with manufacturers and distributors of farm machinery and equipment.

Because of the acceptance of wheat quotas and because of abnormal seasonal conditions of drought followed by prolonged wet conditions there was increased demand for advice on grain drying and storage.

The experimental planter for row crop field trials has been fitted with spray equipment to permit application of herbicides, insecticides, etc. A further modification to permit "water injection" at seeding was provided but the wet summer did not allow evaluation of this technique. A vehicle mounted soil sampler powered from the vehicle battery has been designed and built and has operated successfully in taking soil samples of 2 in. diameter to a depth of 4 ft. A self-propelled forage harvester with three forward speeds and a 30 in. cut has been designed and constructed. An insect suction collector has been designed and constructed, and further models of the above experimental machines have been built for other research teams engaged in field crop research programmes. Two surveys are in progress—removal of poultry manure from cage sheds, and peanut thresher performance.

Apart from the increased need for liaison with the trade on the grain drying situation, consultation was provided on the likely potential demand for agricultural machinery and equipment in view of the world grain supply-demand situation.

## X. Fisheries

Research, extension and regulatory matters concerning fisheries and marine life are handled by the Fisheries Branch, which has the support of various Departmental laboratories. The Branch operates a small laboratory at Mourilyan. A new fisheries laboratory for joint use by the Branch and C.S.I.R.O. is under construction at Deception Bay.

### FISHERIES RESEARCH

The East Coast Prawn Research Project, an investigation being carried out jointly by the Department and the C.S.I.R.O. Division of Fisheries and Oceanography, was restricted during the year to a study of the king prawn (*Penaeus plebejus*) from the aspects of ecology and population dynamics. The ecology section of this programme has aimed at determining the factors responsible for fluctuations in abundance and the habitats most suitable for the growth and development of juvenile prawns. The population dynamics studies have been directed towards calculating the natural and fishing mortalities of the exploited stages of the prawns' life cycle, estimating the size at which the species

may be most economically exploited, and determining the fishing method which most efficiently catches the stock available. As part of these studies some 25,000 tagged prawns were released on the fishing grounds during October and November 1970. By the end of May 1971, nearly 3,000 of these had been recovered, the longest distance from point of release being 70 miles.

The work of market-sampling of mullet continued at Tewantin. No data analyses were attempted in the past year.

A programme of work was commenced in the Southport Broadwater region which aims at assessing the productivity and fish-carrying capacities of various classes of developed areas in comparison with similar untouched regions.



Using a probe to determine temperature change of fish after harvest.

Work on spoilage of fish in Queensland was continued in the Dairy Research Branch. The aim is to determine the chemical and bacteriological changes which occur in fish under the conditions under which they are handled in Queensland. Tests can then be established to determine freshness of fish and efficacy of handling methods used by the fishing industry. The importance of this work lies in the perishable nature of fish and high ambient and water temperatures experienced in Queensland during the greater part of each year. Methods of harvesting, storage, handling and transport have been shown to be factors which may contribute to rate of spoilage, thus determining ultimate table quality.

Presently, the conditions under which the fish are handled are being established and studied, and temperature change of harvested fish is being followed closely throughout storage and transit. In many instances commercial conditions have to be duplicated in the laboratory to enable precise determinations to be made.

At the same time, the types of bacteria present on the surface of fish and in the gut are being studied to establish those types responsible for spoilage under the above conditions. From the present results it appears that these are not necessarily psychrophilic in type, i.e. those that can grow at low temperatures.

A severe mortality was recorded among the oysters located on leases in the Pumicestone Strait and in Deception Bay near Toorbul. The cause of this mortality is not yet known but an investigation is proceeding which may identify the causative agent.

As a result of serious mortalities of pearl oysters, steps have been taken to employ a biologist specifically to examine this problem.

#### MARINE LIFE RESEARCH

Research on the Crown of Thorns starfish was carried out during the year by a team based on a small laboratory at Mourilyan Harbour. Work in this field has been mainly directed along the following lines.

- (a) A study of coral recolonization and regeneration on reefs which have been heavily attacked by the starfish. To date nearly 80 study plots on reefs in the region between Cairns and Townsville have been staked, mapped and photographed.
- (b) A study of the development and settlement of starfish larvae. Fertilized eggs of the starfish have been reared under laboratory conditions through to metamorphosis into the starfish form. The study, which was carried out in conjunction with staff of the James Cook University of North Queensland, has indicated some of the critical factors controlling metamorphosis.
- (c) Monitoring surveys of the location of starfish concentrations between Palm Passage and Flinders' Passage.
- (d) Monitoring of various hydrographic parameters in reef waters off Mourilyan Harbour, with a view to detecting any unusual features which may have triggered the population explosion of this starfish.

Field tests were carried out during the year on the Great Barrier Reef and in Moreton Bay on the effects on coral of contact with crude oil and bunker oil slicks. The experiments indicated that, through their mucus-producing abilities, corals have an efficient mechanism to protect themselves against at least short-term contact with oil. A paper has been produced on this work for presentation to the Royal Commission on Great Barrier Reef Petroleum Drilling.

Contact was continued with the Heron Island Research Station, which was developed and built by the Great Barrier Reef Committee, and which has now become the joint property of the Committee and the University of Queensland. The station was well used during the year. Nine continuing projects are being pursued and many overseas scientists have worked at the station from time to time. Supervised student parties have made good use of the facilities available and a visiting group from the College of Idaho was particularly successful in achieving its objectives.

#### REGULATORY

The fishing grounds adjacent to Karumba and Weipa in the Gulf of Carpentaria were closed to all prawn trawling on January 1, 1971. In Queensland waters, prawn trawling was permitted from March 1 onwards. In the adjacent Commonwealth waters the fishing grounds were re-opened to fishing on March 25 at Weipa and May 1 at Karumba following the catching of sample quantities of prawns of marketable size. The closure, intended to delay the early influx of boats to the fishing grounds, as occurred in 1970 and which resulted in the capture of large quantities of small prawns, was well received by fishermen and appears to have achieved its objective of larger size prawns being taken during the season.

The control now exercised over prawn trawling in the Moreton Bay fishing grounds has been successful in that it slowed down the build-up which was taking place in the size of the fleet. This restriction on prawn trawling in Moreton Bay was introduced in 1970 at the request of the fishing industry.

Total revenue from licenses, royalties and other sources amounted to \$113,113. This is compared with the total budgetary provision for the Fisheries Branch operating expenses and special projects of \$46,522 and salaries appropriation which amounted to \$88,835.

During the period 464 persons were reported for alleged breaches of "The Fisheries Acts, 1957 to 1962".

Increasing development adjacent to estuaries and sheltered inshore waters have lent emphasis to the current policy of establishing Habitat Reserves to protect fish breeding and feeding grounds. During the year under review six new Habitat Reserves were declared (Tallebudgera Creek; Tipplers Passage; Currigee; Pimpama; Peel Island; Hinchinbrook).

# XI. Review of the Primary Industries in 1970-71

## BEEF AND VEAL

The drought of 1969-70 continued towards the end of 1970 in most beef areas. With the onset of drought-breaking rains, graziers commenced to rebuild herds and a strong demand developed for cattle, especially breeders. Industry prospects are encouraging following a favorable summer season, though some areas remain drought affected.

The total number of cattle slaughtered for export for the year ended May 1971 was approximately 10% below that for the same period in 1969-70 and 14% below the level of the previous year. Undoubtedly this is partly due to the carry-over effects of the 1969 drought when there were heavy movements of store and breeding stock to the southern States. Then, too, the widespread improvement in seasonal conditions in Queensland in the current year and the trend towards movement out of sheep into cattle has reduced the numbers of cattle coming forward for slaughter. This is reflected in the considerable drop in the number of cattle slaughtered during the six months to May 1971, a reduction of some 140,000 head, or 27% below that for the same period last year.

The Queensland beef cattle population increased by 7.5% during the year ended March, and although the increases in the New South Wales, Victorian, South Australian and Tasmanian herds were of a higher order, Queensland's herd remained the largest.

The Australian beef industry is heavily dependent on the export market. Queensland, the largest beef producing State, is more heavily dependent on exports than are the other States because of its small population and consequent low domestic consumption.

Exports of beef and veal from Australia rose by 25.9% in 1969-70 compared with the previous year, while in the same period exports from Queensland rose by only 7.0%. In 1968-69, exports of beef and veal from Australia accounted for 44% of production, and in 1969-70 49.5%. The corresponding figures for Queensland, 66.4 and 76.0%, indicate Queensland's relatively greater dependence on the export market.

The United States continued as the major market for Australian beef and veal, taking 80.2% in 1968-69 and 69.9% in 1969-70. All the major markets for Australian beef and veal took substantially larger quantities in 1969-70. Exports to the United States increased by 10.0% while exports to Canada were 2½ times as high as a year earlier. A new market opened with the U.S.S.R., and exports to Japan rose by 11.0%. Sales to the United Kingdom, which had been falling for many years, recovered to 92.8% of the previous year's figure.

## WOOL

Despite drought-breaking rains in late 1970 and early 1971, pastoral conditions during the first half of 1971 were variable, ranging from favorable in the Maranoa to poor or fair in the south-west and central-west. Sheep were in generally good condition, although blowfly and internal parasites were presenting problems.

From the beginning of the 1969-70 wool-selling season up to the end of June 1971, average prices at the Brisbane wool sales fell from 49.88 cents per lb. to 26.29 cents, illustrating the extent and seriousness of the fall in the market over the last 2 years. Australian net farm income for wool in 1970-71 was estimated at \$290-300 million, compared with \$770 million in 1966-67.

The gross value of wool production in Queensland, which was \$65.7m. in 1969-70, was expected to fall to approximately \$40m. for 1970-71. This is the combined result of lower prices and a fall in production. In 1969-70 approximately 605,000 bales of wool were received by Brisbane brokers for sale, while in 1970-71 receivals fell to 504,000 bales.

## PIGS

In the first half of the financial year, pig production was well down in relation to the comparable period of 1969-70, while prices remained high. This situation followed from pressure on declining grain stocks, while protein meals were difficult to obtain in some areas when required. Seasonal conditions improved during December and this encouraged many pig producers to maintain stock numbers in anticipation

of improvement in grain supplies. By April pre-drought production levels were regained notwithstanding high prices for protein meals.

For the 11 months up to the end of May, slaughterings at meatworks and bacon factories in Queensland totalled 531,095 bodies, a decrease of 5.1% on the comparable period of 1969-70. The comparable decrease in carcass weight was 4.3%, indicating that average weights were slightly higher in the latter year.

Towards the end of the year, a strong demand existed in most areas of the State for weaners, stores and good breeding stock. This, together with renewed interest in the construction of buildings, augured well for 1971-72.

Over the year, average prices for both porkers and baconers were approximately 28 cents per lb. on consignment in comparison with 26 cents in 1969-70.

A series of poor grain harvests has contributed to a long-term trend towards an increase of production in southern Queensland and a decrease in central Queensland. Sideline producers continued to leave the industry, while larger and more specialized producers improved their efficiency and increased production.

A considerable increase in overseas exports of breeding stock occurred, most animals going to Singapore, Malaysia and Hong Kong.

Organization within the industry at producer level improved considerably with the formation of several new branches of the Queensland Pig Industry Producers' Association. Legislation enacted by the Commonwealth Parliament to introduce a pig industry research scheme has stimulated much constructive discussion.

## POULTRY

The broiler section of the poultry industry has achieved quite a remarkable degree of stability in recent years. Production has been geared to meet the steadily increasing demand for chicken meat. More than 90% of the State's broiler production is carried out under contract with four major processing firms.

Broiler processing firms have encouraged growers to establish farms within a 30-mile radius of processing plants for reasons of economy in servicing and transport of feed and chickens. This policy has had the effect of concentrating farms in areas close to Brisbane and the majority of farms are now situated within 30 miles of the city. It is felt that this policy may lead to problems related to pollution control in the future as near-city areas become urbanized.

Broiler production during 1970-71 is estimated at 15.3 million birds, an increase of 8% over the 1969-70 figure. Prices paid to growers fell slightly during the year, but this was compensated for by increased growth rates and feed conversion efficiency of broiler chickens. Average liveweight of 4 lb. at 63 days of age is now being achieved commercially with feed conversion efficiency of around 2.2:1.

The number of broiler farms has increased slightly during the year but most of the increase in broiler production has resulted from expansion on existing farms. Improved shedding design, a greater degree of mechanization and the introduction of "whole room" brooding are developments which have allowed growers to expand their flocks without having to employ additional labour.

In south Queensland, the main egg production area of the State, recorded production was approximately 23m. doz., an increase of 6% on 1969-70. In Central Queensland, commercial production fell by 11% to 1.19m. doz. In South Queensland, average returns to Board suppliers fell from 31.35 cents per doz. in 1969-70 to 26.91 cents per doz. in 1970-71. In Central Queensland, average prices were marginally higher but followed a similar decline.

With this continued decline in profitability, growers' attention was directed to containing Australian production and so reduce the present large quantity, surplus to local market requirements, which must be sold on very unremunerative export markets. A scheme to regulate further expansion in the industry was approved in principle by the Australian Agricultural Council. Draft legislation, which will serve as a guide for the other States, was prepared by the New South Wales Poultry Advisory Board within the N.S.W. Department of Agriculture. Subject to modification and/or amendment, the support by the respective States, and acceptance by the industry in each State, the scheme may be introduced during 1971-72.

To avoid unnecessary competition, rationalize distribution and improve overall returns of producers, action was in train at the close of the year to bring the northern areas of the State under statutory marketing control within the jurisdiction of the Egg Marketing Board. A poll of growers will be necessary to decide the issue.

The partnership arrangement between the South Queensland and Central Queensland Marketing Boards continued to prove advantageous in their common interest. The Council of Egg Marketing Authorities of Australia comprising the membership of the various State Egg Marketing Boards continued to serve the overall interests of Australian producers by the avoidance of misunderstanding through conflicting policies on prices and trading activities generally.

It is estimated that overall pullet chicken hatchings for 1970-71 will be about the same as the figure for the previous year. Small hatcheries are finding it increasingly difficult to cope with the present egg industry trend towards increasing size of laying flocks.

The emergence of started pullet growing as a specialized form of production within the egg industry was an important development during 1969 and has become firmly established in 1970-71. From the egg producer's point of view the advantages of buying started pullets instead of day-old chickens include elimination of capital investment in rearing facilities, avoidance of losses from disease during the rearing of replacements, and "all in-all out" replacement of the laying flock.

### DAIRY PRODUCTS

The production situation in the dairying industry was favourable following above-average early summer rainfall, but deteriorated in the autumn. Excessive summer rains destroyed many stands of improved pasture, and the dry autumn was against good autumn-winter fodder crops.

Queensland's butter production for 1970-71 was estimated at 18,560 tons, compared with 22,430 tons in 1969-70, giving an average of about 20,000 tons for the 2 years 1969 and 1970. Up to 1966-67, average annual production was about 30,000 tons. Queensland requires 24,000 tons of butter to supply the local market as well as established export outlets. The local market requires about 14,000 tons for table use, but because of inadequate local supplies butter has for some years been imported from southern States, principally during winter when Queensland's production is at its lowest level.

Because of poor production in Victoria and Queensland, Australia failed to maintain its annual butter quota of 66,700 tons on the United Kingdom market. As a temporary solution to the shortage in supply, the United Kingdom introduced a system of licensing. Prices for Australian butter in the United Kingdom improved by about 50% to £420 Stg. per ton. Because of the present general world shortage of butter, it is expected that these relatively high prices will continue, and it is unfortunate Australia is not in a position to meet this demand.

The general shortage of Australian butter jeopardized some export markets because of inability to supply.

Cheese prices in the United Kingdom for Australian cheese also improved from £250 to £315 Stg. per ton and this price is expected to hold.

The Commonwealth Government passed legislation giving it power to legislate, if necessary, to support the current voluntary system of equalization. The Scheme was strongly supported by a poll of growers concerned.

The Australian Dairy Produce Board added recombined milk plants in Cambodia and Indonesia to plants already operating at Bangkok and Manilla. These plants provide a valuable outlet for Australian butteroil and milk powders, and are part of the industry's efforts to diversify markets in the face of Britain's entry to the Common Market.

There was increasing interest in Japan for a special type of Gouda cheese, most of which, however, is produced in factories in southern States.

Increasing interest continued to be shown in supplying the local Australian market with varieties of cheese other than cheddar, and increasing quantities of locally produced Gouda, Cheshire, Edam and Blue Vein and other varieties were marketed. The successful marketing of yoghurt and milk custards also utilized increasing quantities of milk.

### SUGAR

Queensland produced 2.34m. tons of 94 n.t. sugar in 1970 from a harvest of 16.2m. tons of cane. This represented an increase of 260,000 tons of sugar over the previous season's production. However, this year's production would have been substantially higher but for the operation of the International Sugar Agreement, which caused a restriction in sugar production and cane harvested. It was estimated that the tonnage of cane harvested would have exceeded the record

tonnage of 18.4m. tons of cane crushed in 1968. While movements in the world market price were favourable early in 1971, a downturn in prices during May resulted in an automatic decrease in Australia's entitlement under the International Sugar Agreement from 110% of its basic export tonnage to 105%.

The total value of the 1970 crop was estimated at \$228.2m., a rise of \$22.4m. over last season's total value. The No. 1 Pool price will be approximately \$100 per ton while excess sugar should realize approximately \$70 per ton 94 n.t.

Of the 1970 season's sugar production, approximately 678,000 tons of 94 n.t. sugar will be sold in the domestic market at a fixed price of \$201.60 per ton of refined sugar, yielding a net return available for distribution to the raw sugar industry of approximately \$140 per ton 94 n.t.

Internationally, the negotiated price quota under the British Commonwealth Sugar Agreement remained at 335,000 tons actual sugar. Australia's exports to the United States domestic market in 1970 totalled 193,000 metric tons raw value. However, the United States Sugar Act is due for review at the end of 1971, and Australia has pressed for an increase in its present quota of 175,000 long tons per year. The initial quota allocated to Australia for 1971 was set at 194,965 short tons, compared with 197,125 short tons in 1970. The average realization for our sugar on this market was 8.08 (U.S.) cents per lb. raw value. The net return from these exports was somewhat below that from sales within Australia but above that from sales to the U.K. Sugar Board.

Other significant markets during 1970 were Japan, which received 585,000 metric tons raw value, and Canada, which received 296,000 metric tons raw value at world free market prices.

Throughout the year, the world market price gradually improved and by the end of 1970 had exceeded the target—4.0 cents per lb. (U.S.) f.o.b. bulk Caribbean port—set by the negotiating parties to the International Sugar Agreement as the minimum world price acceptable. In November, this world free market price for raw sugar was 4.09 (U.S.) cents per lb. and in December 4.11 (U.S.) cents.

The strong possibility of Britain's entry into the European Economic Community has stressed the urgency of negotiating further market outlets for Australian sugar prior to the termination of the present Commonwealth Sugar Agreement in 1974.

### WHEAT

Queensland's wheat production in 1970-71 was estimated at 4.0m. bus., which was well below the previous season's crop of 14.9m. bus. This is easily the poorest harvest recorded since 1946. Because of severe drought conditions only 800,000 acres were sown for grain, compared with 1.6m. acres in 1969-70. The yield per acre sown of 5.0 bus. was the second lowest ever recorded.

Central Queensland was the worst area affected by drought and by far the greater part of production came from the Darling Downs. Despite the adverse seasonal conditions, 68% of Board receivals were graded as "prime hard", compared with 10% in 1969-70.

For the first time in 15 years, Queensland was forced to import wheat to meet domestic needs.

In order to assist wheat growers who suffered financial hardship as a result of drought conditions, the State Government paid a subsidy of 75 cents per ton on all wheat delivered to the Board in 1970-71.

The 1970-71 crop was the third to be marketed under the Commonwealth Wheat Stabilization Plan. The guaranteed price for exports up to 200m. bus. was increased by 1.6 cents to \$1.475 per bus., bulk basis, f.o.b. ports for f.a.q. wheat. This price also applied to wheat sold within Australia other than for flour milling. The home consumption price for wheat milled into flour on an f.a.q. basis was increased by 1.5 cents to \$1.74 per bus., bulk basis, f.o.b. ports. This increase was made up of the 1.6 cents per bus. increase in the guaranteed export price, and a decrease in the cost of freighting wheat to Tasmania from 1.6 to 1.5 cents per bus. In Queensland, however, a surcharge of 6 cents per bus. was imposed on all wheat sold for local flour consumption to cover the cost of importing wheat from New South Wales.

The Australian Wheat Delivery Quota for 1971-72, on which the Commonwealth Government has guaranteed a loan to the Australian Wheat Board to pay a first advance of \$1.10 per bus., port basis, was 339m. bus., compared with 318m. bus. in 1970-71. Quotas were increased in all States except Western Australia. Queensland's quota was increased from 36m. to 38m. bus.

Total Australian export sales of wheat and flour for 1970-71 were estimated at 280m. bus. compared with 300m. bus. in 1969-70. Carryover stocks were expected to fall from 267m. bus. in 1969-70 to below 200m. bus. in 1970-71.

**BARLEY**

The total area sown to barley in 1970-71 was estimated at 230,000 acres. However, due to drought conditions, 80,000 acres failed and the resultant production of 2m. bus. was the lowest since 1953. The yield of 9 bus. per acre was the poorest since the 1941 season. In 1969-70, an area of 417,000 acres produced 8m. bus., giving a yield of 18.2 bus. per acre.

Receivals by the Barley Marketing Board totalled 1.1m. bus., only one-third of that of the previous season. Only 20% of Board receivals were of malting quality, compared with 40% in 1969-70 and 65% in a normal season. Thus the Board had only limited quantities of malting barley, and Queensland maltsters were forced to import malting barley from New South Wales to meet their requirements.

As a result of the small intake, the Board was unable to fill all orders for feed barley.

The State Government undertook to pay a subsidy of 75 cents per ton on all barley delivered to the Board in the 1970-71 season, in an endeavour to assist barley growers who had suffered financially as a result of drought conditions in recent years.

**GRAIN SORGHUM**

The area planted to grain sorghum in 1971 was estimated at a record 1 million acres, compared with the previous record of 680,000 acres recorded in 1970. Production, estimated at a record 780,000 tons, resulted in a yield of 29 bus. per acre, the highest achieved since the 1959 season. By comparison, the 1970 season resulted in production of 260,000 tons and an average yield of 16 bus. per acre.

Southern Queensland, producing approximately 520,000 tons in 1971, accounted for almost 70% of the State's total. Due to this large level of production and a limited local market, a record 350,000 tons were expected to be exported from southern Queensland during 1971. Exports from southern Queensland in 1970 amounted to 100,000 tons. In Central Queensland, despite damage to crops by grasshoppers and caterpillars, production was estimated at 240,000 tons. Exports by the Central Queensland Grain Sorghum Marketing Board were expected to reach a record 170,000 tons, compared with 60,000 tons in 1970.

Due to the small quantities of feed grains entering world markets, especially maize from the United States, returns to growers from grain sorghum exports were expected to average \$33.00 per ton on farm, some \$5 per ton higher than last year.

**MAIZE**

The area planted to maize in 1971 was estimated at 115,000 acres. This reduction of 10,000 acres on the 1970 crop was occasioned by losses due to early wet conditions and crop diseases. Production was estimated at 4 m. bus., compared with 3.5 m. bus. in 1970.

The Atherton Tableland crop was expected to reach 1 m. bus. However, yields could be slightly below those of last year as excessive wet conditions caused advance mould and grain germination. In this area, the outlook for higher yields from rust resistant hybrid varieties is very promising, particularly in view of increased acceptance by farmers of better fertilizer application programmes. In the main growing areas of the Darling Downs, despite the adverse affects of waterlogging and mosaic virus on some crops, production was expected to be well in excess of the drought-reduced crop of 1970. The Burnett district experienced reasonable growing conditions.

**PEANUTS**

Following adverse seasonal conditions experienced in the 1969 season, production increased to an estimated 42,000 tons from 87,000 acres planted in 1970.

The 1971 crop experienced extreme weather fluctuations, from near floods at the beginning of the season to near drought conditions at harvest time. The result was an expected production of 32,000 tons, a reduction on the pre-season estimate of 42,000 tons.

With all of the 1970 season crop sold, and a reduced intake from the 1971 season, no marketing difficulties were anticipated for the 1971-72 selling year.

**NAVY BEANS**

Drought conditions in 1970 resulted in only 9,500 acres being retained for harvest out of an estimated 13,500 acres planted. The final production of 833 tons cleaned weight was also very much down on the forecast production of 4,500 tons, cleaned weight. The 1971 season's early excellent prospects were gradually reduced as the unseasonal heavy rains continued and there was serious abandonment from the pre-season estimate of 15,000 acres planted. The crop was estimated at about 2,000 tons from an estimated retained planting of 8,000 acres.

With Australian demand estimated at 7,000 tons per annum and the South Burnett maintaining its reputation as one of the world's highest quality navy bean producing areas, the industry has excellent growth prospects in this region.

**COTTON**

The 1970 season produced 19,694 running bales of raw cotton from 12,996 acres of which 10,399 acres were irrigated. This compared with 20,074 bales produced from 13,328 acres in the 1969 season. Although the proportion of the crop grown under irrigation fell slightly from 83% in 1969 to 80% in 1970, the overall trend remains towards a wholly irrigated crop. The average yield of 904 lb. of raw cotton recorded during 1970 was slightly down on the 1969 season's average yield. Low micronaire values resulted in reduced average returns to the growers, particularly in the southern zone.

The 1971 season started well with good planting rains in December. Unfortunately, the season gradually deteriorated with the continuing rains, with the final expected production for 1971 being reduced from 22,000 bales to about 12,000 bales. The Dawson Valley Irrigation Area was the most severely damaged cotton-growing area in the State. Quality was high with negligible low micronaire readings being recorded as a result of an absence of cold weather during the season.

**TOBACCO**

Tobacco leaf sold in Queensland in 1970 amounted to 17,464,030 lb. and realized \$20,161,810. The average price paid to growers was 115.4 cents per lb., appreciably higher than the average return of 109.4 cents recorded in the previous year. The 1969 result was influenced by an abnormally large quantity of low-quality leaf sold for scrap and on the export market during that year. This situation was not repeated during 1970.

The 1970-71 growing season was satisfactory and 15.4 m. lb. of leaf at an average of 119.9 cents per lb. were sold up to May compared with 14.6 m. lb. of leaf at an average of 118.1 cents per lb. at a similar stage of the 1970 sales.

**OILSEEDS**

*Soybeans.*—Despite abnormal rainfall during the early part of the season, the soybean crop responded well, resulting in an estimated production of 8,000 tons from 11,000 acres planted in 1971. In 1970, production amounted to 3,000 tons from 8,000 acres planted. Following the good to excellent results recorded in all growing areas in 1971, it would appear that soybean growing has at last been firmly established in Queensland.

*Sunflower.*—A record production, estimated at 13,500 tons from 52,500 acres planted, was achieved in 1971. In view of the fact that excessive rainfall severely affected the crop in some areas, the results must be considered satisfactory.

*Safflower.*—Production of safflower in 1968-69 amounted to approximately 9,900 tons from 43,500 acres planted. During the two subsequent seasons, however, seasonal conditions were so adverse that production was negligible.

*Linseed.*—Although linseed acreage has remained relatively constant in Queensland in recent years at approximately 20,000 acres, production has continued to decline. The 1969-70 season resulted in total production of 5,700 tons from 21,000 acres planted, but due to abnormal seasonal conditions experienced in 1970-71 total production amounted to only an estimated 325 tons from 20,000 acres planted, of which only 5,000 acres were retained for harvest.

**GINGER**

Plantings for the 1971 ginger crop were a record 420 acres, an increase of 20% on the previous year. As in 1970, excellent growing conditions prevailed and a further record crop was anticipated. Early harvest yielded 1,530 tons—about on a par with last year. Because of the good climatic conditions, it is expected that total late harvests could produce an even better crop than last year's record 2,830 tons. Should this come to pass, a new record production will be registered.

**FRUIT AND VEGETABLES**

*Pineapples.*—Production for the year ended June 30 is estimated at 123,700 tons, compared with 114,000 tons in 1969-70. Factory absorption of this production amounted to approximately 104,000 tons, but processors were able to handle the increased throughput satisfactorily.

The Pineapple Industry Rationalisation Plan continued to show its worth to the industry, as average returns to growers for factory fruit were almost the same as last year. Sales of pineapple products on the domestic market have levelled off following the substantial increases of the year before, but this has had no effect on returns to growers.

The introduction of a bushel fibreboard carton for the marketing of fresh pineapples has been followed by a series of trials relating to the packing and marketing of fresh fruit and it is hoped that these will lead to improved presentation of pineapples. Returns to growers from the fresh fruit markets were generally comparable with 1969-70.

**Bananas.**—Banana production continues to be steady. Significant increases in plantings have been made in far northern districts. Dry conditions continued to affect some central and southern areas in the first half of the year but these conditions were reversed with the generally heavy and widespread rains in the early part of 1971.

Heavy cyclone damage occurred in both the far north and near north coast areas and over-wet conditions in several localities will help to reduce production for this year and probably next year as well.

During the year joint industry Departmental investigations were commenced into the feasibility of establishing a large-scale export industry for the Japanese market, but finality of this study is not expected for some time as such a project would involve far-reaching ramifications for the banana industry.

**Deciduous fruits.**—This season's apple production in the Granite Belt has been estimated at a record 2.5m. bus., almost double the 1970 crop. Fruit quality was excellent. However, the size of the crop resulted in some serious marketing problems and uneconomic returns to growers.

The feasibility study into the establishment of a fruit processing plant in Stanthorpe, which was completed late in 1970, found that such a project was, at best, only a marginal proposition.

The Stanthorpe stone fruit crop has also been heavy and unfortunately marketing of the crop was upset by two rail strikes at the peak of the season.

**Citrus.**—Citrus areas have all recovered from the dry conditions of 1969 and harvests have been heavy. Fruit quality has been excellent but, like apples, oranges are suffering somewhat from overproduction and uneconomic returns to growers. Queensland mandarin production is increasing rapidly and this fruit is proving to be popular on overseas markets, notably Canada. Grapefruit production is still well below market requirements.

**Vegetables.**—Potato production in south-eastern Queensland suffered a setback in 1971 when excessive rain and waterlogged soils put planting back by at least a month. This may reduce autumn production if frosts occur to any wide extent during early growth stages. Production for 1970-71 was estimated to be steady at about 115,000 tons.

Onion production for the year was maintained at 20,000 tons. Some export sales to Japan were made during this period and there are hopes that further exports will result.

During the year a group of Lockyer onion and potato growers formed a co-operative association, with packing sheds at Laidley and Gatton, and exported some 12,000 bags of onions to Noumea and Fiji.

New-season pumpkin prices on the Brisbane Market during October were the highest ever recorded, mainly because of very light supplies.

Many vegetable crops were hard hit by the long wet spell early in 1971 and considerable losses occurred. The bad weather also delayed plantings but growers in areas lucky enough not to be affected enjoyed good returns for their produce. During this period vegetables from Stanthorpe produced excellent returns for the growers—tomatoes and cabbage in particular.

## FISHERIES

The approximate return to operators from commercial fishing during the year was \$9,636,636.

The estimated production of edible fish was 4,519 tons with a gross value of \$2,180,287. The production of crabs was 645,447 bodies comprising 544,043 sand crabs and 101,404 mud crabs having a gross value of \$258,631. Total production of scallops was 646,019 lb. of shucked meats, valued at \$319,906.

Prawn production is estimated to be about 18,740,215 lb. valued at \$6,779,471. This high level of production resulted from the very good landings in the Gulf of Carpentaria and in Moreton Bay. Exports were valued at \$6,159,000.

One company alone had purchased over two million pounds of Gulf prawns at the beginning of June. The top boat, "Karumba Norman", had taken 500,000 lb. of prawns by mid-June and had also recorded the top single days' catch of 43,000 lb. of prawns. The Moreton Bay fishery has also enjoyed a season of extended and heavy production. Markets for Bay prawns were flooded for a time, resulting in low prices at the retail level.

Sea mullet landings were heavy in spite of the problem posed by "kerosene-taint" in some of the catch. A record season might have been recorded if fishermen had taken all the fish available to them.

The pearl fishing industry is now supported primarily through the purchase of live pearl oysters by the companies operating pearl-culture farms in the Torres Strait region. The market for mother-of-pearl shell is quite limited. The pearl culture industry is the principal employer of labour in the islands. A serious mortality occurred early this year among pearl oysters collected by the pearling lugger fleet for sale to the pearl culture farms. Mortalities of the order of 70% of live shell purchased were recorded. The cause of this mortality is as yet unknown but the result has been a serious set-back to the industry as a whole. The operations of the pearl culture farms in the Torres Strait have also suffered a serious setback because of the heavy mortality amongst the pearl oysters taken by the pearling fleet. Future production and employment of local labour will be affected.

The oyster fishery in Moreton Bay is expanding steadily. Several operators are now in the process of developing oyster farms using techniques similar to those currently used in New South Wales. It is anticipated that most of the oyster ground suitable for the cultivation of oysters in Moreton Bay and Tin Can Bay will have been taken up during the next one or two years.

On the whole, inshore anglers of the central and southern portions of the State experienced another good year; grounds recovered rapidly from the effects of severe mid-summer flooding. Tailor catches on ocean beaches fluctuated widely, but some unusually large individual catches were reported. The near inshore southern reefs fished unusually well for large snapper and sweetlip, and some anglers made record early-winter catches of school mackerel on them.

Tables relating to licenses issued, production, commercial vessel registrations and fishing gear are appended. An increase in the capital investment in vessels amounting to \$2,100,000 is noted.

RETURN SHOWING LICENSES UNDER "THE FISHERIES ACTS, 1957 TO 1962," ISSUED AT ALL PORTS DURING THE YEAR ENDED JUNE 30, 1971

Port	Description of Licenses								
	Oyster Banks	Oyster Boats	Oystermen's Licenses	Coral or Shell-grit	Commercial Fishing Vessel	Master Fishermen	Employee Fishermen	Total No. of Fishermen	Fish Traps
Brisbane .. .. .	182	90	142	19	2,096	909	607	1,516	..
Maryborough .. ..	50	8	21	5	..	111	91	202	..
Bundaberg .. .. .	5	1	8	..	..	98	88	186	..
Gladstone .. .. .	3	2	2	4	..	60	38	98	..
Rockhampton .. ..	49	16	35	1	..	98	69	167	17
Mackay .. .. .	41	9	33	10	..	117	153	270	20
Bowen .. .. .	..	..	..	..	..	80	49	129	..
Townsville .. .. .	8	3	8	6	..	229	252	481	4
Innisfail .. .. .	..	..	..	..	..	30	26	56	..
Cairns .. .. .	5	1	4	16	..	197	313	510	..
Port Douglas .. ..	..	..	..	..	..	2	0	2	..
Weipa .. .. .	..	..	..	..	..	1	2	3	..
Normanton .. .. .	..	..	..	..	..	1	..	1	..
Burketown .. .. .	..	..	..	..	..	..	..	..	..
Thursday Island ..	..	..	..	..	..	23	25	48	..
Karumba .. .. .	..	..	..	..	..	46	41	87	..
Totals .. .. .	343	130	253	61	2,096*	2,002	1,754	3,756	41

\* Licenses for Commercial Fishing Vessels are all issued from Brisbane.



COMMERCIAL FISHING BOAT REGISTRATIONS—1969  
NUMBER OF VESSELS AND VALUE

District	Under 20 ft.		20 ft. and under 30 ft.		30 ft. and under 40 ft.		40 ft. and under 50 ft.		50 ft. and under 60 ft.		60 ft. and under 70 ft.		70 ft. and under 85 ft.		85 ft. and under 100 ft.		100 ft. and Over		Totals		Tender Boats		Persons Engaged	
	No.	\$	No.	\$	No.	\$	No.	\$	No.	\$	No.	\$	No.	\$	No.	\$	No.	\$	No.	\$	No.	\$		
Brisbane ..	191	170,294	146	382,090	100	690,300	105	1,593,200	60	1,611,000	15	742,000	..	..	1	70,000	3	808,000	621	6,066,884	244	53,536	1,169	
Maryborough ..	19	12,800	34	46,950	25	156,450	9	167,500	4	90,000	1	38,000	..	..	..	..	..	..	92	511,700	112	24,340	178	
Bundaberg ..	64	27,280	18	33,730	10	58,500	17	197,300	3	107,000	..	..	..	..	..	..	..	..	112	423,810	39	12,570	212	
Gladstone ..	12	14,230	13	30,900	10	65,600	7	126,000	2	45,000	..	..	..	..	..	..	..	..	44	281,730	28	6,625	61	
Rockhampton ..	33	20,920	25	78,400	8	70,000	11	156,000	4	103,000	..	..	..	..	..	..	..	..	81	428,320	35	11,505	124	
Mackay ..	68	82,575	32	130,300	21	178,500	10	168,000	2	57,000	..	..	..	..	..	..	..	..	133	616,375	57	21,265	247	
Townsville ..	79	65,426	44	184,786	23	155,300	16	271,000	3	110,000	1	25,000	..	..	..	..	..	2	177,000	168	988,512	49	16,455	346
Cairns ..	63	84,284	45	188,350	27	267,500	19	403,000	11	275,500	2	95,000	1	96,000	..	..	1	21,000	169	1,430,134	43	19,766	357	
Far North ..	10	11,000	7	23,300	4	19,000	12	228,500	8	190,500	8	411,000	3	350,000	..	..	..	..	52	1,233,300	8	1,850	153	
Interstate ..	5	915	2	600	6	49,000	24	433,000	12	360,000	6	380,000	2	70,000	1	40,000	4	795,000	62	2,128,515	16	9,440	188	
Totals ..	544	489,724	366	1,099,406	234	1,710,150	230	3,743,500	109	2,948,500	33	1,691,000	6	516,000	2	110,000	10	1,801,000	1,534	14,109,280	631	177,352	3,035	

## GENERAL FISHERIES, EXCLUDING OYSTERS, PEARL-SHELL AND TROCHUS-SHELL

Year	Number of Boats Licensed	Number of Men Licensed	Estimated Quantity of—		
			Fish	Prawns	Crabs
1965-66 .. ..	3,298	5,162	Tons 4,564	lb. 6,033,710	Bodies 523,747
1966-67 .. ..	2,885	4,582	4,175	5,933,842	518,624
1967-68 .. ..	2,758	4,203	4,301	10,558,588	587,809
1968-69 .. ..	1,946	2,979	3,551	10,030,862	570,282
1969-70 .. ..	2,045	3,047	3,709	10,000,000(est.)	755,777
1970-71 .. ..	2,096	3,756	4,519	18,740,215	645,447

## FISHING UNITS CLASSIFIED ACCORDING TO GEAR USED—1969

District	Beach Seine Net	Mesh Net	Ring Net	State Net or Tunnel Net	Otter Trawl	Hand Line	Troll Line	Crab Net or Crab Pots
Brisbane .. ..	110	173	40	53	280	178	117	87
Maryborough .. ..	48	66	61	30	24	23	27	34
Bundaberg .. ..	55	72	10	2	32	30	31	27
Gladstone .. ..	13	20	13	2	5	29	21	28
Rockhampton .. ..	10	32	16	4	19	44	43	30
Mackay .. ..	35	66	38	3	8	102	95	46
Townsville .. ..	41	90	59	9	40	90	98	50
Cairns .. ..	20	61	35	1	34	109	111	12
Far North .. ..	5	14	3	..	24	10	7	1
Interstate .. ..	7	2	..	..	44	11	9	..
Totals .. ..	344	596	275	104	510	626	559	315



